



McNair Journal

FALL ■ 2019



Editor

Jeremy Bloss, Program Coordinator,
McNair Scholars Program

Editorial Review Board

LaShonda Boone, PhD
Senior Decision Support Analyst-Clinical
University of Missouri Health Care
Andrew Mulvania, PhD
Language and Literature Instructor
Moberly Area Community College
Danielle Graef, PhD
2007-2008 McNair Scholar
Assistant Professor of Pediatrics
University of Cincinnati College of Medicine
Cincinnati Children's Hospital Medical Center

2018-2019 McNair Scholars Advisory Committee

Vicki Boyd-Kennedy
John David, PhD
Melissa Herzog, PhD
Charles Nilon, PhD
Ninive Sanchez, PhD

McNair Staff

NaTashua Davis, Director
Natalie Downer, Associate Director
Jeremy Bloss, Program Coordinator
James Hamilton, Program Assistant
Johanna Milord, Graduate Assistant

Cover Photo - Provided by McNair Scholars Program

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.

Copyrights are owned by the University of Missouri. Reproduction of material in this publication is hereby authorized provided the use is for non-commercial or educational purposes and does not exceed 100 copies. Copyright (c) 2019 by the University of Missouri.



On the Cover:

Rebecca Winkler stands in a greenhouse among her maize plants.

McNair Journal

VOLUME 26 ■ FALL 2019

Table of Contents

4

Rebecca Winkler

Characterization of the novel maize
carbohydrate partitioning defective mutant P135-21B

12

Amanda Bennett

Association Among Adverse Childhood Experiences
and Social Support on Adult Mental Health
and Substance Abuse

20

Mirnes Mustafic

Fatigue Life Enhancement for Steel Girders using
Ultra-high Modulus Carbon Fiber Reinforced Polymers

27

Kiana King

Positivity in Sibling Relationships and Its Influences on
Mother-Older Child Relations vs
Mother-Younger Child Relations

33

Shawndrea Magee

Look Around, It's Not Just You:
The Effect of a Media Campaign on Mental Health Stigma
and Health-Seeking of African American Youth

40

Featured Scholar

Amber Bell

41

2019-2020 Research Topics

42

2019-2020 McNair Scholars

Message from the Director

It is with great pride that I introduce this outstanding collection of articles from the 2019-2020 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 University-wide effort that continues to attract students and faculty mentors from a variety of academic departments and fields of inquiry. Students have had the opportunity to learn about

the importance of earning an advanced degree, while gaining the skills and tools that will guide them through their future academic journeys. The program proudly bears the name of astronaut and scientist, Dr. Ronald E. McNair, who died in the Challenger explosion in 1986. His accomplishments and high standards set an outstanding example for these developing scholars.

I am truly honored to be associated with an initiative such as this. So many faculty, staff and administrative members of the MU community have worked to ensure a supportive and cohesive environment that prepares these exceptional students for graduate programs. We are proud to highlight the work of these talented young researchers, in this, the 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
Interim Vice Chancellor, Division of Inclusion, Diversity & Equity
Executive Director of Access and Leadership Development

The McNair Scholars Program

BACKGROUND

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

PROGRAM ELEMENTS

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

Characterization of the novel maize *carbohydrate partitioning defective* mutant *P135-21B*

REBECCA WINKLER

Rachel A. Mertz, PhD, Mentor
Division of Biological Sciences

David Braun, PhD, Mentor
Division of Biological Sciences



Rebecca Winkler is majoring in biological sciences and minoring in chemistry, spanish and anthropology. She received the Curator's Scholar Award, the Missouri Land Grant Honors Award and the Gordon Family Endowed Scholarship for STEM.

She is a member of the Little Sisters of the Gold Rose, MU Women in STEM and Beta Beta Beta Biological Honors Society.

This summer she worked in the Braun Lab. In the fall she is beginning her senior year and preparing her applications to pursue a doctoral degree.

Abstract

Sugar synthesized by photosynthesis needs to be efficiently exported from the leaves as sucrose to feed developing tissues. There are a class of maize mutants called *carbohydrate partitioning defective* (*cpd*) mutants which overaccumulate starch and soluble sugars in their leaves. High sugar levels in the leaves result in repression of photosynthetic gene expression, chlorosis, and anthocyanin accumulation in leaves. *P135-21B*, a novel maize mutant conditioned by a semi-dominant mutation, exhibits a progressive basipetal chlorosis and starch accumulation. Three main questions were addressed: whether both starch and soluble sugars hyperaccumulate, why there is carbohydrate hyperaccumulation in mutant leaves, and what is the causal gene. In order to locate and quantify the carbohydrate accumulation in source leaves, an Iodine/Potassium Iodide stain and a quantitative measurement of sugar and starch levels using High Pressure Anion Exchange Chromatography (HPAEC) were performed. Aniline Blue staining of adult leaves suggested that the mutant phenotype may be caused by a partial blockage of leaf veins by callose accumulation. To find the rough mapping interval, pools of mutants and wild type siblings were collected and DNA was extracted for a bulked segregant analysis. A region on chromosome 1S and an interval on chromosome 7S were found to be enriched in the mutants and deficient in the wild type. In order to find the causal genes, recombination breakpoints are being screened with polymorphic markers to narrow this interval down. Neither locus is shared with any previously characterized *cpd* mutant; thus, *P135-21B* is a novel gene.

Introduction

In order for a plant to grow and produce food products such as fruits, vegetables, and grains, it needs to photosynthesize. In photosynthesis, sugar is made as a source of nutrition for the plant and needs to be efficiently exported as sucrose from the leaves to feed the plant. There are a class of maize mutants called *carbohydrate partitioning defective* mutants. These plants overaccumulate starch and soluble sugars in their leaves. High sugar levels in the leaves may result in a visible phenotypic effect on the plant, such as repression of photosynthetic gene expression, as the excess sugar down-regulates photosynthesis and results in chlorosis (yellowing of the leaves; Baker and Braun, 2007). The yellow regions are where the excess carbohydrates accumulate, and the levels of soluble sugars and starch in these tissues can be quantified to determine the amount of carbohydrate buildup (Braun et al. 2006). Starch buildup can be caused by the mutant plant's inability to transport sucrose through the veins of the leaf (Ma et al. 2008). In maize, sucrose is made in the mesophyll cells and then travels along a pathway from photosynthetic source tissue to non-photosynthetic sink tissue. The maize leaf exhibits Kranz ("wreath") Anatomy, in which sucrose

travels from the mesophyll cells into the bundle sheath cells and then into the vascular parenchyma cells. From there, sucrose is eventually loaded into the phloem (Baker and Braun, 2008). The phloem is responsible for transporting sugars and other molecules throughout the plant. Transport can be blocked during any point of this pathway, which could cause the starch build up in the leaves. One possible cause of blockages along the transport path is deposition of the plant polysaccharide callose between cells or within the phloem itself (Julius et al., 2018). Few maize genes with this particular phenotype have been discovered and characterized to date.

A novel maize *carbohydrate partitioning defective* mutant, P135-21B, is conditioned by a semi-dominant mutation and exhibits chlorosis and starch accumulation. In characterizing this mutant, three main questions were addressed: whether both starch and soluble sugars hyperaccumulate, why there is carbohydrate hyperaccumulation in mutant leaves, and what is the causal gene. In order to locate and quantify the carbohydrate accumulation in source leaves, an Iodine/Potassium Iodide stain and a quantitative measurement of sugar and starch levels using High Pressure Anion Exchange Chromatography (HPAEC) were performed. Aniline Blue staining of adult leaves suggested that the mutant phenotype may be caused by a partial blockage of leaf veins by callose accumulation. To find the rough mapping interval, pools of mutants and wild type siblings were collected and DNA was extracted for a bulked segregant analysis. A region on chromosome 1S and an interval on chromosome 7S were found to be enriched in the mutants and deficient in the wild type. In order to find the causal genes, recombination breakpoints are being screened with polymorphic markers to narrow this interval down. Neither locus is shared with any previously characterized *cpd* mutant; thus, *P135-21B* is a novel gene.

How the physical anatomy of the maize plant affects carbohydrate partitioning

The mature maize leaf is composed of parallel longitudinal veins that are responsible for the transport of photoassimilates (carbon-containing compounds produced during photosynthesis). There are three types of longitudinal veins in the maize leaf: large, intermediate, and small. As leaves mature from immature sink leaves that depend on carbohydrate partitioning to mature source leaves that export carbohydrates, the large veins, also called laterals, develop acropetally (proceeding from the base to the tip), while the remaining small and intermediate longitudinal veins, also called minor, develop basipetally (proceeding from the tip to the base; Evert et al., 1978). Small and intermediate veins are more abundant and where most of the photoassimilates are loaded. They connect to the large veins, which transport photoassimilates long-distance to sink organs (Fritz et al., 1989). The developing leaf matures basipetally, which means the sink-to-source transition begins at the leaf tip and spreads towards the base (Evert and Russin, 1993; Baker and Braun, 2008). The mature leaf exports photoassimilates as sucrose to other parts of the plant for growth and storage basipetally. Transport within the source leaf occurs both cell-to-cell (symplastically) via pores between cells called plasmodesmata (PD) and apoplasmically as sucrose exits the symplast via protein transporters. The path from mesophyll to vascular parenchyma (VP) is symplasmic, but there is an apoplasmic step with transporters at the VP/companion cell (CC) interface, and then symplasmic movement through the CC into the sieve element (SE) and long-distance through the SE via modified plasmodesmata (Slewinski et al., 2012; Evert et al., 1977; Evert et al., 1978). Sucrose

produced in mesophyll cells is ultimately transported into the cell wall space, and then taken up into the minor vein phloem by transporters (Slewinski et al. 2013; Baker and Braun, 2008). The phloem is a vascular tissue in plants that moves sugars and other metabolites through the leaves. The phloem consists of two specialized cell types, sieve tubes and companion cells. The sieve element (SE) connects end-to-end with other SE to form the tubes that enable long-distance transport between organs, whereas the companion cell (CC) provides metabolic support to the SE and loads sucrose into it via many plasmodesmatal connections (Van Bel, 2003). The phloem is best characterized for its role in carbohydrate partitioning. Carbohydrate partitioning is the process of carbon moving through the veins of the leaf, which all aspects of plant development rely on in order to receive nutrition and grow. If there is a blockage of the phloem, sucrose cannot be transported through which leads to hyperaccumulation of starch in the leaves. Additionally, accumulated sugar in the leaves can repress photosynthesis and lead to variegated chlorotic sectors (Julius et al., 2018; Baker and Braun, 2007). The chlorotic sectors are where the starch buildup is occurring in the leaf.

Callose buildup

Callose is a plant polysaccharide composed of glucose residues linked together through β -1,3-linkages, and is synthesized by a multigene family of callose synthases, also known as glucan synthase-like genes (GSLs; Cui and Lee, 2016). Callose is an important regulator of plasmodesmata permeability because callose deposits have been known to block movement of solutes, hormones, and proteins in cell to cell transport (Julius et al. 2018; Tilsner et al. 2016). Callose is deposited at various times and locations in plants. This can include during new cell wall formation, in growing pollen tubes, at sieve plates and around the neck regions of PD, or in response to wounding (Slewinski et al., 2012). These changes can affect the transport path specifically. Blockages in PD necks along the M to VP route can block sucrose export (Ma et al., 2008). Improper callose synthase function during vascular development can result in phloem that are defective in sucrose uptake even though long-distance transport through the SE itself appears normal (Slewinski et al., 2012). Insufficient callose deposition in the modified PD of the sieve plate pore reduces carbon partitioning through the phloem and starves distal sink organs (Barratt et al., 2011 and Xie et al., 2011). Ectopic callose deposition can block sieve tubes and reduce transport (Julius et al., 2018). If there are callose deposits in the phloem, it can cause a blockage which causes hyperaccumulation of starch in the leaves. Thus, accumulation of callose at plasmodesmata by specific callose synthases is a key part in regulating molecular movement between cells through the plasmodesmata (Cui and Lee, 2016).

Work previously done on *carbohydrate partitioning defective* mutants of grasses

There have been six maize *carbohydrate partitioning defective* mutants characterized: *Carbohydrate partitioning defective1* (*Cpd1*), *sucrose export defective1* (*sxd1*), *sucrose transporter1* (*sut1*), *psychedelic* (*pse*), and the *tie-dyed1* (*tdy1*) and *tdy2* mutants (Braun et al., 2006; Baker and Braun, 2008). Another sign of a carbohydrate partitioning defect is reduced plant height, which was seen in both *tie-dyed1* and *sucrose export defective1*, although the two mutants act independently. At the time, other mutants had been seen with chlorotic sectors, but none had a hyperaccumulation of starch in those regions (Ma et al., 2007). Although genes that affect various parts

of the export pathway have been discovered, genes that occlude the SE with callose are rare. *Cpd1* is the only one described in maize so far. Because of this, mapping and characterizing the mutant *P135-21B* will lead to a deeper understanding of the relationship between callose biosynthesis and carbohydrate partitioning.

Materials and Methods

Soluble Sugar and Starch Quantification

Adult leaves were harvested at end of day (EOD) and end of night (EON) from the South Farm in Columbia, MO and then stored at -80°C until measurement. Soluble sugars and starch were extracted according to Leach and Braun (2016). The purified sugar and starch samples were then quantified using High Pressure Anion Exchange Chromatography (HPAEC) according to Leach and Braun (2016).

DNA Extraction

Genomic DNA was extracted according to protocol of Jiang (2011; available upon request) which was modified from both the CTAB protocol in “*Arabidopsis - A Laboratory Manual*,” p.165f and Fulton et al., 1995.

Polymerase Chain Reaction and Gel Electrophoresis

To amplify genomic regions of interest by Polymerase Chain Reaction (PCR), the genomic DNA was normalized to approximately 25 ng/uL concentration with dH₂O. 2 uL of sample DNA was added to 18 uL of a reaction mixture containing 1x Green Flexi Buffer, 1.5 mM MgCl₂, 0.5 U GoTaq Flexi DNA Polymerase, 0.2 mM dNTPs, 2 uM Forward and Reverse Primers, [4% v/v] DMSO, and sterile dH₂O was made. For PCR, the thermocycler was programmed with an initial denaturation of 95°C for 2 minutes, followed by denaturation (95°C for 30 seconds annealing, (57°C for 30 seconds), and product extension (72°C for 1 minute) repeated for 34 cycles. The program ended with a final product extension at 72°C for 5 minutes an indefinite hold at 12°C.

Products were visualized by agarose gel electrophoresis using 2% w/v gel Agarose GPG/LE solubilized in 0.5x TBE buffer. Product sizes were confirmed using a 100 bp DNA ladder. The samples were resolved on the gel at approximately 120 mV and imaged on a GelDoc using ImageLab software with UV-transillumination.

Maize Growth Protocol

In order to grow the plants in the greenhouse, the Donald Danforth Plant Science Center Plant Growth Facility Maize Protocol was used at <https://www.danforthcenter.org/scientists-research/core-technologies/plant-growth/resources>.

Starch Staining

Leaves were cleared and stained with iodine–potassium iodide according to (Baker and Braun, 2007).

Aniline Blue Staining Protocol

Freehand transverse sections of leaf tissue were cut and transferred to a solution of 0.1% (w/v) Aniline Blue in 0.15M Potassium Phosphate buffer and stained for 15 minutes. Aniline Blue stained tissue sections were imaged under UV light using a Nikon Eclipse 80i microscope and the NIS-Elements F 3.0 computer software.

Pilot Dosage Study

A pilot study was performed on greenhouse-grown plants to characterize the genetic interaction of the two loci. Mutant plants were genotyped at the Chr1S loci and dosage was determined based on the Chr1S genotype and the phenotype of the individual plant.

Results

The novel maize mutant, *P135-21B*, is conditioned by a semi-dominant mutation. The mutant phenotype first appears when the plant is around 6-8 weeks old. This mutant has chlorotic, progressive leaf sectors that develop basipetally (from the leaf tip to the base), as shown in Figure 1. In addition to the leaf chlorosis, these plants are much shorter than the wild-type plants observed. They make ears and pollen, but reproductive maturity is delayed and yield is reduced relative to the wild-type plants. In order to characterize the phenotype, various experiments were performed.



Figure 1.

- A. 8-week old P135-21B (B73) heterozygote exhibiting progressive chlorosis in upper canopy leaves and intermittent streaking and cross-banding in mid-canopy leaves.
B. Closer view of upper (left) and mid-canopy (right) leaves.

P135-21B hyperaccumulates sugars and starch in mature leaves

It was hypothesized that starch was accumulating in the mutant leaves within the chlorotic sectors. To test this, an Iodine/Potassium Iodide Stain was performed on adult leaves harvested at end of night from the South Farm in Columbia, MO. End of night leaves were selected to provide the greatest contrast between photosynthates remaining in the mutant and wild-type leaves, as the majority of starch is metabolized and exported from wild-type leaves during the night. Figure 2 shows the comparison between mutant and wild-type leaves. The stain showed a hyperaccumulation of starch in mutant leaves and no accumulation of starch in

wild-type leaves, which supported the hypothesis. High Pressure Anion Exchange Chromatography (HPAEC) was used to quantify the soluble sugars glucose, fructose, and sucrose, in adult leaves that were harvested at end of night from the South Farm in Columbia, MO. Figure 3 shows the quantitative sugar data. Results showed a hyperaccumulation of sugars in the mutant leaves relative to wild type. To measure starch concentration, starch was enzymatically converted to glucose, and preliminary data shows that the mutants also have a hyperaccumulation of starch (data not shown).



Figure 2.

- A. Upper canopy leaves of P135-21B (B73) wild type (top) and chlorotic heterozygote (bottom).
 B. Cleared and I₂KI stained upper canopy leaves. The heterozygote is hyperaccumulating starch in chlorotic regions (dark regions).
 C. Mid-canopy leaves of P135-21B (B73) wild type (top) and chlorotic heterozygote (bottom).
 D. Cleared and I₂KI stained mid-canopy leaves. Much less starch accumulation is apparent compared to the upper canopy.

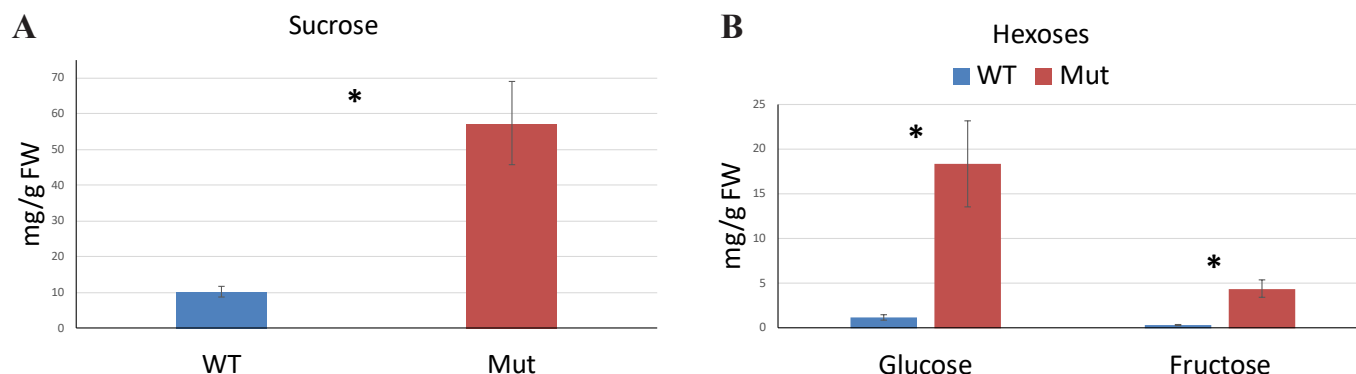


Figure 3.

- A. Sucrose hyperaccumulates in chlorotic regions of *P135-21B* heterozygotes relative to wild-type siblings. Error bars show standard error. *, t-test $p < 0.05$
 B. Glucose and fructose hyperaccumulate in chlorotic regions of *P135-21B* heterozygotes relative to wild-type siblings. Error bars show standard error. *, $p < 0.05$

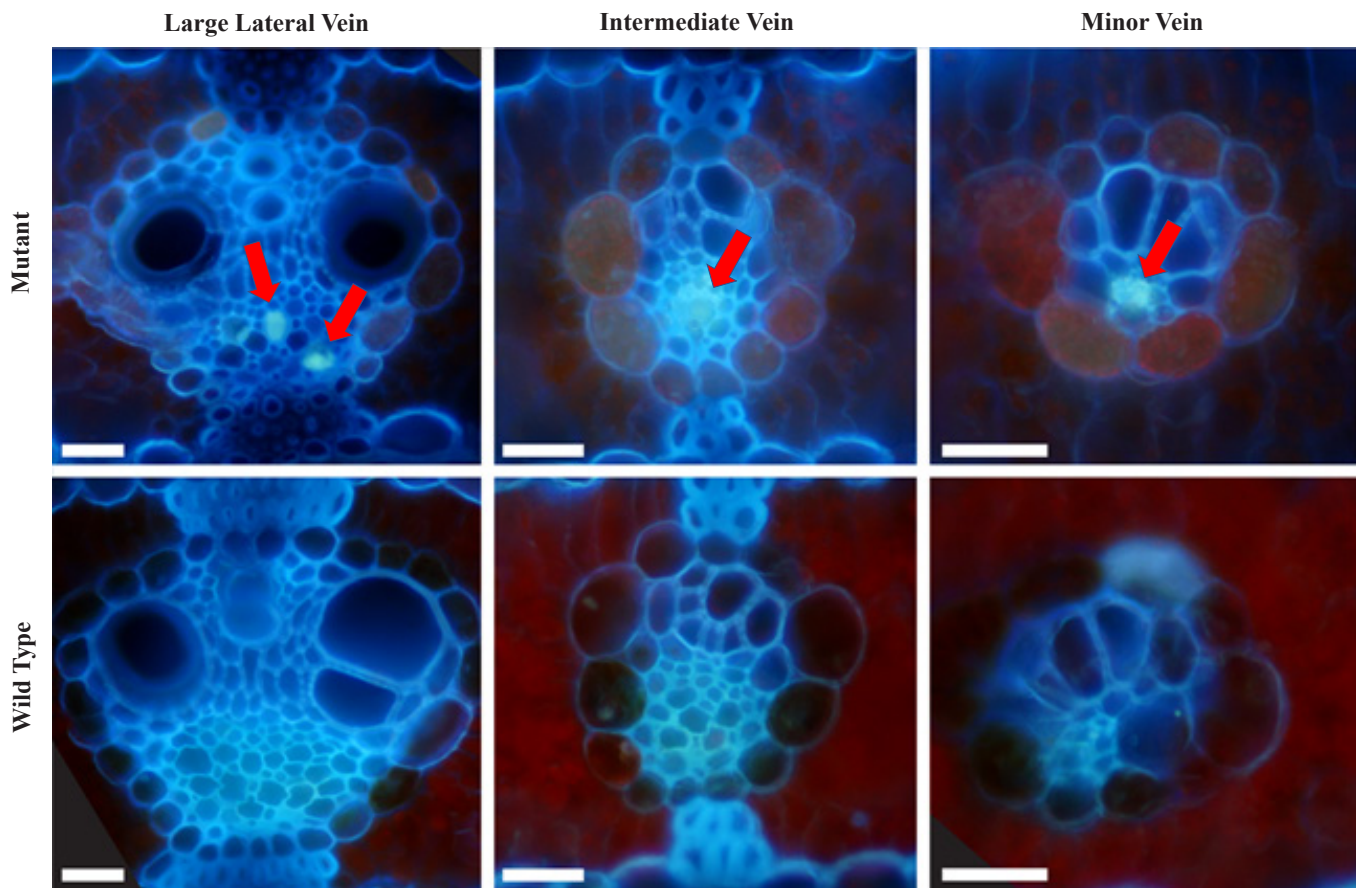


Figure 4. 8-week old P135-21B (B73) heterozygote (Mutant) and isogenic wild-type sibling stained with Aniline Blue and visualized under UV light to visualize the cell wall polymer callose. The mutant is hyperaccumulating ectopic callose (arrowheads) within the phloem of all three vein classes.

Callose blockages were found in the phloem of mutant plants

UV fluorescence microscopy were performed to determine the cause of the starch buildup. Callose is a cell wall polymer that has been shown to block the phloem in some *cpd* mutants (Julius et al., 2019). Figure 4 shows the aniline blue stain that was performed for callose. Three vein classes were stained: large lateral veins, intermediate veins, and minor veins. In all three vein classes, the mutant leaves contained callose in the phloem where the wild-type leaves did not.

***P135-21B* is conditioned by two independent loci in B73 and one locus in Mo17**

The mutant *P135-21B* originates from ethyl methanesulfonate (EMS) mutagenesis in a Va35 inbred background. In order to segregate away non-causal background mutations and generate polymorphic mapping populations to identify the causal genes, the mutant plant was cross-pollinated to introgress into inbred backgrounds B73 and Mo17 and then scored in the field to identify the mutant phenotype. It was observed that the B73 introgression segregated 3 wild-type plants to 1 mutant plant (3:1) and the Mo17 introgression segregated 1:1. Table 1 shows the Chi-Squared test performed to evaluate the observed segregation ratios. From this, the mutant was expected to be conditioned by two independent loci in the B73 background, and a single locus in the Mo17 background. After a Bulk Segregant Analysis was performed, rough mapping intervals were determined with one locus on the short arm of chromosome 1 in the B73 mapping population and the other locus on the short arm of chromosome 7 in the Mo17 mapping population. Figure 5 shows the rough mapping intervals on Chr1S and Chr7S. The nearest polymorphic marker in the rough mapping population for the B73 population was downstream of the rough map position and no markers within the identified rough mapping interval were available for the B73 mapping population. It was hypothesized that this is why only one rough map position was identified in the B73 population despite the Chi-Squared experiment indicating that it segregates two independent loci.

Population	Total Mutants	Total WT	χ^2 1:1	χ^2 3:1
B73 x <i>P135/+</i>	113	349	9.1e-7*	0.86
Mo17 x <i>P135/+</i>	275	322	0.85	ND

Table 1. Individuals from multiple families of a segregating mapping population were scored for the mutant phenotype and analyzed for 1:1 or 3:1 segregation using a Chi-Squared Test. *, null hypothesis rejected.

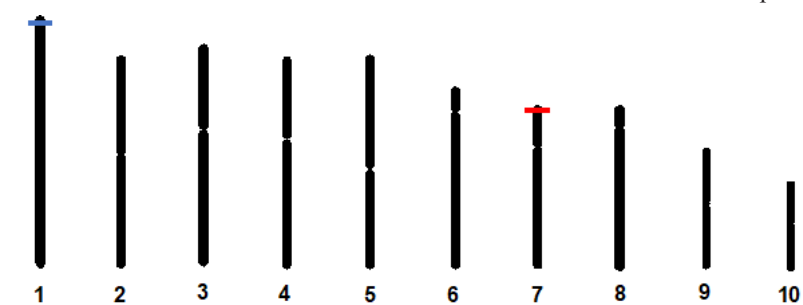


Figure 5a
A. Overview of Bulk Segregant Analysis results for B73 x *P135-21B/+* (Va35; Blue) and Mo17 x *P135-21B/+* (Red) mapping populations.

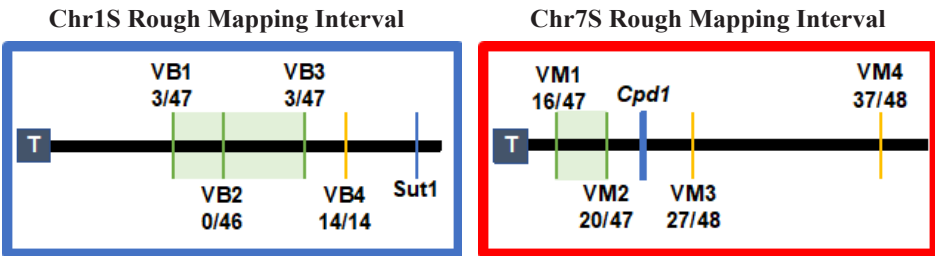


Figure 5b
B. Rough Mapping Intervals. Both intervals map near a known *cpd* mutant, but are novel. Mapping Legend: VB/VM, polymorphic DNA markers between VA35 (V) and B73 (B) or Mo17 (M); #/#, Recombinant Mutants/Total Mutants Screened; Boxed T, Telomere.

Discussion and Future Directions

P135-21B is a novel *carbohydrate partitioning defective* mutant with chlorotic sectors of the leaves similar in appearance to other *carbohydrate partitioning defective* mutants' phenotypes. *Carbohydrate partitioning defective* mutant leaves can be broadly grouped into two different phenotypic classes: stable leaf sectors that don't expand after they develop and progressive sectors that do expand. *P135-21B* has chlorotic sectors that form basipetally and expand, such as in the *cpd* mutant *Sucrose transporter1 (SUT1)*. Conversely, in the *cpd* mutants *tdy1*, *tdy2*, and *psychedelic (psc)*, chlorotic clonal sectors are stable (Slewiniski et al., 2009; Baker and Braun, 2007; Slewiniski and Braun, 2010). Additionally, it is known that *carbohydrate partitioning defective* mutants hyperaccumulate sugars and starch in their leaves, and as qualitative starch data has already been generated, the next step is to quantify the amount of starch in the leaves.

Another unique aspect of *P135-21B*, is the callose blockage observed in the phloem. Genes that affect different parts of the transport pathways have been discovered, however genes that block the pathway with callose prior to the onset of the *cpd* phenotype are rare. *Sxd1* has blockages earlier in the transport pathway outside of the phloem, but *Cpd1* is the only mutant containing causal callose blockages in the phloem that has been described in maize so far (Ma et al., 2008; Julius et al., 2018). The next steps include performing experiments on developing plants that don't yet exhibit the chlorotic phenotype to determine if callose blockage occurs before or after the phenotype to determine if it is a cause or an effect of carbohydrate accumulation.

Cpd mutants conditioned by a single locus in some inbred backgrounds and multiple independent loci in others are very rare. The recessive mutant *psychedelic* is the only other one to do so, and *P135-21B* is the first semi-dominant *cpd* mutant discovered with this mode of inheritance (Slewiniski and Braun, 2010). To determine the causal genes, additional polymorphic PCR markers are being developed within the rough mapping intervals on Chr1S and Chr7S to fine map the regions toward candidate genes. It has been determined that the second locus required to condition the *P135-21B* phenotype in the B73 mapping population is linked to the same chromosome 7 interval identified in the Mo17 mapping population. New markers have been designed and validated to narrow both the Chr1S and Chr7S regions.

A pilot study was performed on greenhouse-grown plants from a population segregating homozygous, heterozygous, and wild-type individuals at both the Chr1S and Chr7S positions to characterize the genetic interaction of the two loci. Mutant plants from the greenhouse were genotyped at the Chr1S position and then their phenotypes were analyzed. During this pilot study, the markers on Chr7S had not been designed yet, and therefore these plants could not be genotyped at the Chr7S position. It was determined that with two loci conditioning this mutation, there is variable phenotypic severity depending on the probable genotype at each locus. For example, plants that genotyped as a heterozygote at the Chr1 locus could be 1-dose, 2-dose, or 3-dose, depending upon the genotype at the Chr7S locus, which was unknown. Based on the phenotype of the plant and after taking the Chr1S genotype into account, probable dosages could be determined. It seems as if homozygosity for the mutation at one locus is sufficient to cause a phenotype in the absence of a mutant allele at the second locus. However, plants with putative higher dosages, due to homozygous or heterozygous mutations at both loci, had much stronger phenotypes. Further dosage experiments will be performed to determine how the two loci interact to cause the *P135-21B* phenotype. Through the work done on *P135-21B*, two new genes required for carbohydrate partitioning with a unique interaction mechanism will be discovered.

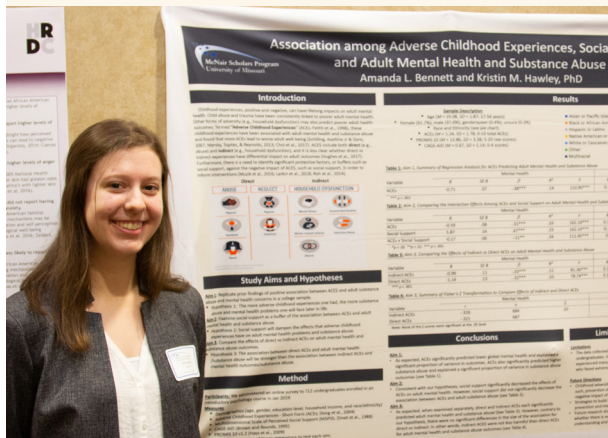
References

1. Baker, RF and Braun, DM. 2007. *tie-dyed1* Functions Non-Cell Autonomously to Control Carbohydrate Accumulation in Maize Leaves. *Plant Physiology* 144, 867-878.
2. Baker, RF and Braun, DM. 2008. *Tie-dyed2* Functions with *Tie-dyed1* to Promote Carbohydrate Export from Maize Leaves. *Plant Physiology* 146, 1085-1097.
3. Barratt, DHP, Kölling, Katharina, Graf, Alexander, Pike, Marilyn, Calder, Grant, Findlay, Kim, Zeeman, SC, and Smith, AM. 2011. Callose Synthase *GSL7* Is Necessary for Normal Phloem Transport and Inflorescence Growth in Arabidopsis. *Plant Physiology* 155, 328-341.
4. Braun, DM, Ma, Yi, Inada, Noriko, Muszynski, MG, and Baker, RF. 2006. *tie-dyed1* Regulates Carbohydrate Accumulation in Maize Leaves. *Plant Physiology* 142, 1511-1522.
5. Cui, Weier and Lee, Jung-Youn. 2016. *Arabidopsis* callose synthases *CalS1/8* regulate plasmodesmal permeability during stress. *Nature Plants* 2, 1-9.
6. Evert, RF, Escherich, W, and Heyser, W. 1977. Distribution and Structure of Plasmodesmata in Mesophyll and Bundle-sheath Cells of *Zea mays* L. *Planta* 136, 77-89.
7. Evert, RF, Eschrich, W and Heyser, W. 1978. Leaf Structure in Relation to Solute Transport and Phloem Loading in *Zea mays* L. *Planta* 138, 279-294.
8. Evert, RF and Russin, WA. 1993. Structurally, Phloem Unloading in the Maize Leaf cannot be Symplastic. *American Journal of Botany* 80, 1310-1317.
9. Fritz, Eberhard, Evert, RF, and Nasse, Hubert. 1989. Loading and transport of assimilates in different maize leaf bundles. *Planta* 178, 1-9.
10. Fulton TM, Chunwongse J, and Tanksley SD. 1995. Microprep Protocol for Extraction of DNA from Tomato and other Herbaceous Plants. *Plant Molecular Biology Reporter* 13 (3): 207-209.
11. Julius, BT, Slewinski, TL, Baker, RF, Tzin, Vered, Zhou, Shaoqun, Bihmidine, Saadia, Jander, Georg, and Braun, DM. 2018. Maize *Carbohydrate partitioning defective1* impacts carbohydrate distribution, callose accumulation, and phloem function. *Journal of Experimental Botany* 69, 3917-1931.
12. Ma, Yi, Baker, RF, Magallanes-Lundback, Maria, DellaPenna, Dean, and Braun, DM. 2008. *Tie-dyed1* and *Sucrose export defective1* act independently to promote carbohydrate export from maize leaves. *Planta* 227, 527-538.
13. Slewinski, TL and Braun, DM. 2010. The *Psychodelic* Genes of Maize Redundantly Promote Carbohydrate Export From Leaves. *Genetics* 185, 221-232.
14. Slewinski, TL, Baker, RF, Stubart, Adam, and Braun, DM. 2012. *Tie-dyed2* Encodes a Callose Synthase That Functions in Vein Development and Affects Symplastic Trafficking within the Phloem of the Maize Leaves. *Plant Physiology* 160, 1540-1550.
15. Slewinski, TL, Zhang Cankui, and Turgeon, Robert. 2013. Structural and functional heterogeneity in phloem loading and transport. *Frontiers in Plant Science* 4, 1-11.
16. Tilsner, Jens, Nicolas, William, Rosado, Abel, and Bayer, EM. 2016. *Annual Review of Plant Biology*, 337-364.
17. Van Bel, AJE. 2003. The phloem, a miracle of ingenuity. *Plant, Cell and Environment* 26, 125-149.
18. Xie, Boe, Wang, Xiaomin, Zhu, Mosheng, Zhang, Zhongming, and Hong, Zonglie. 2011. *CalS7* encodes a callose synthase responsible for callose deposition in the phloem. *The Plant Journal* 65, 1-14.

Association Among Adverse Childhood Experiences and Social Support on Adult Mental Health and Substance Abuse

AMANDA L. BENNETT

Kristen Hawley, PhD, Mentor
Department of Psychology



Amanda Bennet is a psychology major who received the Mizzou Diversity Award Scholarship. She is an Undergraduate Research Ambassador and also a member of Psi Chi and Alpha Phi Omega Service Fraternity.

In the summer of 2019 she completed a global service trip to Vietnam through the MU Office of Service Learning where she worked with at-risk youth in the community.

This fall she will complete her senior year while she prepares her applications to graduate school.

Abstract

Previous studies have identified the lasting impact of traumatic, or adverse, childhood experiences on mental health (MH) and substance abuse (SA) outcomes throughout life. However, less is known about whether direct (e.g., abuse) versus indirect (e.g., parental incarceration) adversity have differential impact, and whether childhood social support may protect against the negative impact of childhood adversity. This study aims to examine the association between direct and indirect adverse childhood experiences (ACEs) on adult MH and SA outcomes, and to examine childhood social support (SS) as a potential protective factor. In this study, a sample of 712 undergraduate participants were recruited from an introductory psychology course in January 2019. Participants completed an anonymous 30-item self-report survey, including history of ACEs and perceived SS during childhood, and current MH and SA. We replicated prior findings of the association between ACEs and adult MH and adult SA (i.e., higher ACEs associated with poorer MH and greater SA). Contrary to expectations, we found that both direct and indirect ACEs were equally strong negative predictors of adult MH and SA outcomes. As expected, greater childhood SS was associated with better adult MH and less SA. When ACEs were added to the model, SS continued to show significant association with better adult MH and less adult SA. When we examined the interaction between ACEs and SS on adult MH and SA, we found that while SS remained a protective factor, the strength of the association between SS and adult MH and SA was weaker for those with more ACEs. We found no interaction between ACEs and SS for adult SA. Increased efforts should go to identifying significant protective factors and implementing protective strategies in prevention and intervention efforts.

Introduction

Childhood experiences, whether positive or negative, can have lifelong impacts on physical and mental health, academic achievement and career attainment, overall functioning and mortality (e.g., Felitti et al., 1998; Hughes et al., 2017). Research on childhood abuse and trauma has consistently demonstrated a lasting, negative impact well beyond childhood and adolescence (Hughes et al., 2017). In other words, the adversity faced in childhood has negative consequences on adult health and well-being (Hughes et al., 2017).

Over the past quarter century, researchers have broadened the scope of abuse to consider other forms of trauma, including those that may impact children more indirectly such as exposure to domestic violence or the experience of divorce or parental incarceration. By examining how multiple adverse experiences affect adult health, we gain a better understanding of how adversity relates to health. The term adverse childhood experiences or ACEs

was coined in the 1998 CDC-Kaiser ACE study. This study aimed to examine the association of childhood experiences with long-term health outcomes that may result in early death among adults (Felitti et al., 1998). In their seminal report, Felitti and colleagues (1998) found that ACEs yielded a strongly negative impact on adult health; more ACEs predicted both a higher probability of adult illness as well as greater severity of adult disease. This study was very important in establishing the relationship between exposure to adverse childhood experiences and adult health risk and disease. It was also one of the first demonstrations of the lasting, negative impact that even more indirect, seemingly less severe, forms of childhood trauma may have on health.

One potential concern with the CDC-Kaiser ACE study was its reliance on retrospective self-report measures. Examining the impact of ACEs prospectively has many challenges, including the need for very large sample sizes, retaining participants over long follow ups for repeated measurement, and the ethical challenges of determining whether and how to intervene when abuse or neglect are reported. As such, several studies have examined the reliability and validity of retrospective reports of ACEs. These have found that self-reports are generally stable over time and accurately measure adversity (e.g., Dube, Williamson, Thompson, Felitti, & Anda, 2004; Pinto, Correia, Maia 2014).

Furthermore, studies have increasingly looked at why it is important to identify these traumatic early life experiences that have been repeatedly shown to lead individuals to higher likelihoods of having poorer overall health during adulthood. We see these health differences when looking at the mental (as well as physical) health of adults who had ACEs compared to those who did not. Several well documented studies have examined and extended our understanding of the relationships between ACEs and adult mental health and well-being. These studies aim to highlight the detrimental effects of adverse childhood experiences on adulthood and have demonstrated positive relationships between ACEs and mental health (Dube, Felitti, Dong, Giles, & Anda, 2003; Reiser, McMillan, Wright, & Asmundson, 2014; Nurius, Green, Logan-Greene, & Borja, 2015; Merrick et al., 2017). Studies have shown that the more ACEs we have, the more at risk we are for many health problems. Previous research that looked at a number of different health issues and how they are related to what is called direct (e.g., maltreatment) and indirect (e.g., household dysfunction) adverse childhood experiences shows how ACEs have been previously linked to poor adult health (Hughes et al., 2017). Specifically, the strength of the relationships between some ACEs and certain health risks. This study also suggests that ACEs may be able to be broken down and examined as direct or indirect experiences, however, it is less clear whether direct vs indirect ACEs have differential impact on adult well-being.

To further facilitate the significance of adverse childhood experiences on health, many studies have looked specifically at their relationship with mental health and substance abuse. Previous studies do confirm ACEs as a significant risk factor leading to increased substance use in both early adulthood and later-life, as well as poorer adult mental health (Choi, DiNitto, Marti, & Choi 2017; Dube, Anda, Felitti, Edwards, & Croft, 2002; Dube et al., 2003; Dube et al., 2006; Mersky, Topitez, & Reynolds, 2013; Schilling, Aseltine Jr & Gore, 2007). These studies are essential to our understanding of how adversity throughout childhood can lead to poor mental health and substance abuse problems beginning from early adulthood and lasting all the way to the end of adulthood. The associations and the

likeliness of people who experienced childhood trauma to developing mental health and substance use disorders is increasingly studied and extremely important to our understanding of how to prevent such outcomes.

When looking at the previous literature, an emerging theme is the lack of knowledge about building resiliency towards the effects of ACEs on later-life mental health and substance abuse outcomes. The efforts to develop prevention programs and build resiliency has been slow moving and so it has become increasingly important to focus our research and our attention on the prevention of the negative effects of childhood trauma (Hughes et al., 2017).

Studies have focused their efforts on looking at how different protective factors might act as a buffer towards adversity. A number of previous studies have tried and failed at identifying protective factors that may act as a buffer against adversity and state that more research is needed in order to identify measures of protective factors that work to shelter children from adversity (Larkin et al., 2018; Muzik, Umarji, Sexton, & Davis, 2016). Previous studies have demonstrated that identifying effective protective factors may not be a simple task, but they urge researchers to continue looking for such buffers.

When looking at social support, the literature indicates that it acts as a protective factor against depression and the likelihood of suicide (Babiss & Gangwisch, 2009; Cheong, Sinnot, Dahly, & Kearney, 2017; Kleiman & Liu, 2012). Additionally, one recent study found that social support boosted resiliency against depression among elder native American Indians, who had ACEs (Roh et al., 2014). More research is needed on how social support during childhood may boost resilience against adversity both during childhood and more long-term. By learning more about whether social support during childhood may work as a protective factor, we may increase our understanding of what can be done to protect against the negative impact of adversity. To help addresses the previously stated gaps in the literature, this study has the following four aims:

Aim 1: Replicate prior findings of association between ACEs and adult mental health (MH) and substance abuse (SA) in a college sample

- Hypothesis 1a: ACEs will be negatively associated with adult MH
- Hypothesis 1b: ACEs will be positively associated with adult SA

Aim 2: Examine whether direct ACEs have a stronger association with adult MH and with adult SA than indirect ACEs.

- Hypothesis 2a: Direct ACEs will have a stronger negative association with adult MH than indirect ACEs
- Hypothesis 2b: Direct ACEs will have a stronger positive association with adult SA than indirect ACEs

Aim 3: Replicate prior findings of association between perceived childhood SS and adult MH and SA in a college sample

- Hypothesis 3a: SS will be positively associated with adult MH
- Hypothesis 3b: SS will be negatively associated with adult SA

Aim 4. Examine the association of perceived childhood SS in the context of ACEs and determine whether childhood SS has a consistent association with adult MH and SA, regardless of the level of ACEs. In other words, examine the interaction between childhood SS and ACEs to determine whether the protective effect of childhood SS on adult MH and SA varies based on level of ACEs.

- Hypothesis 4a: Childhood SS has a weaker, but still significant, protective effect on adult MH for those with more ACEs
- Hypothesis 4b: Childhood SS has a weaker, but still significant, protective effect on adult SA for those with more ACEs

Methods

Sample and Data Collection

Data for our study was drawn from a sample of undergraduate students ($N=712$) from the University of Missouri – Columbia who were enrolled in an introductory psychology course in January 2019. Students from all sections of the introductory psychology course created the participant pool and students participated at their own convenience. We administered our survey online and it was taken at the students' convenience. All consenting participants completed our anonymous online survey of approximately 35 items, covering demographic information (see table 1) and 4 measures used for the current study. Demographic information from the sample indicated that the majority of participants ranged from ages 17-26 with a mean age of 19 ($SD = 1.87$). The sample consisted of 61.7% female, 37.6% male, 0.4% genderqueer, and 0.3% not sure. The racial/ethnic composition of the sample was 71.5% Caucasian, 10.9% Black, 9.8% multiracial, 4% Asian, 2.1% Hispanic, and 1.7% categorized as other. Of the sample, 70.6% of participants were first year students, 18.7% were in their second year, 6.1% in their third year, 3.7% in their fourth year, and 1% in their fifth or more year. Approximately a quarter (24.7%) of the sample's household income was over \$150,000, 28.8% were between \$81,000 and \$150,000, 19.6% were between \$40,000 and \$80,000 and 26.8% had a household income below \$39,000 annually. Students received course credit for their participation.

Measures

The survey, comprised of 4 measures, was 30 items in length and asked about adverse childhood experiences (first 18 years of life), childhood social support (first 18 years of life), and current adult mental health and substance abuse.

Adverse Childhood Experiences - short form (ACEs; Dong et al., 2004). The ACEs short form is a 10 item, self-report measure where each item is answered on a dichotomous, yes/no scale, yielding an ACE score ranging from 0-10. The ACEs Short Form was developed using items from the Conflict Tactics Scale (Straus, Gelles & Smith, 1990), the Childhood Trauma Questionnaire (Bernstein et al., 2003) and Wyatt's 1985 study (Wyatt, 1985). The ACEs short form measures 10 ACEs that fit into one of three categories: abuse, neglect, and household dysfunction. This ACE measure has been shown to be a reliable and valid measure of adverse experiences in childhood (Anda et al., 2010; Zanotti et al., 2018). In this study, we used the ACE measure to look at direct (abuse and neglect) and indirect (family and household dysfunction) experiences.

Multidimensional Scale of Perceived Social Support (MSPSS; Zimet et al., 1988). The MSPSS is a 12 item self-report measure of perceived social support from friends, family, and significant others

Table 1. Participant Demographic Information

Measure	Study
M Age (SD)	19.08 (1.872)
% Gender	
Female	61.70%
Male	37.60%
Genderqueer	0.40%
Not sure	0.30%
% Education Level	
First year	70.60%
Second year	18.70%
Third year	6.10%
Fourth year	3.70%
Fifth or more	1%
% Household Income	
Under \$10,000	12.60%
\$10,000-\$24,000	7.20%
\$25,000-\$39,000	7%
\$40,000-\$80,000	19.60%
\$81,000-\$150,000	28.80%
Over \$150,000	24.70%
% Race/Ethnicity	
Asian or Pacific Islander	4%
Black or African American	10.90%
Hispanic or Latino	2.10%
Native American or American Indian	0%
White or Caucasian	71.50%
Other	1.70%
Multiracial	9.80%

(Zimet et al., 1988). Items are rated on a 7-point Likert scale from 1 (very strongly disagree) to 7 (very strongly agree) where higher scores indicate higher levels of perceived social support than lower scores. Each type of social support (friends, family, and significant others) has 4 items (Zimet et al., 1988). The MSPSS has been shown to be a valid and reliable measure of perceived social support among various populations (e.g., Zimet et al., 1990; Canty-Mitchell & Zimet, 2000). Previous factor analyses have supported three subscales of the MSPSS: (1) friends, (2) family, (3) significant others, with distinct responses to each subscale (Dahlem et al., 1991; Clara et al., 2003). In the current study, we revised the instructions and worded the items in past tense to ask about perceived social support during their first 18 years, rather than current social support.

CAGE-AID (Brown and Rounds, 1995). The CAGE measure Adapted to Include Drugs (CAGE-AID) is a 4 item self-report measure of problematic alcohol and drug use rated on a dichotomous yes/no scale. The original CAGE (Mayfield, McLeod, & Hall, 1974) is a widely used measure of alcohol use. The CAGE-AID is an expanded form to include other drug use in addition to alcohol (Brown and Rounds, 1995). Included in the CAGE-AID are questions about cutting down on use, others critique of your use, feelings of guilt, and an eye-opener. The scale has shown to be a reliable and valid measure of substance abuse with one positive answer indicating

a need for further evaluation and two positive answers indicating a positive screen for drug and alcohol abuse (Leonardson et al., 2005).

PROMIS 10 v1.2 (Hays et al., 2009). The Patient-Reported Outcomes Measurement Information System (PROMIS) is a 10 item self-report measure of physical and mental health status. The PROMIS 10 has two subscales: global physical health and global mental health. This two-factor model has been supported by exploratory and confirmatory factor analyses (Hays et al., 2009). Items are rated from 1 to 5, where 1 is poor and 5 is excellent. The PROMIS 10 mental health subscale has been shown to be a valid and reliable measure of mental health (Cella et al., 2010). We used the 4-item global mental health scale in the current study where higher scores indicate better mental health while lowers scores indicate worse mental health.

Data Screening and Analysis

Prior to analysis, data was screened following guidelines that examined accuracy, missing data, outliers, and normality assumptions (Tabachnick & Fidell, 2013). See Table 2 for a table of bivariate correlations among the above measures.

For aim 1, we computed two regression equations: (1) one with total childhood ACEs as predictor of adult mental health, and (2) one with total childhood ACEs as predictor of adult substance abuse in the second equation. For aim 2, we ran 4 regressions: (1) one with total indirect ACEs as a predictor of adult mental health, (2) one with total indirect ACEs as a predictor of adult substance abuse, (3) one with total direct ACEs as a predictor of adult mental health, and (4) one with total direct ACEs as a predictor of adult substance abuse. We then ran two Fisher's r to z transformations: (1) comparing the correlations of indirect and direct ACEs on adult mental health, and (2) comparing the correlations of indirect and direct ACEs on adult substance abuse. For aim 3, we computed two regression equations examining childhood social support as a predictor of (1) adult mental health and (2) adult substance abuse. For aim 4, we ran two regression analyses to examine the interaction effects between ACEs and childhood social support on (1) adult mental health and (2) adult substance abuse. All statistical analyses were conducted using IBM SPSS Statistics 25.

Table 2. Correlations among Measures

	ACEs Total	Direct ACEs		Cage-Aid Total	PROMIS Total	Social Support Total
ACEs Total	-	-	-	-	-	-
Direct ACEs	.833**	-	-	-	-	-
Indirect ACEs	.883**	.477**	-	-	-	-
Cage-Aid Total	.182**	.181**	.140**	-	-	-
PROMIS Total	-.376**	-.321**	-.326**	-.202**	-	-
Social Support Total	-.289**	-.302**	-.219**	-.148**	.519**	-

** $p < .001$

Results

We first tested the associations between ACEs and adult mental health and substance abuse to reproduce previous findings. We hypothesized that adverse childhood experiences will be negatively correlated with mental health and positively correlated with adult

substance abuse. We ran a simple linear regression to test if ACEs were predictive of adult mental health. As expected, we found a negative association between ACEs and adult mental health, accounting for 14% of the variability in adult mental health ($p < .001$, see table 3). We then ran another simple linear regression to test if ACEs predicted adult substance abuse. Regression results found a positive association between ACEs and adult substance abuse accounting for 3% of the variability in adult substance abuse ($p < .001$, see table 4).

Table 3: Aim 1, Summary of Regression Analysis for ACEs Predicting Adult Mental Health

Variable	Mental Health				
	<i>B</i>	<i>SE B</i>	β	R^2	<i>F</i>
ACEs	-0.71	.07	-.38***	.14	110.90***

Note: *** $p < .001$

Table 4: Aim 1, Summary of Regression Analysis for ACEs Predicting Adult Substance Abuse

Variable	Substance Abuse				
	<i>B</i>	<i>SE B</i>	β	R^2	<i>F</i>
ACEs	0.12	.02	.18***	.03	22.26***

Note: *** $p < .001$

For our second aim, we looked at the effects of direct versus indirect ACEs on adult mental health and substance abuse. We hypothesize a stronger association between direct ACEs and adult mental health than between indirect ACEs and adult mental health. We also hypothesize a stronger association between direct ACEs and adult substance abuse than between indirect ACEs and adult substance abuse. We ran two linear regressions to test if indirect and direct ACEs predicted poorer adult mental health. The results of these regressions found that when examined independently, direct and indirect ACEs are each negatively associated with mental health where indirect ACEs account for 11% of the variability in adult mental health and direct ACEs account for 10% of the variability ($p < .001$, table 5).

Table 5: Aim 2, Comparing the Effects of Indirect vs Direct ACEs on Adult Mental Health

Variable	Mental Health				
	<i>B</i>	<i>SE B</i>	β	R^2	<i>F</i>
IndirectACEs	-0.99	.11	-.33***	.11	81.36***
Direct ACEs	-1.14	.13	-.32***	.10	78.74***

Note: *** $p < .001$

We also ran two regressions examining the association between direct and indirect ACEs on adult substance abuse. We found that indirect and direct ACEs are each positively associated with substance abuse where indirect ACEs account for 2% of the variability in adult substance abuse and direct ACEs account for 3% of the variability ($p < .001$, see table 6).

Table 6: Aim 2, Comparing the Effects of Indirect vs Direct ACEs on Adult Substance Abuse

Variable	Substance Abuse				
	<i>B</i>	<i>SE B</i>	β	R^2	<i>F</i>
IndirectACEs	0.14	.04	.14***	.02	13.13***
Direct ACEs	0.21	.05	.18***	.03	22.43***

Note: *** $p < .001$

To compare the effects of direct versus indirect ACEs, we used Fisher's Z-transformation. We first calculated the Z score comparing the effects between indirect ACEs and direct ACEs on mental health. We found that the Z score was not significant at the .05 level (see table 7). We then calculated the Z score comparing the effects between indirect ACEs and direct ACEs on substance abuse. Again, we found that the Z score was not significant at the .05 level (see table 8).

Table 7: Aim 2, Summary of Fisher's Z Transformation to Compare Effects of Indirect and Direct ACEs on Adult Mental Health

Variable	Mental Health		
	<i>r</i>	<i>n</i>	<i>Z</i>
Indirect ACEs	-.326	684	.10
Direct ACEs	-.321	687	

Note: None of the Z scores were significant at the .05 level

Table 8: Aim 2, Summary of Fisher's Z Transformation to Compare Effects of Indirect and Direct ACEs on Adult Substance Abuse

Variable	Substance Abuse		
	<i>r</i>	<i>n</i>	<i>Z</i>
Indirect ACEs	.140	661	.77
Direct ACEs	.181	665	

Note: None of the Z scores were significant at the .05 level

For our third aim, we tested the associations between childhood social support and adult mental health and substance abuse to replicate previous findings. We hypothesized that childhood social support would be positively correlated with mental health and negatively correlated with adult substance abuse. We ran a simple linear regression to test if childhood social support was predictive of adult mental health. The results of this regression found a positive association between childhood social support and adult mental health that accounts for 27% of the variability in adult mental health ($p < .001$, see table 9). We then ran another simple linear regression to test if childhood social support predicted adult substance abuse. Regression results found a negative association between childhood social support and adult substance abuse accounting for 2% of the variability in adult substance abuse ($p < .001$, see table 10).

Table 9: Aim 3, Summary of Regression Analysis for SS Predicting Adult Mental Health

Variable	Mental Health				
	<i>B</i>	<i>SE B</i>	β	<i>R</i> ²	<i>F</i>
SS	2.07	.13	.52***	.27	252.30***

Note: *** $p < .001$

Table 10: Aim 3, Summary of Regression Analysis for SS Predicting Adult Substance Abuse

Variable	Substance Abuse				
	<i>B</i>	<i>SE B</i>	β	<i>R</i> ²	<i>F</i>
SS	-0.20	.05	-.15***	.02	14.82***

Note: *** $p < .001$

For our last aim, we examined the protective effect of childhood social support within the context of ACEs to determine whether its protective effect on adult mental health and substance abuse varies based on the level of childhood adversity experienced. We hypothesized that childhood social support will have a weaker, yet still significant, protective effect on those with more ACEs. First, we entered ACEs and childhood SS, which alone, accounted for a higher variance of mental health scores at 33%. Next, when we entered the interaction, our regression then found that the interaction between ACEs and childhood social support was negatively associated with adult mental health while accounting for just 1% more of the variability in adult mental health, beyond that already accounted for by ACEs and childhood SS alone ($p < .01$, see table 11). Our following regression found no significant interaction between ACEs and childhood social support on adult substance abuse ($p > .05$, see table 12).

Table 11: Aim 4, Interaction Effects among ACEs and Childhood Social Support on Adult Mental Health

Variable	Mental Health				
	<i>B</i>	<i>SE B</i>	β	<i>R</i> ²	<i>F</i>
ACEs	-0.59	.08	-.31***		
Social Support	1.87	.14	.47***	.33	162.19***
ACEs x Social Support	-0.17	.06	-.11**	.34	111.45***

Note: ** $p < .01$ *** $p < .001$

Table 12: Aim 4, Interaction Effects among ACEs and Childhood Social Support on Adult Substance Abuse

Variable	Substance Abuse				
	<i>B</i>	<i>SE B</i>	β	<i>R</i> ²	<i>F</i>
ACEs	0.11	.03	.17***		
Social Support	-0.13	.05	-.10*	.04	13.71***
ACEs x Social Support	.02	.03	.03	.04	9.26***

Note: * $p < .05$ *** $p < .001$

Discussion

Our study examined the associations among adverse childhood experiences and adult mental health and substance abuse. Consistent with prior studies, we found that childhood adversity is significantly associated with poorer adult mental health and greater adult substance abuse. These findings suggest that adverse childhood experiences may be a significant risk factor for poor adult outcomes. Interestingly, we saw stronger associations between childhood adversity and adult mental health than we found between childhood adversity and adult substance abuse. This was somewhat puzzling because previous studies have found ACEs equally as strong of a predictor towards mental health and substance abuse (e.g., Dube et al., 2003; Schilling, Aseltine Jr, & Gore, 2007; Mersky, Topitez, & Reynolds, 2013). It is possible that our association between ACEs and adult substance abuse was somewhat dampened in our study given that we used a college sample who may have shown a more truncated range of moderate to high substance use, with few abstaining; indeed, college students typically show high rates of substance use compared to the broader population (e.g., Prendergast, 1994; Slutske et al., 2004). Our sample showed a higher mean and percentage of "yes" answers on the

CAGE-AID than in other samples (Couwenbergh et al., 2009).

Our data also suggests that adverse childhood experiences may be equally damaging whether that adversity was experienced directly (e.g., abuse) or indirectly (e.g., incarcerated family member). In other words, it appears that indirect childhood experiences may be just as damaging for adult outcomes as those more directly experienced. It is worth noting that we had somewhat lower rates of total ACEs as well as the more severe, direct childhood experiences of abuse and neglect in our college sample than has been observed in population-representative samples (Carlson et al., 2019). Direct and indirect adverse childhood experiences were strongly correlated at .48 and suggest that there is substantial overlap between the two factors. It is recommended that the correlation be above .70 to show a measure of the same construct (Carlson & Herdman, 2012). There is a limited amount of research that looks at the presumed two-factor structure suggesting more research is needed here (Hughes et al., 2017).

Our study then examined the associations among childhood social support and adult mental health and substance abuse, both along and within the context of childhood adversity. As expected, our findings suggests that social support during childhood predicts better adult mental health and less substance abuse overall, and within the context of childhood adversity. These findings suggest that childhood social support may be a significant protective factor for adult mental health and substance abuse. Our data also shows that childhood social support accounts for more variability in mental health outcomes than in substance abuse outcomes. Again, this may be because our college sample showed higher rates on substance use than a broader population sample (e.g., Prendergast, 1994; Slutske et al., 2004). Our study also looked at the interaction between social support and adverse childhood experiences as a potential buffer of these effects. Our findings indicate that childhood social support remains a significant protective factor for adult mental health, though it may have a somewhat weaker protective effect for those with the highest levels of childhood adversity. We found no interaction between ACEs and childhood social support for adult substance abuse. Again, the findings regarding adult substance abuse should be considered with some caution given our college sample may not represent the range of substance use in a more typical adult population.

This study had several limitations worth noting. First, as noted above, we used a convenience sample of college undergraduates, with higher rates of substance use and low rates of child abuse and/or neglect. Given the consistent finding from prior research that childhood adversity negatively impacts a wide range of adult outcomes, the low rates of more severe childhood adversity in a college-attending sample is not surprising. It does however, limit the generalizability of our findings somewhat. If we had used a more representative population, we may have found both a wider range of substance use (particularly in the low use end of the range) and higher rates of adversity. This may have resulted in stronger, or weaker, associations than shown here. In addition, the online survey we used restricted us to a total of only 30 items which restricted the measures we could use. There are a wide variety of validated measures used to assess adverse childhood experiences in first 18 years of life and it may be that the 10-item measure used in this study limited our data on adverse childhood experiences. Also, there are a wide variety of measures that have been validated to measure social support and it may be that a different measure which looked at a wider range of social support would have shown stronger effects. Our study looked at social support as a whole, rather than looking at support coming

from friends, family and significant others as individual subscales. Our study may have benefited from looking at support coming from different sources and may have further benefited from a measure that looked more specifically at social support from academic advisors and teachers in the first 18 years of life. Lastly, we must acknowledge that all of our measures were self-report and our measures for childhood social support and ACEs were also retrospective.

There is still a gap in the literature that works to identify specific protective factors which build resilience among adverse childhood experiences. It is worth noting that childhood adversity is a consistent predictor of poorer adult health outcomes and, as such, prevention of adverse childhood experiences and the identification of significant buffers against the negative impact of adverse childhood experiences remain high research priorities. While the prevention of outcomes associated with adverse childhood experiences are slowly progressing, we must increasingly focus our attention here. By identifying buffers of adversity, we can begin developing and implementing programs and strategies that will identify adverse childhood experiences early on and work to prevent their negative outcomes before it becomes too late. According to our findings, strategies to build social support may be worthwhile components to build into prevention and intervention programs. Future research may benefit from examining the presumed two-factor structure of adverse childhood experiences to determine whether there is merit to differentiating between direct vs indirect experiences in understanding and intervening in adverse childhood experiences. This would allow researchers to better examine how the type of adversity may differ in adult mental health and substance abuse outcomes. We would then be able to better tailor our prevention efforts to the type of adversity that children experience.

References

- Aiken, L. S., West, S. G., & Reno, R. R. (1991). Multiple regression: Testing and interpreting interactions. Sage.
- Anda, R. F., Butchart, A., Felitti, V. J., & Brown, D. W. (2010). Building a Framework for Global Surveillance of the Public Health Implications of Adverse Childhood Experiences. *American Journal of Preventive Medicine*, 39(1), 93–98.
- Babiss, L. A., & Gangwisch, J. E. (2009). Sports Participation as a Protective Factor Against Depression and Suicidal Ideation in Adolescents as Mediated by Self-Esteem and Social Support: *Journal of Developmental & Behavioral Pediatrics*, 30(5), 376–384.
- Bernstein, D. P., Stein, J. A., Newcomb, M. D., Walker, E., Pogge, D., Ahluvalia, T., ... Zule, W. (2003). Development and validation of a brief screening version of the Childhood Trauma Questionnaire. *Child Abuse & Neglect*, 27(2), 169–190.
- Brown, R. L., & Rounds, L. A. (1995). Conjoint screening questionnaires for alcohol and other drug abuse: criterion validity in a primary care practice. *Wisconsin Medical Journal*, 94(3), 135–140.
- Canty-Mitchell, J., & Zimet, G. D. (2000). Psychometric Properties of the Multidimensional Scale of Perceived Social Support in Urban Adolescents. *American Journal of Community Psychology*, 28(3), 391–400.
- Carlson, K. D., & Herdman, A. O. (2012). Understanding the Impact of Convergent Validity on Research Results. *Organizational Research Methods*, 15(1), 17–32.
- Carlson, J. S., Yohannan, J., Darr, C. L., Turley, M. R., Larez, N. A., & Perfect, M. M. (2019). Prevalence of adverse childhood

- experiences in school-aged youth: A systematic review (1990–2015). *International Journal of School & Educational Psychology*.
- Cella, D., Riley, W., Stone, A., Rothrock, N., Reeve, B., Yount, S., ... Hays, R. (2010). The Patient-Reported Outcomes Measurement Information System (PROMIS) developed and tested its first wave of adult self-reported health outcome item banks: 2005–2008. *Journal of Clinical Epidemiology*, 63(11), 1179–1194.
- Cheong, E. V., Sinnott, C., Dahly, D., & Kearney, P. M. (2017). Adverse childhood experiences (ACEs) and later-life depression: perceived social support as a potential protective factor. *BMJ Open*, 7(9), e013228.
- Choi, N. G., DiNitto, D. M., Marti, C. N., & Choi, B. Y. (2017). Association of adverse childhood experiences with lifetime mental and substance use disorders among men and women aged 50+ years. *International Psychogeriatrics*, 29(03), 359–372.
- Clara, I. P., Cox, B. J., Enns, M. W., Murray, L. T., & Torgrud, L. J. (2003). Confirmatory Factor Analysis of The Multidimensional Scale of Perceived Social Support in Clinically Distressed and Student Samples. *Journal of Personality Assessment*, 81(3), 265–270.
- Couwenbergh, C., van der Gaag, R. J., Koeter, M., de Ruiter, C., & van den Brink, W. (2009). Screening for substance abuse among adolescents validity of the CAGE-AID in youth mental health care. *Substance Use & Misuse*, 44(6), 823–834.
- Dahlem, N. W., Zimet, G. D., & Walker, R. R. (1991). The multidimensional scale of perceived social support: A confirmation study. *Journal of Clinical Psychology*, 47(6), 756–761.
- Dong, M., Anda, R. F., Felitti, V. J., Dube, S. R., Williamson, D. F., Thompson, T. J., ... Giles, W. H. (2004). The interrelatedness of multiple forms of childhood abuse, neglect, and household dysfunction. *Child Abuse & Neglect*, 28(7), 771–784.
- Dube, S. R., Felitti, V. J., Dong, M., Chapman, D. P., Giles, W. H., & Anda, R. F. (2003). Childhood Abuse, Neglect, and Household Dysfunction and the Risk of Illicit Drug Use: The Adverse Childhood Experiences Study. *PEDIATRICS*, 111(3), 564–572.
- Dube, S. R., Anda, R. F., Felitti, V. J., Edwards, V. J., & Croft, J. B. (2002). Adverse childhood experiences and personal alcohol abuse as an adult. *Addictive Behaviors*, 27(5), 713–725.
- Dube, S. R., Felitti, V. J., Dong, M., Chapman, D. P., Giles, W. H., & Anda, R. F. (2003). Childhood abuse, neglect, and household dysfunction and the risk of illicit drug use: the adverse childhood experiences study. *Pediatrics*, 111(3), 564–572.
- Dube, S. R., Felitti, V. J., Dong, M., Giles, W. H., & Anda, R. F. (2003). The impact of adverse childhood experiences on health problems: evidence from four birth cohorts dating back to 1900. *Preventive Medicine*, 37(3), 268–277.
- Dube, S. R., Williamson, D. F., Thompson, T., Felitti, V. J., & Anda, R. F. (2004). Assessing the reliability of retrospective reports of adverse childhood experiences among adult HMO members attending a primary care clinic. *Child Abuse & Neglect*, 28(7), 729–737.
- Dube, S. R., Miller, J. W., Brown, D. W., Giles, W. H., Felitti, V. J., Dong, M., & Anda, R. F. (2006). Adverse childhood experiences and the association with ever using alcohol and initiating alcohol use during adolescence. *Journal of Adolescent Health*, 38(4), 444.e1–444.e10.
- Felitti, V. J., Anda, R. F., Nordenberg, D., Williamson, D. F., Spitz, A. M., Edwards, V., ... Marks, J. S. (1998). Relationship of Childhood Abuse and Household Dysfunction to Many of the Leading Causes of Death in Adults. *American Journal of Preventive Medicine*, 14(4), 245–258.
- Hays, R. D., Bjorner, J. B., Revicki, D. A., Spritzer, K. L., & Cella, D. (2009). Development of physical and mental health summary scores from the patient-reported outcomes measurement information system (PROMIS) global items. *Quality of Life Research*, 18(7), 873–880.
- Hughes, K., Bellis, M. A., Hardcastle, K. A., Sethi, D., Butchart, A., Mikton, C., ... Dunne, M. P. (2017). The effect of multiple adverse childhood experiences on health: a systematic review and meta-analysis. *The Lancet Public Health*, 2(8), e356–e366.
- Kleiman, E. M., & Liu, R. T. (2013). Social support as a protective factor in suicide: Findings from two nationally representative samples. *Journal of Affective Disorders*, 150(2), 540–545.
- Larkin, H., Lee, E., Esaki, N., DeMasi, M., Trifoso, S., Briar-Lawson, K., ... Yusko, J. A. (2018). The effects of protective factors and adverse childhood experiences on behavioral health services use: Findings from a population-based sample. *Social Work in Health Care*, 57(7), 548–562.
- Leonardson, G. R., Ness, F. K., Daniels, M. C., Kemper, E., Koplin, B. A., & Leonardson, G. A. (2005). Validity and Reliability of the Audit and Case-Aid in Northern Plains American Indians. *Psychological Reports*, 97(1), 161–166.
- Mason, M. J., Zaharakis, N., & Benotsch, E. G. (2014). Social networks, substance use, and mental health in college students. *Journal of American College Health*, 62(7), 470–477.
- Mayfield, D., McLeod, G., & Hall, P. (1974). The CAGE questionnaire: validation of a new alcoholism screening instrument. *American journal of psychiatry*, 131(10), 1121–1123.
- Merrick, M. T., Ports, K. A., Ford, D. C., Afifi, T. O., Gershoff, E. T., & Grogan-Kaylor, A. (2017). Unpacking the impact of adverse childhood experiences on adult mental health. *Child Abuse & Neglect*, 69, 10–19.
- Mersky, J. P., Topitzes, J., & Reynolds, A. J. (2013). Impacts of adverse childhood experiences on health, mental health, and substance use in early adulthood: A cohort study of an, minority sample in the U.S. *Child Abuse & Neglect*, 37(11), 917–925.
- Muzik, M., Umarji, R., Sexton, M. B., & Davis, M. T. (2017). Family Social Support Modifies the Relationships Between Childhood Maltreatment Severity, Economic Adversity and Postpartum Depressive Symptoms. *Maternal and Child Health Journal*, 21(5), 1018–1025.
- Nurius, P. S., Green, S., Logan-Greene, P., & Borja, S. (2015). Life course pathways of adverse childhood experiences toward adult psychological well-being: A stress process analysis. *Child Abuse & Neglect*, 45, 143–153.
- Pinto, R., Correia, L., & Maia, Â. (2014). Assessing the Reliability of Retrospective Reports of Adverse Childhood Experiences among Adolescents with Documented Childhood Maltreatment. *Journal of Family Violence*, 29(4), 431–438.
- Prendergast, M. L. (1994). Substance use and abuse among college students: A review of recent literature. *Journal of American College Health*, 43(3), 99–113.
- Reiser, S. J., McMillan, K. A., Wright, K. D., & Asmundson, G. J. G. (2014). Adverse childhood experiences and health anxiety in adulthood. *Child Abuse & Neglect*, 38(3), 407–413.
- Roh, S., Burnette, C. E., Lee, K. H., Lee, Y.-S., Easton, S. D., & Lawler, M. J. (2015). Risk and protective factors for depressive symptoms among American Indian older adults: Adverse

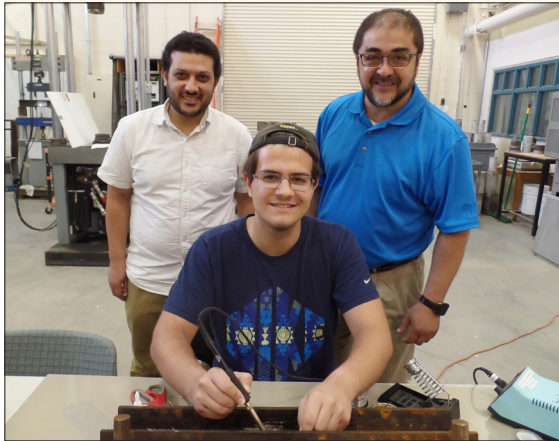
- childhood experiences and social support. *Aging & Mental Health*, 19(4), 371–380.
- Schilling, E. A., Aseltine, R. H., & Gore, S. (2007). Adverse childhood experiences and mental health in young adults: a longitudinal survey. *BMC Public Health*, 7(1).
- Slutske, W. S., Hunt-Carter, E. E., Nabors-Oberg, R. E., Sher, K. J., Bucholz, K. K., Madden, P. A., ... & Heath, A. C. (2004). Do college students drink more than their non-college-attending peers? Evidence from a population-based longitudinal female twin study. *Journal of abnormal psychology*, 113(4), 530.
- Straus MA, Gelles RJ, Smith C. Physical violence in American families: Risk factors and adaptations to violence in 8, 145 families. New Brunswick, NJ: Transaction Publishers; 1990. pp. 49–73.
- Tabachnick, B. G., & Fidell, L. S. (2013). Using multivariate statistics (6th ed). Boston: Pearson Education.
- Wyatt, G. E. (1985). The sexual abuse of Afro-American and White-American women in childhood. *Child Abuse & Neglect*, 9(4), 507–519.
- Zanotti, D. C., Kaier, E., Vanasse, R., Davis, J. L., Strunk, K. C., & Cromer, L. D. (2018). An examination of the test–retest reliability of the ACE-SQ in a sample of college athletes. *Psychological Trauma: Theory, Research, Practice, and Policy*, 10(5), 559–562.
- Zimet, G. D., Dahlem, N. W., Zimet, S. G., & Farley, G. K. (1988). The Multidimensional Scale of Perceived Social Support. *Journal of Personality Assessment*, 52(1), 30–41.
- Zimet, G. D., Powell, S. S., Farley, G. K., Werkman, S., & Berkoff, K. A. (1990). Psychometric Characteristics of the Multidimensional Scale of Perceived Social Support. *Journal of Personality Assessment*, 55(3–4), 610–617.

Fatigue Life Enhancement for Steel Girders using Ultra-high Modulus Carbon Fiber Reinforced Polymers

MIRNES MUSTAFIC

Hesham El-Emam, PhD, Mentor
Zagazig University
Materials Engineering Department

Hani Salim, PhD, Mentor
University of Missouri
Department of Civil and Environmental
Engineering



Mirnes Mustafic is a member of the engineering honors society Tau Beta Pi. he is also the treasurer of the civil engineering honors society Chi Epsilon.

His next research in the Salim Lab will involve glass shattering when exposed to explosive forces.

This fall, Mirnes plans on preparing his applications to graduate civil engineering programs.

Abstract

Fatigue stresses in steel bridges can cause cracks to propagate and slowly weaken the structural integrity and stability of the bridge. Traditional rehabilitation techniques have proven to be disadvantageous and do little to stop the crack from growing. This research looks into using ultra high modulus carbon fiber reinforced polymer (UHM CFRP) plates to extend the fatigue life of cracked steel beams. All of the steel specimens had the same initial crack length which was manually created, and they were prepared by cleaning the specimens and applying the epoxy adhesive which would bond the CFRP plates to the steel beams cracked flange. The goal of the experiments was to compare the fatigue life improvements of the cracked steel beams reinforced using regular application of the CFRP plates compared to prestressed CFRP plates. A total of five beams were tested under the same loading conditions. The first and second beams were control beams meant to compare the fatigue life of beams at different loading ranges, the third beam was reinforced with the CFRP plates, the fourth beam was reinforced with CFRP plates that were prestressed, and the fifth beam was reinforced with CFRP plates and anchored using 1 kip clamps. Many factors went into comparing the performance of the different reinforcement configurations, such as the midspan deflection of the beam, the strain in the beam, and the fatigue life of the repaired beam.

Introduction

The steel beams and girders in bridges are susceptible to short fatigue life due to the propagation of cracks that are formed by repeated cyclic loads due to vehicular traffic. Once a crack is initiated, it can be difficult to stop the it from growing. Since the replacement of the beam in a bridge under service can be impossible and cost-prohibitive due to the sudden decrease in stability and the need to shut down traffic over the bridge, rehabilitation is the most viable option. Rehabilitation techniques include cutting out a circular hole at the tip of the crack so that the crack intensity and stresses around the crack tip can be reduced, welding the crack, and reinforcing the crack area by bolting steel plates around it to create a compressive force in the beam and keep the crack from growing (Jiao et al. 2012). But traditional rehabilitation techniques also have some noticeable disadvantages such as the increase in weight near the crack area, the welded crack being fatigue sensitive, risk of corrosion happening near the bolts connecting the steel plates, and high maintenance and installation costs (Zhao and Zhang 2007; Teng et al. 2012). Because of the numerous disadvantages associated with traditional rehabilitation techniques, carbon fiber reinforced polymer (CFRP) plates have been adopted as the preferred solution to rehabilitating fatigue cracked steel beams and girders in bridges (Baker 1999; Teng et al. 2012). CFRP plates are excellent for repairing cracked steel beams because of the material properties of the composite material, such as increased stiffness and strength, reduced weight, high

flexibility and durability. The material properties also contribute to a lower maintenance and installation cost due to the ease of installation (Zhao and Zhang 2007). However, problems arise when considering how to attach the CFRP plates to the damaged steel beams. Since bolting could result in the possibility of corrosion occurring between the bolt and the steel, that leaves the only viable option left as the application of an adhesive (Teng et al. 2012; Zhao and Zhang 2007). An effective adhesive that is often times used is an epoxy adhesive that is composed of a two part mix of components A and B. The epoxy adhesive is excellent for bonding the CFRP to the steel beam, but it also comes with some noticeable disadvantages. The downsides to using the epoxy adhesive are that it cannot be exposed to extreme temperatures or excessive moisture because that will weaken the bond between the steel beam and the CFRP plates. Also, if the adhesive is not completely covering all the area between the CFRP plates and the steel beam, this means that the CFRP plate can come into contact with the steel beam and produce a galvanic cell which can lead to galvanic corrosion and further lower the stability of the beam. The area where the epoxy adhesive is to be applied must also be cleaned so that the adhesive is in contact with only the steel surface, as the adhesive being in contact with the non-steel surface most corroded beams have on them will make interface failure more likely. The failure modes after the epoxy adhesive has been applied to the CFRP plate and the steel beam can be split into three modes. The first mode is interface failure, this occurs between the steel interface and the adhesive interface. The interface failure mode can be avoided by applying mechanical anchorage such as some clamps at the ends of the CFRP plates. The second mode is cohesive failure, which is also avoidable by proper selection of the adhesive type, as not all adhesives are good for bonding steel to carbon fibers. The third mode of failure involves the debonding of the CFRP plate. The debonding of the CFRP plate can be avoided by properly selecting an adhesive with the right mechanical properties for bonding carbon fiber to steel.

Previous research that examines the effects of CFRP plates on cracked or weakened steel beams has been performed. Colombi and Fava (2015) performed fatigue tests on nine steel I-beams and came to the conclusion that with the application of additional layers of the CFRP plates, the fatigue life of the cracked steel beams was greatly enhanced. Hosseini et al. (2018) conducted fatigue tests on cracked steel beams after they applied prestressed unbonded CFRP plates to it and concluded that the system they had come up with was highly effective at transferring the tensile stress from the prestressed CFRP plates to the steel member and thus would make their prestressed unbonded solution more effective at remediating cracked steel members than the bonded CFRP system. Kamruzzaman, Jumaat, and Sulong (2014) looked at the effects that prestressed, strengthened, and ultra-high modulus CFRP could have on the fatigue life of steel beams and concluded that they reduce the crack growth rate and also extend the fatigue life of the steel beam. On top of this, they also concluded that if cyclic loading is applied to the member without giving the epoxy adhesive time to cure, the loading will decrease the fatigue life of the steel beam by weakening the bond strength of the epoxy adhesive. Many times when a crack begins in a steel member, it is welded to prevent immediate crack growth, but research shows that fatigue cracks often times develop in welded joints. Inaba et al. (2005) and Chen et al. (2012, 2013) performed fatigue tests on welded joints, and the results of which indicated that CFRP plates could be applied in similar ways to welded joints, just like with cracked steel members, to increase the fatigue life.

The prior research on this issue deals mostly with addressing one solution to the problem, such as the use of either not prestressed, or prestressed CFRP plates, epoxy adhesive, or mechanical anchorage with only a friction force bonding the CFRP plates to the steel beam. The prestressed CFRP plates are more effective at closing the crack than the not prestressed CFRP plates, but they are also more difficult to create and applying them is a more advanced process. Also, while the use of mechanical anchorage as the force that bonds the CFRP plate to the steel beam is a good method for attaching the two together without the use of an adhesive, the fact that the adhesive has little to no risk of corrosion and is also much more cost efficient cannot be overlooked. It is because of the advantages and disadvantages of the various methods, I would like to compare the effects that prestressed and not prestressed CFRP plates could have on the fatigue life of the steel beams if they are each bonded to the beam using epoxy adhesive and with mechanical anchorage for the sole purpose of preventing the debonding of the CFRP plates.

Methods

Material Properties:

The steel beams used in the experiment consisted of ASTM A36 steel plates which were welded to form a W4x13 hot-rolled steel beam. The geometry of the beam consists of three steel plates welded together to form an I-beam of the dimensions stated in figure 1. The known average yield strength of the steel plates is 400 MPa (58 ksi), and the ultimate strength of the steel plates is 551.6 MPa (80 ksi). The modulus of elasticity of the steel plates is 193 GPa (28000 ksi) and the poisson's ratio is 0.35.

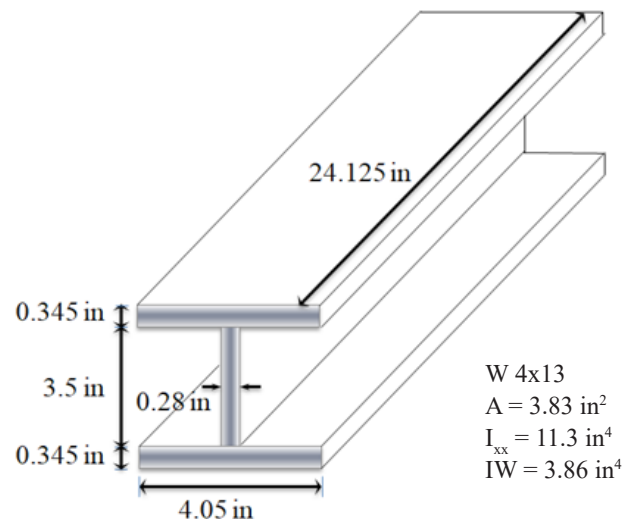


Figure 1. Steel Beam Specimen Geometry

The CFRP plates are UHM (ultra-high modulus) ePLATE HM512 created by Mitsubishi Plastics Composites America Incorporated. The length of the CFRP plates is 381 mm (15 in) and the width of the plates is 25 mm (1 in). The tensile modulus of the plates is 514 GPa (74586 ksi), the tensile strength is 1923 MPa (279 ksi) and the ultimate tensile strain is 0.00332.

The epoxy resin used is known as Sikadur-30. The epoxy resin was employed to act as an adhesive and bond the CFRP plates to the steel. The resin is a thixotropic adhesive mortar that requires the mixing of two components to activate. The mixing ratio of the epoxy resin is three to one of the softener (component A) and the hardener (component B) respectively.

Data Collection Instruments:

The linear variable differential transformer (LVDT) is a measuring device that is placed underneath the cracked steel beam during the testing phase. The LVDT measures the vertical displacement of the midspan of the beam as the crack propagates.

An extensometer is placed at the mouth of the crack to measure the distance between the crack lips through the length of the experiment. Since the extensometer must be attached by placing its teeth either around an object or impaled into an object, small grooves are made into the steel so that the teeth of the extensometer can fit in the grooves, thus holding the extensometer in place.

A super eye microscope is taped very close to the beginning of the crack. Since the crack becomes quite sharp as it propagates due to fatigue loading, it cannot be seen with the naked eye. The super eye microscope is used to magnify the crack so that it can be viewed and so that the crack can be accurately measured. The strain gauges that are attached to the steel beam measure the strain in the beam while the loading and unloading is occurring.

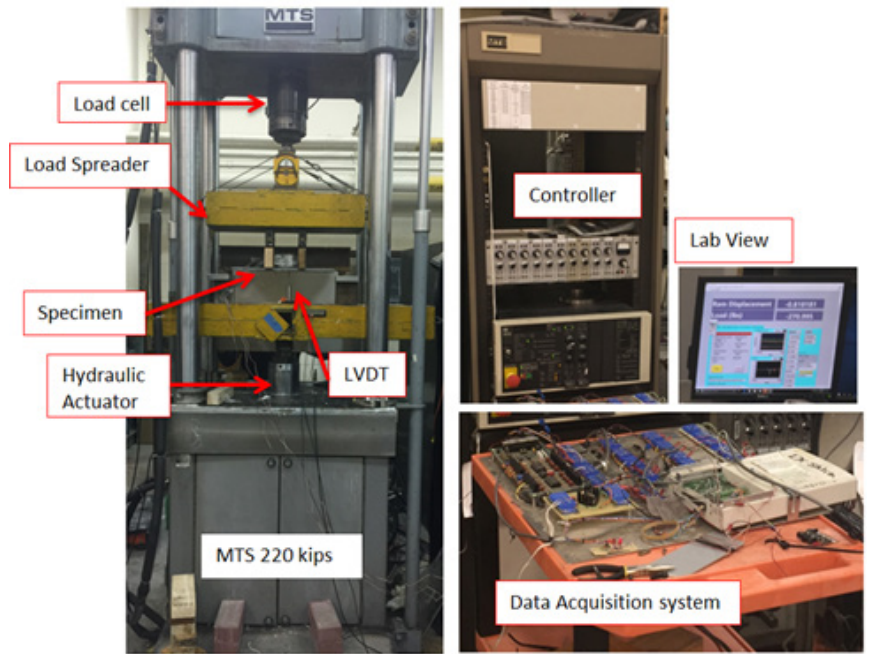


Figure 3. Lab Configuration

Procedure:

The steel beam specimens that have had UHM-CFRP applied to them will undergo fatigue stress as a four-point load is applied across the cracked beam. Various aspects of the experiment will be measured, such as the strain in the steel near the cracked area and on the compression side of the steel, the vertical deflection of the steel beam, the approximate length of the crack, and the width of the crack mouth. The procedure for performing a trial with the UHM-CFRP plates looks like this:

- 1) Specimen is prepared by first cleaning all spots where strain gauges will be attached with an abrasion tool until the rusted layer of the steel beam has been removed and the shiny layer is visible. The beam is further cleaned using coarse sand paper, then finer sand paper, and then acetone to finish it off, and left to dry.
- 2) An artificial crack is initiated by first cutting into the steel on the tension side with a band saw of thickness 0.078 inches until the blade has reached the full depth of the flange and is almost touching the web of the beam. The crack is further initiated by cutting into the new crack using a thinner 0.03 inch hand saw for about a quarter of the original depth.
- 3) The crack is fully initiated when the steel beam is placed in the fatigue loading machine so that a sharp crack can be produced, like those found in actual fatigue cracked steel beams in bridges.
- 4) The adhesive is prepared by mixing the hardener with the softener using proper mixing ratios and then is applied to the area where the CFRP plates will be held. Some of the CFRP plates are not pre-stressed and some of the CFRP plates were pre-stressed prior to being attached to the steel beam. The pre-stressing was done by placing the steel specimen with the CFRP plates attached to it onto a manual actuator (which is a type of loading machine similar to the MTS) and then applying a load of approximately 10 percent of the tensile strength of the CFRP plates in such a way that the load would cause the plates to be in a state of compression.

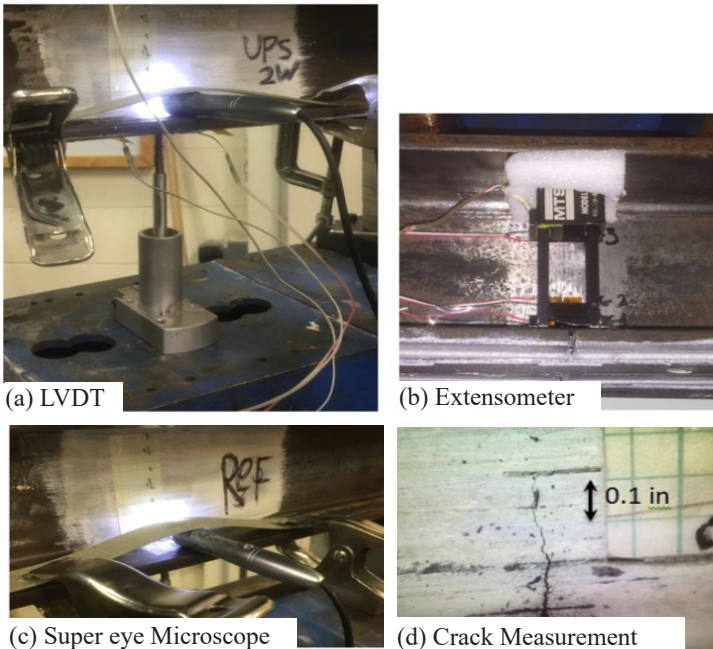


Figure 2. Data Collection Instruments

Test Setup:

To run a full trial on one of the steel specimens and gather necessary data, four machines are needed. The lab during one of the trials consists of an MTS 20 kip hydraulic actuator for applying the load, a data acquisition system (DAS) for collecting the data, a controller for being able to change the frequency of the load and the maximum load output, and a computer for viewing the collected data. All of the machines can be seen in figure

- 5) The adhesive cures in a hot oven (above 60 degrees Celsius) for approximately eight hours and comes out hardened. The strain gauges are attached to the specimen on the side of the steel beam where the crack is propagating, on the compression side near and further away from the crack initiation location, and on the web of the beam at various locations from the crack as seen in figure 4 and figure 5.

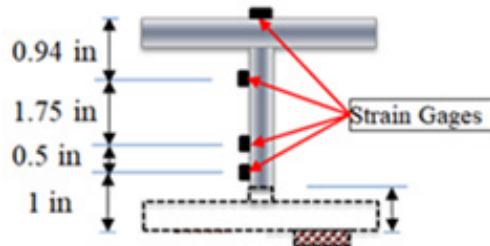


Figure 4. Strain Gauge Locations on Web of Beam

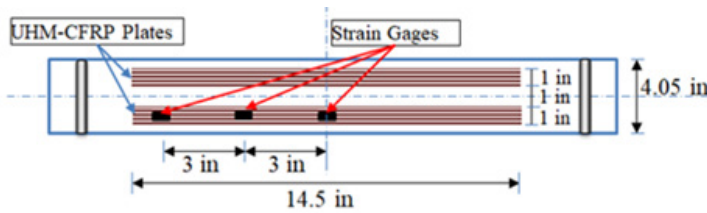


Figure 5. Strain Gauge Locations on Compression Side of Beam

- 6) The linear variable differential transformer (LVDT) is placed underneath the steel beam, and an extensometer is placed at the crack mouth.
- 7) A super eye microscope is taped near the crack so that the rate at which the crack grows can be measured and so that the crack can always be identifiable.
- 8) Lastly, 1000 lbs clamping loads are applied to the ends of the UHM-CFRP plates so that they do not peel off during unloading or due to the high shear stresses.

The testing can begin in the 20 kip maximum load MTS machine. The sinusoidal cycle load range was 15.75 kips with a load ratio of $R = 0.1$. The loading frequency was 5 Hz. The steel beam then underwent fatigue loads or until it failed.

Results and Discussion

A total of five specimens were tested. The fatigue tests were done at constant amplitude cyclic loads with the same frequency as seen in Table 1. Specimen B1 was an unreinforced beam that was tested at a load range of 0.8-8 kips and a frequency of 5 Hz. Specimen B2 was also unreinforced reinforced, but the load range was 1.75-17.5 kips. Specimen B3 was reinforced with CFRP plates, but they were non prestressed. Specimen B4 was reinforced with prestressed CFRP plates, but they were applied without any kind of clamping mechanism. And Specimen B5 was reinforced with prestressed CFRP plates that were also clamped down by 1 kip clamps at the ends of the plates. The reasoning for choosing 17.5 kips as the maximum to the load range was because 17.5 kips is half the yield load for an unreinforced steel beam. Failure was considered the moment that the last fracture was seen, that being the point at which the crack reached the beginning of the top flange. And the number of cycles (N_f) the beam lasted and the failure modes can also be seen in Table 1.

Specimen	Repair Material	Prestressing Level (%)	$2P_{\max}$ (kips)	$2P_{\min}$ (kips)	f (Hz)	N_f	Failure mode
B1	-	-	8	0.8	5	21620	FF ^a
B2	-	-	17.5	1.75	5	6010	FF ^a
B3	UHM-CFRP	-	17.5	1.75	5	50125	FF ^a +CD ^b
B4	UHM-CFRP	10%	17.5	1.75	5	75033	FF ^a +CD ^b
B5	UHM-CFRP	10%	17.5	1.75	5	98793	FF ^a +CP ^c

FF^a = Flexural failure, CD^b = CFRP plate end debonding, and CP^c = CFRP plate was pulled out at end anchorage.

Table 1. Specimen Testing Details

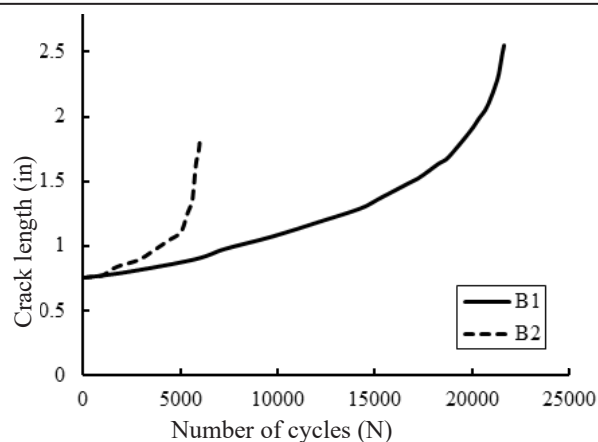


Figure 6. Fatigue Crack Propagation in Specimens B1 and B2

Figure 6 compares the fatigue life of a cracked steel beam specimens B1 and B2. The difference between the two specimens was that B2 had the greater loading range as seen in Table 1. As was expected, the fatigue life of B1, which was the lower loading range specimen, was about 2.5 times the fatigue life of specimen B2. What should also be noted is that in both curves, the rate at which the crack propagates along the web of the beam increases as the number of cycles increases and is greatest just before failure. Lastly, specimen B1 failed at a greater crack length than specimen B2, this likely had something to do with the rate of crack propagation.

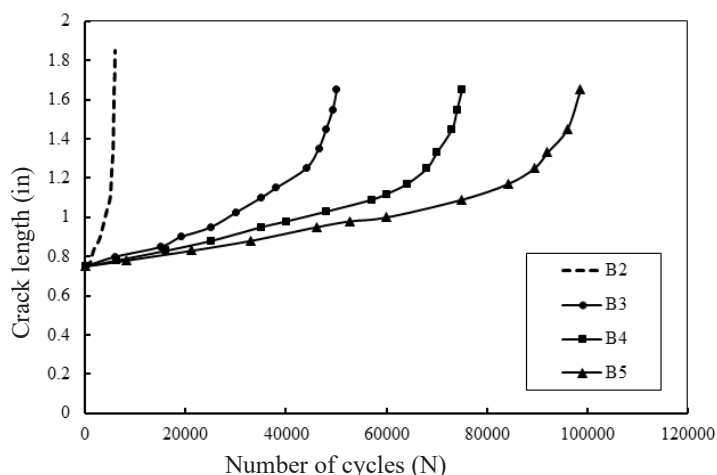


Figure 7. Fatigue Crack Propagation curves for specimen B2, B3, B4, and B5

Figure 7 compares specimens B2-B5 on their crack length and number of cycles they could endure before failure. Specimen B2 was considered the control specimen that the other would all be compared to as it had the same initial conditions such as a loading range of 1.75-17.5 kips, and an initial crack length of 0.75 inches, just as specimens B3-B5. It can be seen that specimen B3 had a fatigue life about eight times the fatigue life of control specimen B2. Specimen B4 which had prestressed CFRP plates attached to it, but no clamping, had a fatigue life of approximately 12 times specimen B2. And specimen B5 had prestressed CFRP plates and clamping applied to it, which allowed it to have the greatest fatigue life, which last 16 times the number of cycles of specimen B2. It should be noted that the rate at which the crack propagated was reduced greatly with the application of UHM-CFRP plates, and it was further reduced with prestressing, and

then clamping. This means that the application of UHM-CFRP plates will extend the fatigue life of a cracked steel beam by slowing crack growth, and if the reinforcement has been prestressed, it can even help to promote crack closure if properly anchored to the beam. Static tests were performed with the maximum load of 17.5 kips for all specimens. The strain distributions across the web of the beams are plotted in Figure 8 for specimens B3 and B4. The vertical axis measures the distance from the bottom of the beam where the crack begins, and the horizontal axis measures the strain along the web of the beams. As expected, the neutral axis moved upward as the crack grew along the web, and also the compression areas decreased as the crack propagated. The strain on the remaining cross sections increased as the number of loading cycles increased. The maximum strain was located in the beginning of the loading, and at the failure point. It should be noted that specimen B3 had smaller strain values than specimen B4. The difference in strain values between specimens B3 and B4 can be attributed to the fact that B4 was reinforced with prestressed UHM-CFRP plates, while B3 had non prestressed UHM-CFRP plates. It can be concluded that prestressed UHM-CFRP repaired cracked steel beams can endure larger strain values at their failure points. The reasoning for this has to do with the prestressed CFRP plates generating compression on the bottom flange where the crack is, this counters the tension caused by the loading. In the beginning of crack propagation, the strain slowly increases due to the slow rate of crack propagation. Then the strain increased with the crack propagation. The sudden increase in strain was where the specimens all failed as can be seen in Figure 8.

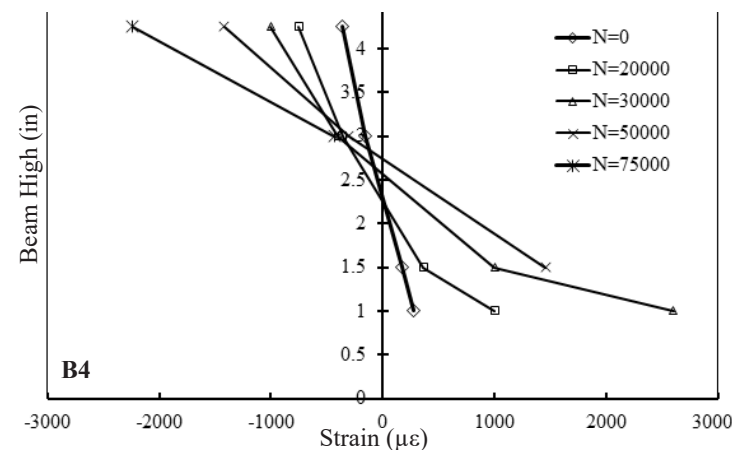
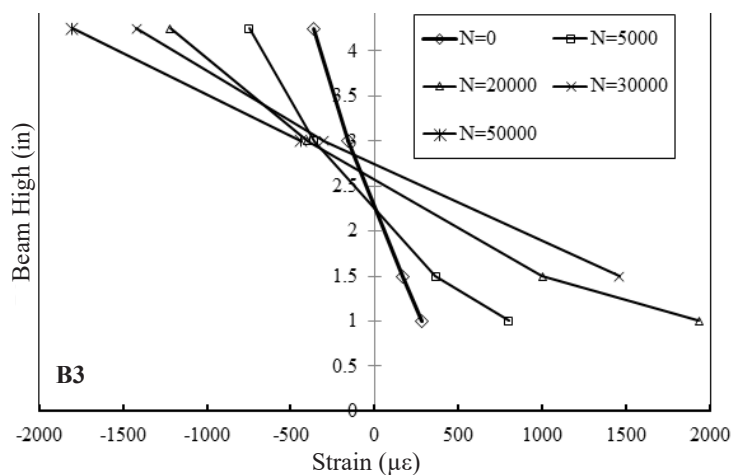


Figure 8. Strain Distributions on Web for Specimens B3 and B4

The load deflection curves were created for four of the specimens to show the effects that the UHM-CFRP plate reinforcements and prestressing could have on the deflection of the midspans of the steel beams. In specimen B1 and B2, their load deflection curves as seen in Figures 9 and 10, look quite similar. The only difference between the initial conditions for specimen B1 and B2 was the loading range. B1 had a loading range going from 0.8-8 kips, while B2 had a loading range from 1.75-17.5 kips. The specimens were first loaded statically from zero to their maximum load, and then unloaded again after enduring a certain number of loading cycles. None of the deflection curves overlap each other at their beginning and end points which means that plastic deformation occurred and the beam could not go back to its original position. The plastic deformation that occurred in both specimen B1 and B2 could be attributed to the damage that accumulated from the high stress around the crack tip, and the damage coming from the closing of the crack at the unloading phase.

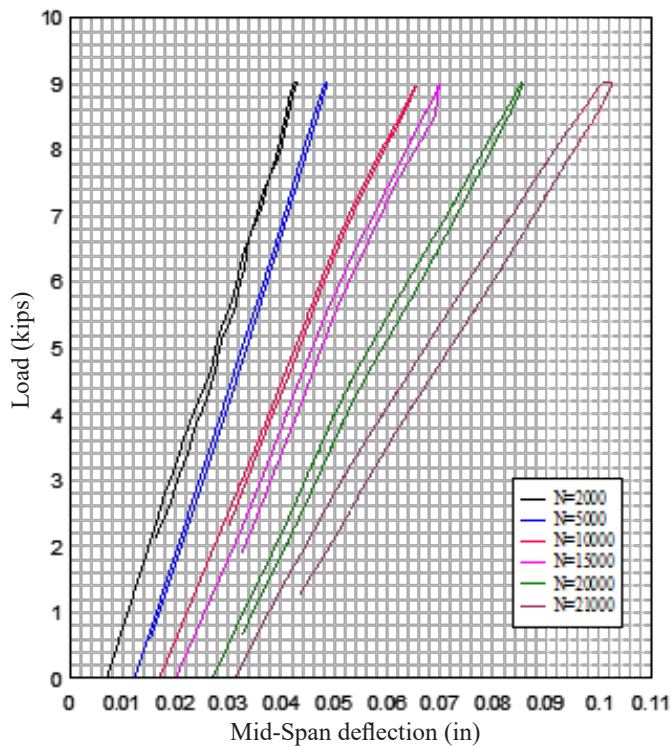


Figure 9. Load Deflection Curve for Specimen B1

Specimen B3 was reinforced using UHM-CFRP plates that were non prestressed and was subjected to the same loading range as specimens B2-B5, that being 1.75-17.5 kips. Specimen B3 underwent the same loading tests that specimen B2 performed such as the static loading test, but the cycles were different for the fatigue testing as B3 had data measured at 20000, 30000, and 50000 fatigue loading cycles. The load deflection curve for specimen B3 can be seen in Figure 11. The loading curve for B3 had similar results to the ones in B1 and B2 as the loading and unloading curves do not overlap, meaning that plastic deformation occurred at the crack tip so that the steel could not go back to its original state. These similar results further strengthen the argument that non prestressed UHM-CFRP plates do little to decrease the deflection of the midspan during fatigue testing.

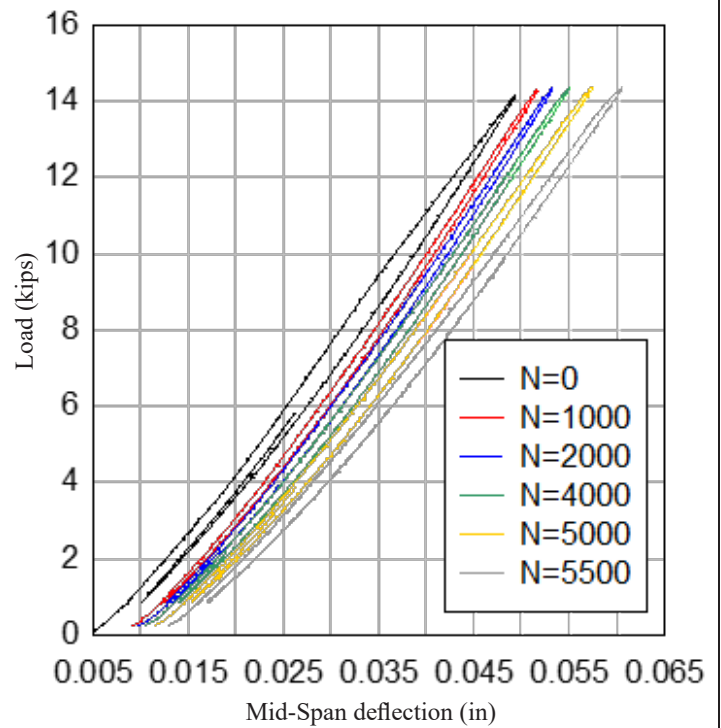


Figure 10. Load Deflection Curve for Specimen B2

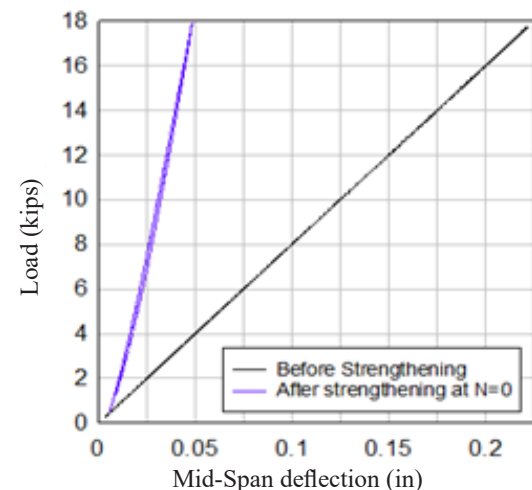
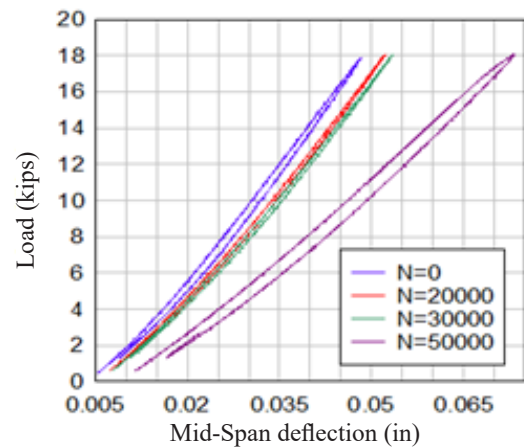


Figure 11. Load Deflection Curve for Specimen B3

Specimen B5 was reinforced using 10 percent prestressed UHM-CFRP plates and had mechanical anchorage applied to it. The 10 percent prestressing comes from 10 percent of the tensile strength, applied as a load to prestress the UHM-CFRP plates prior to curing of the adhesive. Figure 12 shows the load deflection curve for specimen B5 as it underwent static loading and un-loading, and fatigue loading and un-loading for certain cycle lengths. It can be seen that the stiffness of the beam lessens with the increase of fatigue cycles, but this loss in stiffness is less than that which occurred in specimen B3, this is due to the CFRP plate not being stressed in B3. The addition of prestressing the UHM-CFRP plates has a drastic effect on the crack mode, which dictates when the crack begins to propagate. In B3, the crack began to open up immediately after the loading was initiated. However, in specimen B5 the crack would be in a passive mode where it did not initially open up for a certain increase in load, but then at a certain point it would progress to a semi-active mode where the crack would open up slightly, then it would come to the active mode where the crack would begin opening up quicker. While the crack is in passive mode, the steel beam is unaffected by the crack, and therefore the bending stiffness of the beam remains constant as it was before the beam was damaged. As can be seen in Figure 12, the difference in the midspan deflection between the beginning of loading and the end of unloading is small compared to that of specimens B2 and B3. This is due to the effects of the prestressed UHM-CFRP plates, the tensile force in the CFRP plates transferred to the steel beam as a compressive force which promoted the closure of the crack mouth.

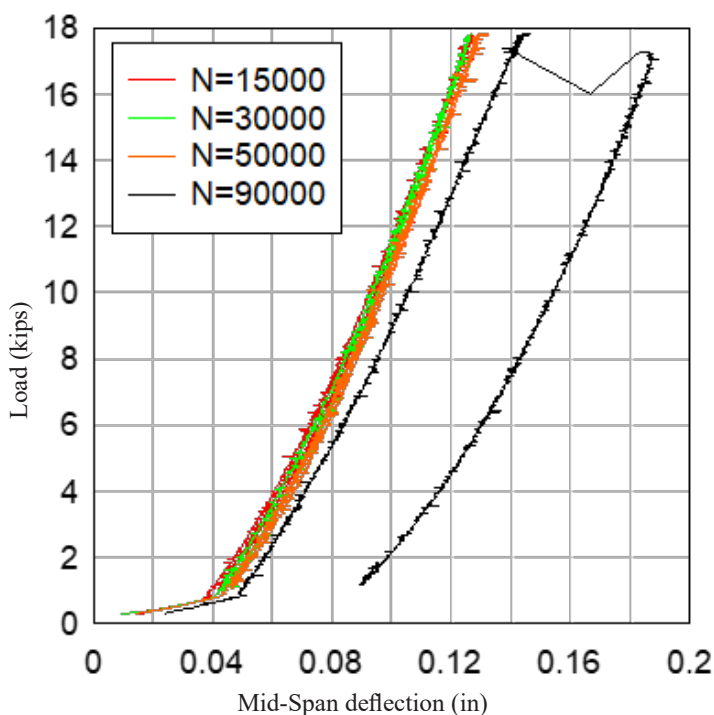


Figure 12. Load Deflection Curve for Specimen B5

From the previously discussed results, the conclusions that could be drawn are the following:

- By using UHM-CFRP plates, the fatigue life of cracked steel beams can increase.
- The debonding of the reinforcement is a common form of failure due to the adhesive layer being a weak point in the system.
- The growth of the crack in a steel beam can be slowed down using UHM-CFRP plates.
- Using 0.75 inches as the initial crack length, and a loading range of 1.75 to 17.5 kips as the constant conditions, the fatigue life of a UHM-CFRP reinforced steel beam could be increased to eight times its fatigue life if it were unreinforced.
- Under the same constant conditions, a steel beam that was reinforced using prestressed UHM-CFRP would have a fatigue life of 12 times the fatigue life of a cracked steel beam that was unreinforced.
- Under the same constant conditions, a steel beam that was reinforced using prestressed UHM-CFRP plates and having mechanical anchorage would have a fatigue life 16 times the fatigue life of a cracked steel beam that was unreinforced.

References

- Baker, A. (1999). "Bonded composite repair of fatigue-cracked primary aircraft structure." *Composite Structures*, 47(1–4), 431–443.
- Chen, T., Yu, Q. Q., Gu, X. L., and Zhao, X. L. (2012). "Study on fatigue behavior of strengthened non-load-carrying cruciform welded joints using carbon fiber sheets." *International Journal of Structural Stability and Dynamics*, 12(1), 179–194.
- Chen, T., Yu, Q. Q., Gu, X. L., and Nie, G. H. (2013). "Stress intensity factors (KI) of cracked non-load-carrying cruciform welded joints repaired with CFRP materials." *Composites Part B: Engineering*, Elsevier Ltd, 45(1), 1629–1635.
- Colombi, P., and Fava, G. (2015). "Experimental study on the fatigue behaviour of cracked steel beams repaired with CFRP plates." *Engineering Fracture Mechanics*, Elsevier Ltd, 145, 128–142.
- Hosseini, A., Ghafoori, E., Motavalli, M., Nussbaumer, A., Zhao, X. L., and Koller, R. (2018). "Prestressed unbonded reinforcement system with multiple CFRP plates for fatigue strengthening of steel members." *Polymers*, 10(264), 1–13. doi:10.3390/polym10030264
- Inaba, N., Tomita, Y., Shito, K., Suzuki, H., and Okamoto, Y. (2005). "Fundamental study on a fatigue strength of a cruciform welded joint patched a glass fiber reinforced plastic." *Doboku Gakkai Ronbunshuu*, VI-68(798), 89–99.
- Jiao, H., Mashiri, F., and Zhao, X. L. (2012). "A comparative study on fatigue behaviour of steel beams retrofitted with welding, pultruded CFRP plates and wet layup CFRP sheets." *Thin-Walled Structures*, Elsevier, 59, 144–152.
- Kamruzzaman, M., Jumaat, M.Z., Sulong, R.N.H., and Islam, S.A.B.M. (2014). "A review on strengthening steel beams using FRP under fatigue." *The Scientific World Journal*, vol. 2014, 1–21. doi:10.1155/2014/702537
- Teng, J. G., Yu, T., and Fernando, D. (2012). "Strengthening of steel structures with fiber-reinforced polymer composites." *Journal of Constructional Steel Research*, 78, 131–143.
- Zhao, X. L., and Zhang, L. (2007). "State-of-the-art review on FRP strengthened steel structures." *Engineering Structures*, 29(8), 1808–1823.

Positivity in sibling relationships and its influences on mother-older child relations vs mother-younger child relations

KIANA KING

Nicole Campione-Barr, PhD, Mentor
Department of Psychology



Kiana King is a psychology major from Bloomington, Illinois. She received the Diversity Award Scholarship and the Hummel Family Scholarship. She is a member of Psi Chi and the Legion of Black Collegians Gospel Choir.

She is a former Jumpstart (AmeriCorps) member and has also served as a tutor for MU Student Athletes.

This fall she is finalizing her senior Honor's College capstone project as well as preparing her applications to pursue a PhD in Industrial Organization Psychology.

Abstract

Previous research on Family Systems Theory (FST), suggests that all relationships and individuals within a family impact all other relationships and individuals (Cox & Paley, 1997). The spillover hypothesis within FST suggests that positivity or negativity within one dyad may “spillover” to other dyads. However, studies also show that mothers have distinct relationships with each child, so a positive relationship with one, may not necessarily result in a similar interaction with another child (Maccoby, 1995). Extending on this research, the current study examines how the association between parent-older child relationship positivity is associated with parent-younger child relationship positivity, as mediated by the quality of the sibling relationship. 145 families participated in one-on-one interviews, questionnaires and two sibling interactions. Positive relationship quality in parent-older, parent younger, and sibling relationships was measured by the Network of Relationships Inventory (Furman & Buhrmester, 1985) from mothers’ and siblings’ perspectives at three time points. We hypothesized a positive spillover from the mother-older child relationship at Time 1 to the mother-younger relationship at Time 3, and a mediating effect of the sibling relationship at Time 2. Findings revealed there was a significant mediating effect of the sibling relationship, such that the more positively mothers reported their relationship with older children at Time 1, the more positively younger siblings reported their relationships to be with their older sibling at Time 2, which led to mothers reporting more positive relationships with their younger children at Time 3. The results suggest that the spillover hypothesis may best describe relationship positivity between mothers and siblings and that interventions targeting parent-older child dynamics may also improve other familial relationships.

Key Words: Spillover hypothesis, Parent-child relationships, sibling relationships, positivity

Introduction

The relationships between nuclear family members are of great interest to science. According to Family Systems Theory, all members of the family make up the family system, and each individual or relationship within the family, has an effect on every other member or relationship (Cox & Paley 1997). This theory also explains that each family member has a certain role and that there are relationship agreements and rules that determine how the system functions. Research has been conducted on the impact of parental relationships on children and siblings, however, limited research has investigated the sibling relationship and the resulting influence it has on parent-child relationships. A plethora of research today discusses changes in the parent-child relationship throughout adolescence. Key dimensions

include control or regulation parents have over their children and the extent to which the parent-child relationship can be modified emotionally. Affective quality incorporates factors naturally regarded as positive, (e.g. warmth and support). The current study extends previous research by examining the mediating role of the sibling relationship in the association between parent-older child positivity and parent-younger child positivity.

Associations between Multiple Parent-Child Relationships

It is critical to begin by examining perceptions of the parent-child relationship from each relationship member's perspective. To demonstrate the similarities and differences between parent-child interactions, Shanahan and colleagues (2007) designed a study to compare perceptions of maternal/paternal warmth as rated by first- and second-born children (Shanahan, McHale, Crouter & Osgood 2007). The researchers found that first-born children rated maternal warmth higher than second-borns did. However, as children grew older, ratings of maternal warmth decreased in both siblings from around nine to 16 years of age (Shanahan, McHale, Crouter & Osgood 2007). Further, both siblings showed changes in parental warmth ratings, around the same time when they were making the transition from childhood to early adolescence. These findings suggest that the age and birth order of each sibling impacts the relationship each child has with their mother differently. This may demonstrate that every individual in a family has an impact on every other individual and that the resulting relationships also affect all other relationships (Cox & Paley, 1997).

Cook (2001), discovered that mothers have a unique bond with each of their children. As a result, relationships between mothers and their oldest children could be extremely different from their relationships with their younger children. However, this is contrasted by research on conflict within family systems which suggests that parent-child, sibling, and marital conflict are often linked with one another (Rinaldi & Howe, 2003). Such findings are best described in terms of the spillover hypothesis of family dynamics (Margolin et al. 1996; Minuchin, 1988); dynamics within one relationship "spillover" to influence the dynamics of other relationships within the family. This hypothesis, however, has been more frequently studied in terms of the spillover of negative dynamics, rather than positive dynamics. Therefore, the present study aims to examine the potential for positive spillover from parent-first-born, to the sibling relationship, and from the sibling relationship, to parent-second-born positivity. Together, family systems theory and the literature suggest that there could be some connections between multiple parent-child relationships. Although the literature implies that there is a possible correlation between sibling relationship positivity and mother-child relationship positivity, previous research has encountered limitations. There is a lack of longitudinal studies that assess changes in family relationship quality over time, as well as the direction of influence (e.g., does the parent-child relationship influence the sibling relationship or vice versa?).

Associations between Parent-Child Relationships and Sibling Relationships

Studies on sibling relationships often connect them to the marital relationship and emotional expression of the parents within the family. In (Stocker, Ahmed, Stall, 1997), researchers examined emotional expression of mothers with their children, and the impacts on the sibling relationship. Sixty-four (64) seven year olds and their mothers were selected for participation in this study. Thirty-two (32) children were younger siblings while 20 were the older siblings. The participants came to an on campus laboratory, where the mothers were given questionnaires regarding their own perspective of their emotional expression and their marital satisfaction, and children were interviewed on their thoughts about their mothers' emotional expression. The items in this study were used to measure the marital relationship, maternal emotional expressiveness, and the sibling relationship. Results demonstrated that marital satisfaction and mother expressiveness significantly impacted the amount of hostility observed in the sibling relationship. When mothers showed more affectionate expressiveness and were more satisfied with their marriage, sibling rivalry and hostility was lower. Although the marital relationship does not involve the children, it affects the sibling relationship indirectly, because it can affect the mother-child relationship, which then will impact the sibling relationship.

Along with some marital relationship factors, parenting styles also have an indirect impact on the success or failure of the sibling relationship. (Yu & Gamble, 2008) uses this idea to investigate significance of the association between marital relationship quality, parenting style, and the sibling relationship. A group of 130 preschoolers with siblings close in age and their mothers, were selected for participation. Mothers self-reported on their parenting styles and the quality of their children's relationships. Measures were used to assess child temperament, marital relationship, sibling relationship quality, parenting styles. Similar to previous studies, results found a significant association between warmer parenting styles and more positive sibling relationship quality. Results also concluded that there is a direct impact of marital relationship quality on the sibling relationship quality. Taken together, these results suggest that "positive spillover" does occur from parents (and their relationships with spouses and children) to the sibling relationship.

Associations between Sibling Relationships and Parent-Child Relationships

The sibling relationship is one that is influenced by a variety of factors. These factors include the age of each sibling, the gender constellation of all siblings in the family, and timing of transitions into new developmental periods. Past studies confirm that positive relationship quality between siblings tends to decline during adolescence, but rebounds in late adolescence or emerging adulthood (Shanahan, McHale, Crouter & Osgood, 2007). This same curvilinear pattern is also evident with parent-adolescent relationships during this same period. Importantly, first-born children will hit this decline first as they will be the first to transition into adolescence. The present study, therefore, tests whether or not this process then has a cascading, or spillover, effect. Utilizing a longitudinal design in order to test direction of influence, we hypothesized that parent-

first-born positivity would influence later sibling positivity, which would in-turn, influence later parent-second-born positivity. Stated another way, we predicted that the sibling relationship would serve as a mediator in the association between parent-first-born and parent-second-born relationship qualities.

Method

Participants

This study began with 145 families. The participants were 99 older siblings (42 male, 57 female), and 97 younger sibling (49 male, 48 female) dyads and their mothers. All older siblings were first-borns and their subsequent younger siblings were second-borns. At Time 2 in the study, 127 families continued participation. At the beginning of Time 3, only 67.35% (n=99) of the original families participated for a third time. Older siblings averaged 16.8 years old, while younger siblings averaged 14.06 years old. 40% of mothers had at least a college degree. Most participants in the sample were European American (92% European American, 3.9% African American, 1.9% Asian and 1.9% other). Marital status varied, with 75% married with both birth parents. 4.8 % were married step families, 1.9% were single mothers never married, and 16.3% were singles divorced or separated. Average income of the families ranged from \$70,000 to \$84,000 a year. Data was collected at 3 different times over the period of three years. Most families continued participation through wave 3, but 33% (n=47) of families did dropout of the study. Ethnicity and parental marital status proved to be the highest predictors of which families would drop out. It is worthwhile to note, that although most participants in the present study were European American and lived with married and biological parents, the non-white families that did not have both biological parents in the home, were most likely to drop out.

Procedures

Students in grades 8, 10 and 12 from a Midwestern city, agreed to participate in this study. Letters were mailed to all students enrolled in the local public-school system serving the city. The letters requested that all first-born children with a second-born sibling no less than four years younger, contact researchers for possible participation in this study. After this process, families scheduled a time to meet with researchers at a university laboratory setting for 2 hours. The study began with the reading and signing of consent forms, and then both older and younger siblings, and one parent completed questionnaires. One year later, at Time 2, and two years later at Time 3, questionnaires were mailed to participants, and they were prompted to return the questionnaires at the earliest convenience. All families were compensated after completion of the questionnaires at each time.

Measures

Mother-Adolescent Positivity. The Network of Relationships Inventory (NRI; Furman & Buhrmester, 1985) was used to assess positivity within the mother-adolescent relationships. Nine subscales, with 3 items each, were used in determining overall positivity. Examples of items used for the inventory included questions like, “How much do you turn to this person for support with personal problems” and “How much does this person like or love you”. The sub-scales included: intimacy, admiration, instrumental help, affection, companionship, nurturance, reliable alliance, support, admiration (Adams & Laursen, 2007; Furmen, 1996). A Likert scale ranging from 1 (little to none) to 5 (most) was utilized for each child’s rating of positivity with their mother and sibling for each item. At Time 1, mother-older positivity, $\alpha = .75$, and mother-younger positivity, $\alpha = .81$, were assessed. Additionally, at Time 3 mother-older positivity, $\alpha = .86$, and mother-younger positivity, $\alpha = .84$, was analyzed.

Sibling Relationship Positivity. Siblings were also administered the Network of Relationships Inventory (NRI; Furman & Buhrmester, 1985) to indicate the positive quality of their relationship with their corresponding sibling on a scale of 1 (little to none) to 5 (the most). Positivity within the sibling interaction was reported at Time 2 ($\alpha = .65$ for older-younger, $\alpha = .85$ for younger-older)

Results

Descriptive means, standard deviations and intercorrelations of primary study variables are presented in Tables 1 and 2. Path analyses were used to examine the association between reports of parent-older relationship positivity and parent-younger relationship positivity over time. Furthermore, path analyses were utilized to investigate if relationship positivity within the sibling dyad mediated the proposed association (see Figure 1).

Table 1. Means, Standard Deviations (SD), and Correlations Matrix of Main Study Variables

Variable	Mean (SD)	1	2	3	4	5	6	7
1. Maternal Edu	3.94 (.90)							
2. Older Gender	1.55 (.50)	-.01						
3. Younger Gender	1.50 (.50)	-.07	.11					
4. Older-Mother Pos T1	3.52 (.77)	-.00	.16	.04				
5. Older-Younger Pos T2	3.09 (.83)	.25**	.11	.10	.35**			
6. Younger-Older Pos T3	3.21 (.71)	.14	.12	.14	.16	.47**		
7. Younger-Mother Pos T3	3.21 (.71)	.00	.08	.14	.22*	.49**	.49**	

Note. * significance at the <.05 level, ** significance at the <.01 level

T1=Time 1; T2=Time 2; Pos=Positivity; Edu=Education

Table 2. Means (Standard Deviations) of Adolescent-Parent Positivity by Reporter, Dyad Partner, Time, Sex, and Birth Order

	Males		Females	
	1 st Born	2 nd Born	1 st Born	2 nd Born
Time 1				
Adolescent				
Mother	3.44 (.67)	3.71 (.69)	3.62 (.87)	3.91 (.74)
Sibling	2.88 (.74)	3.16 (.83)	3.38 (.73)	3.37 (.80)
Mother				
Adolescent	3.03 (.52)	3.22 (.48)	3.09 (.56)	3.18 (.52)
Sibling	3.18 (.45)	3.10 (.59)	3.18 (.53)	3.06 (.53)
Time 2				
Adolescent				
Mother	3.33 (.70)	3.64 (.70)	3.48 (.69)	3.59 (.68)
Sibling	2.90 (.75)	3.06 (.89)	3.08 (.71)	3.19 (.65)
Mother				
Adolescent	3.02 (.59)	3.07 (.46)	3.00 (.52)	3.06 (.70)
Sibling	3.11 (.46)	2.99 (.54)	3.10 (.47)	2.91 (.80)
Time 3				
Adolescent				
Mother	3.26 (.72)	3.08 (.99)	3.33 (.81)	2.94 (.98)
Sibling	3.35 (.88)	3.84 (1.34)	3.47 (.99)	3.76 (1.41)
Mother				
Adolescent	2.99 (.53)	3.12 (.58)	2.96 (.54)	3.04 (.47)
Sibling	3.12 (.53)	3.03 (.59)	3.04 (.54)	2.93 (.49)

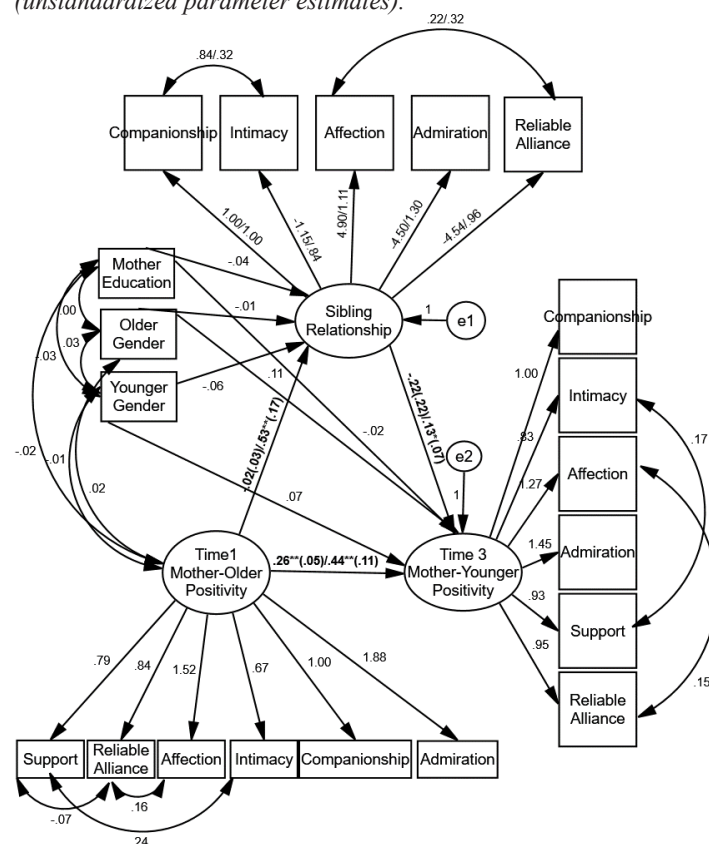
Path analyses were used to investigate if the sibling relationship mediates the effect of relationship positivity reports from mothers on parent-older adolescent relationship positivity on reports from mothers on parent-younger adolescent relationship positivity. Although the chi-square for the model was significant, $\chi^2(151) = 277.8, p < .001$, alternative fit indices indicated a good fit to the data, CFI = .90, RMSEA = .79, AIC = 435.83. Results indicated that reports from mothers on parent-older adolescent relationship positivity was a significant predictor of mothers' reports of parent-younger adolescent relationship positivity, $B = .498, SE = .114, p < .001$. However, mother-older sibling relationship positivity not being a significant predictor of sibling relationship positivity, $B = -.053, SE = .042, p = .60$, and sibling relationship positivity not being a significant predictor of mother-younger sibling relationship positivity, $B = -.149, SE = .314, p = .247$. Furthermore, the indirect effect was not significant, $B = .008, SE = .020, p = .328$, suggesting no mediation.

Path analyses were used to investigate the hypothesis that sibling relationship mediates the effect of positivity reports from older adolescent-parent relationship positivity on reports from younger adolescent-parent relationship positivity. Although the chi-square for the model was significant, $\chi^2(151) = 315.5, p = .00$, alternative fit indices indicated a good fit to the data, CFI = .89, RMSEA = .09, AIC

= 473.50. Results indicated that older adolescent-parent relationship positivity was a significant predictor of younger adolescent-parent relationship positivity, $B = .323, SE = .090, p < .001$. Older adolescent-parent relationship positivity was not a significant predictor of sibling relationship positivity, $B = -.026, SE = .049, p = .117$, and sibling relationship positivity was not a significant predictor of younger adolescent-parent relationship positivity, $B = -.262, SE = .503, p = .117$. However, examining the indirect effect, older adolescent-parent relationship positivity was a significant predictor of younger adolescent-parent relationship positivity after controlling for the mediator, sibling relationship positivity, $B = .061, SE = .033, p < .010$, suggesting partial mediation. Older siblings reporting a positive relationship with their mothers was associated with an approximately .35 increase younger siblings reporting a positive relationship with their mothers two years later when mediated by sibling relationship positivity.

Path analyses were used to investigate the hypothesis that sibling relationship positivity mediates the effect of younger adolescent-mother relationship positivity on older adolescent-mother relationship positivity. Although the chi-square for the model was significant, $\chi^2(151) = 253.6, p = .00$, alternative fit indices indicated a good fit to the data, CFI = .93, RMSEA = .71, AIC = 411.617. Results indicated that younger adolescent-mother relationship positivity was a significant predictor of older adolescent-mother relationship positivity, $B = .256, SE = .105, p < .03$. Although

Figure 1. The association between mother report of parent-adolescent positivity with the older sibling (Time1) and mother report of parent-adolescent positivity with the younger sibling (Time 3) mediated by younger sibling report of sibling positivity (Time 2) (unstandardized parameter estimates).



younger adolescent-mother relationship positivity was a significant predictor of older adolescent-mother relationship positivity, younger adolescent-mother relationship positivity was not a significant predictor of sibling relationship positivity, $B = .048$, $SE = .031$, $p = .662$, and sibling relationship positivity was not a significant predictor of older adolescent-mother relationship positivity, $B = -.328$, $SE = .817$, $p = .155$. Furthermore, the indirect effect was not significant, $B = -.016$, $SE = .039$, $p = .631$, suggesting no mediation.

Discussion

The family system is made up of several different relationships, and each individual and dyad should be analyzed in relation with every other individual and dyad, to better understand the family dynamic. The spillover hypothesis can also be examined to explain the process of different aspects of each relationship within the family spilling over into other relationships in the family (Margolin et al 1996; Minuchin 1988). Of particular interest to this study is the relationship between mothers and their children along with the relationship between siblings. Ratings of maternal warmth have consistently been higher when rated by first born children which implies differing mother-child relationships linked to birth order (Shanahan, McHale, Crouter & Osgood 2007). These ratings along with younger-child reports of maternal warmth, seem to decline around similar times during early adolescence, and then increase again during late adolescence (Shanahan, McHale, Crouter & Osgood 2007). These findings suggest a pattern between ratings of maternal warmth and age, which are topics of interest for later studies. Sibling relationship quality tends to follow a similar pattern, experiencing a decline in the early teenage years, and increasing again in late adolescence. Many studies find that conflict is often described as an inevitable part of every family system (Margolin 1996). However, little research has been devoted to analyzing whether positivity has an equally prominent place in the family system. Thus, the aim of the current study was to examine the association between mother-older/mother-younger child and sibling relationships to further understand the impact the sibling relationship might have on the mother-child dyadic relationships. To accomplish this, several subscales from the Network of Relationship Inventory were utilized to compose measures of positivity within the mother-child and sibling relationships, for later comparison and assessment (Furman & Buhrmester 1985).

First, we assessed the hypothesis that positivity in the mother-older child relationship at Time 1 would have a positive spillover into mother-younger child relationship positivity at Time 3 (2 years later). This claim was partially supported such that the more positively mothers reported their relationships with their oldest child at Time 1, the more positively they reported their relationship with their younger child at Time 3. However, the hypothesis can only be partially supported due to the failure of the 2 models assessing maternal-positivity from the children's perspectives, to meet acceptable fit indices and significance. Previous literature has discussed the idea that families regard parent-child relationships in middle childhood as mutual and not specific to one or the other party (Shanahan, McHale, Crouter & Osgood 2007; Selman, 1980). This is worth further analyzing, since the results of our study only found fit indices for mothers perspectives on their relationships with their children, and not the for the children's perspectives. However, as stated

before, warmth in the parent-child relationship has still been noted to increase or remain stable during the later years of adolescence (Shanahan, McHale, Crouter & Osgood, 2007), which is supported by our findings of higher positivity ratings from the older siblings. Our results are consistent with the pattern presented in previous research of negativity spilling over into other relationships within the family, but the body of research specifically related to positive spillover is still quite limited. We know that the spillover of conflict through family subsystems can also affect family members who were not involved in the conflict original (Margolin, Christensen & John, 1996). This can be used for further implications of this study to look into how and if this pattern is true for positivity in different family subsystems and if so, to what extent.

The second hypothesis stated that the sibling relationship is the mechanism by which this positive spillover between the mother-older and mother-younger relationships happens. Findings were consistent with the hypothesis in the results that there was a significant mediating effect of the sibling relationship such that mother-older positivity at time 1 was associated with greater sibling positivity at time 2 which was associated with greater younger-mother positivity at time 3. This hypothesis was also partially supported due to the acceptable fit indices of two out of the four proposed models. These findings compare to previous research in the way they allude to the importance of the sibling relationship within the family system. The literature pertaining to sibling relationships often focuses studies around sub-systems like the marital relationship and parenting styles and their resulting influences on the sibling and parent-child relationships. However, the specific mechanisms by which these associations happen are unclear and require more in-depth research to investigate (Margolin, Christensen & John, 1996).

Limitations and Future Implications

Although the present study did yield significant results, there is still a need for more in depth and thorough research on the impacts of the sibling relationship. The current study was limited as a result of a non-representative sample. Almost 92% of the participating families were European American, middle aged families. In the future, research should strive to gather more representative and diverse samples so that results can be more generalizable to the entire population, and therefore more accurate. Future research might consider sampling from different locations in order to maximize sample diversity as well. A second limitation of the current study was the lack of family dyads used for examination. The study was successful in finding significance between the sibling and mother-child relationships, however, this does not provide an accurate depiction of the dynamic of the entire family. For future directions, studies should aim to assess the dyads utilized in this study along with others; particularly the marital relationship. Research has found that aspects of the marital relationship, sibling relationship, and parent-child relationship can all be associated with each other, so it is critical that future research takes this idea into account when proposing new studies (Rinaldi & Howe 2003). Previous research has already established the importance of the sibling relationship, and this study has further enhanced the discussion on the need for more research devoted to impacts of the sibling relationship on other family relationships. From the results of this study, spillover hypothesis may best describe the relationship positivity between mother-child and sibling dyads. This implies that further steps

should be taken involving interventions targeting parent-older child relationship dynamics. According to the findings of this study, these interventions could be useful since the oldest child must experience family relationships and dynamics first, and because so many studies have found parallels in sibling and parent-child relationship trends during similar growth stages. Implementing these suggestions could greatly impact our understanding of how family systems work and could also help us figure out how to make family systems more productive and beneficial to each and every member along with their relationships.

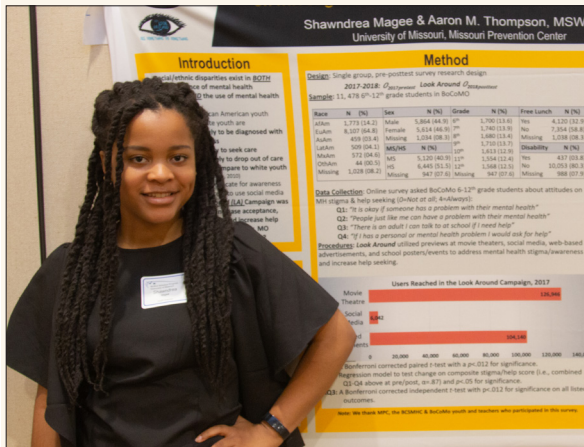
References

- Adams, R. E., & Laursen, B. (2007). The correlates of conflict: disagreement is not necessarily detrimental. *Journal of Family Psychology*, 21, 445.
- Cox, M. J., & Paley, B. (1997). Families As Systems. *Annual Review of Psychology*, 48, 243–267. doi:10.1146/annurev.psych.48.1.243.
- Furman, W. (1996). The measurement of friendship perceptions: Conceptual and methodological issues. In W.M. Bukowski, A.F. Newcomb, & W.W. Hartup (Eds), *The company they keep: Friendships in childhood and adolescence*. Cambridge: Cambridge university press.
- Furman, W., & Buhrmester, D. (1985). Children's perceptions of the personal relationships in their social networks. *Developmental Psychology*, 21, 1016-1024.
- Margolin G, Christensen A, John RS. 1996. The continuance and spillover of everyday tensions in distressed and nondistressed families. *Journal of Family Psychology*, 10, 304–321.
- Minuchin P. 1988. Relationships within the family: a systems perspective on development. In *Relationships within Families: Mutual Influences*. Hinde RA, Stevenson-Hinde J.(eds), Clarendon Press: Oxford, 7–26.
- Rinaldi, C. M., & Howe, N. (2003). Perceptions of constructive and destructive conflict within and across family subsystems. *Infant and Child Development: An International Journal of Research and Practice*, 12, 441-459.
- Shanahan, L., McHale, S. M., Crouter, A. C., & Osgood, D. W. (2007). Warmth with mothers and fathers from middle childhood to late adolescence: Within-and between-families comparisons. *Developmental Psychology*, 43, 551.
- Stocker, C., Ahmed, K., & Stall, M. (1997). Marital satisfaction and maternal emotional expressiveness: Links with children's sibling relationships. *Social Development*, 6, 373-385.
- Yu, J. J., & Gamble, W. C. (2008). Pathways of influence: Marital relationships and their association with parenting styles and sibling relationship quality. *Journal of Child and Family Studies*, 17, 757-778.

Look Around, It's Not Just You: The Effect of a Media Campaign on Mental Health Stigma and Health-Seeking of African American Youth

SHAWNDRREA MAGEE

Aaron M. Thompson, PhD, Mentor
Mentor Dept.



Shawndrea Magee is majoring in health sciences and minoring in psychology.

She has been an active member of Jumpstart (Americorps) serving as a team leader to 13 pre-school aged children.

She recently started with "The Literacy Lab: Kansas City" where she is working with preschoolers in her hometown as she works on her graduate school applications.

Abstract

Problem: Racial and ethnic disparities exist in both the prevalence of mental health diagnoses and the use of mental health services, adversely impacting help seeking due to stigma. **Study purpose:** The Look Around (LA) Campaign was designed to increase acceptance of, reduce stigma around, and increase help seeking for mental health concerns in youth grades 6-12 in a Midwestern county. **Study design:** This study utilized a single county population level preposttest survey research design. **Sample:** Our sample included 11,478 6th-12th graders. Of the sample, 1,773 (15%) of the students identified as African American. **Intervention:** Look Around utilized previews at movie theaters, social media messaging, web-based advertisements, and school posters/events over the course of a school year. **Analysis:** We used paired t-tests to examine changes in youth stigma and help seeking attitudes from pre to posttest after exposure to the Look Around campaign, regression models to examine race as a moderator of change, and independent t-tests to examine differences between high change youth and low change youth on academic performance, attendance, discipline, and mental health screening scores. **Results:** We found significant changes for all youth, but controlling for all covariates (grade level, gender, etc.) African American youth reported less change in stigma and help-seeking compared to other youth. **Conclusions:** We conclude that social media campaigns are useful in addressing mental health stigma and help seeking in youth, but there needs to be an approach tailored to the needs of African American youth specifically. Practice, policy and research suggestions are offered on how to include diverse voices in social media campaigns to create a trauma informed school or community.

Great racial and ethnic disparities exist in mental health problems and service use among school-aged youth. African American youth, for example, are 2 times more likely to be diagnosed with a mental illness, 1.5 times less likely to seek help for that diagnosis, and 2.5 times more likely to drop out of care if they access services compared to their European American counterparts (McGuire & Miranda, 2008). Among lower income children who access Medicaid, for example, only 6% of African American youth access behavioral health services compared to nearly 10% of European American youth (Pires, Grimes, Gilmer, et al., 2013). The disproportionate level at which African American youth, specifically, experience mental illness has been well-researched- as opposed to their white peers, their racial minority status increases the likelihood that they will suffer from mental illnesses. Some risk factors for the development of mental health problems that may instigate further distress include low-income status, gender minority status, and poor health. African American youth not only have to deal with their school-related responsibilities but may be dealing with anguish from

experiencing micro stress due to environmental trauma related to generational poverty and daily acts of subtle or overt racism. They could also be experiencing hardship due to other aspects of their identities. Clearly, a number of studies reveal a disproportionate response to mental health issues for African American youth—possibly culturally oriented stigma responses adversely impacting acceptance of mental health problems and depressing capacity to seek help for mental health problems.

Barriers to treatments disproportionately affect children from African American, Asian, and Hispanic families, which makes early intervention in schools that much more imperative. Barriers could include but are not limited to: stigma towards mental illnesses, a lack of transportation and access to appropriate mental health services, disappointing prior experiences, and lack of resources to pay for counseling and other services. Sadly, one of the largest barriers to persons or reasons they do not seek help is a simple lack of awareness of what mental health symptoms look like, stigma and vulnerability towards seeking help if they are aware, and lack of awareness towards where to seek help if they are aware of symptoms and willing to get help.

To be sure, because of increasing use and ease of access to social media outlets social media campaigns have become popular methods to improve awareness of behavioral health risk factors and increase awareness of resources and means to seek help for behavioral health problems (Hu, Sung & Keeler, 2008). For example, the state of California using investments recuperated from the tobacco settlements—passed a proposition in 1989 to increase taxes on cigarette sales and to target youth attitudes underlying smoking behavior through a variety of media approaches. The media campaign methods included television ads, video messages, radio, billboard, and internet/social media approaches provided to the California public from the mid 1990s through early 2000s. These ads and messaging were focused on targeting tobacco-related attitudes and behaviors of youth along other groups. Time series analyses reveal that consumption as measured by tobacco sales significantly declined and that the steepness of the slope of those declines were significantly related to the amount of social media expended into the environment (Hu et al., 2008). In a large scale review, Flay (1987) examined 40 mass media campaigns to reduce tobacco usage and found mild to moderate effects across all studies of increasing awareness knowledge and improving attitudes towards to targeted or intended outcome (Flay, 1987). Other studies have examined social media campaign impact on youth attitudes towards mental health, stigma, and awareness of symptoms and knowledge of where to seek help with positive effects favoring these approaches (Mailbach, 1993; Livingston, Cianfrone, Korf-Uzan, & Coniglio, 2014; Pinfold, Byrne, & Toulmin, 2005; Wright, McGorry, Harris, Jorm, & Pennell, 2006).

Stemming from the long history of well-documented success of social media efforts to increase awareness and knowledge and reduce or change stigma and help seeking attitudes, the current study examines the impact of a one-year implementation of the impact of the Look Around (LA) campaign. The LA campaign was a community effort to create a brand (see Figure 1) around mental health awareness. The purpose of the LA campaign was three fold—to increase acceptance of mental health symptoms, reduce stigma towards mental health conditions, and increase help-seeking for mental health struggles among youth in grades 6-12 in a

largely suburban and rural environment. The LA program included a range of approaches including social media, movie preview messages, television ads, targeted billboards and other avenues of information dissemination. A large effort was made in the LA campaign to include schools in the dissipation of the information. Stemming from their access to youth and social responsibility to educate and improve youth outcomes, schools are excellent conduits for intervening and educating youth about mental health. School avenues not only provide accessibility to all youth, but it increased the odds that all minority populations would be reached as well, increasing the odds that those youth might receive the knowledge and access to mental health services if needed (Bear, Finer, Guo, & Lau, 2014). The goals of this study sought to examine the following research questions:

1. Is there a statistically significant change between pre and posttest attitudes of youth in grades 6-12 in survey items tapping stigma, acceptance, and help seeking behaviors for mental health concerns? It was hypothesized that there would be a significant difference in youth attitudes from pre to posttest favoring improved levels of stigma, awareness, and help seeking.
2. Is there a statistically significant difference between African American youth and other racial/ethnic groups in their attitudes surrounding stigma related to mental health awareness and help seeking? We hypothesize that African American students will evidence significantly less change in stigma and help seeking compared to other youth.
3. Lastly, do students with high levels of change from pre to posttest compared to those with low levels of change in stigma and help seeking attitudes differ in attendance, academic achievement test scores, grades, mental health screening scores, office referral rates or suspension/expulsions from school for serious disciplinary actions. We hypothesize that there will be significant differences between these groups such that students with less self-reported change from pre to posttest on the stigma and help seeking items will have significantly worse attendance, achievement, grades, mental health screening scores, office referral rates, and suspension and expulsions for serious disciplinary actions.



Figure 1. LA Campaign Brand

Method

Sample and Setting

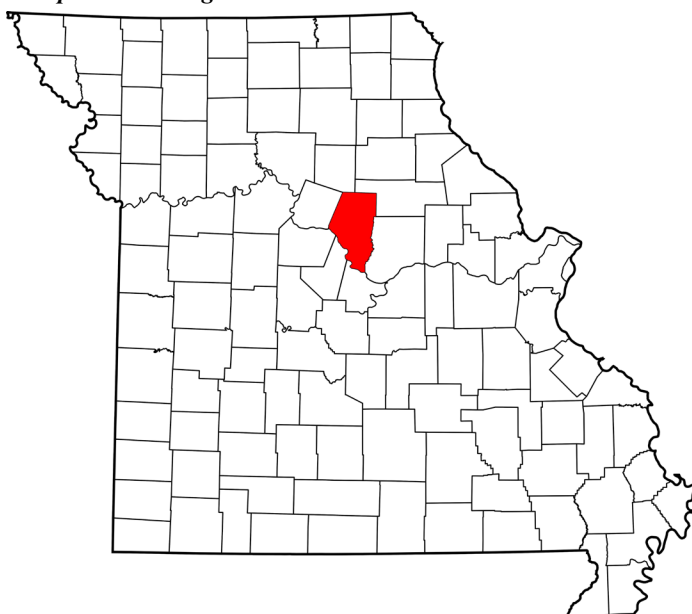


Figure 2. Boone County, MO

Figure 2 shows where the study was implemented, Boone County, MO. Data were collected from students in grades 6-12 in middle and high schools in the County where Look Around (LA) was implemented. Table I reports the demographic characteristics of the entire sampling population. Overall, there were 11,478 students in the study. More specifically, and relevant to one of the research questions being tested in this study also 1,773 Black students were included in the sample. Among the 11,478 students, 15.4% were Black, 48.9% were female, and 35.9% qualified for free or reduces lunch. These data were collected from 5120 (40.9%) students situated in 12 middle schools and 6445 (51.5%) students situated in 9 high schools. Table 1. Sample characteristics of 6-12th grade students and missingness

The setting of the study takes place in Boone, County Missouri (see Figure 2). Boone County, Missouri had a 2017 population of 178,271 permanent residents with 16 incorporated yet rural communities and one larger population center, Columbia (120,612). The population of Boone County closely reflects the national mix of persons who identify as European American (81.8%), African American (9.6%), Native American (0.4%), Asian American (5.0%), Hispanic-Latino American (3.4%), or Mixed (5%).

American (3.1%). The median household income is \$52,005 per family, slightly above the 2017 Missouri (\$49,593) and below the 2017 national (\$55,322) averages. Boone County has 6 independent school districts and two parochial or private schools. Columbia Public schools is the seventh largest district in Missouri with 18,552 students in 2017—which constitutes 74% of the total school-aged population in Boone County. In 2016 (Quick Facts, US Census Bureau, 2015; US Census Bureau, Urban/Rural Demographics, 201 5), approximately 15.8% of Missouri's working aged population earned a living wage considered to be below the poverty line (\$24,250), a rank of 30th nationally and affecting nearly 19.9% of youth living and attending Boone County Missouri's schools.

Table 1. Sample characteristics of 6-12th grade students and missingness

Variable	N	Valid %	Missing n (%) [*]
Sex	11,478	91.7	1,034 (8.3)
Female	5,614	51.1	
Male	5,864	48.9	
Race/Ethnicity	11,484	91.8	1,028 (8.2)
European American (White)	8,107	70.6	
African American	1,773	15.4	
Asian American	459	4.0	
Hispanic/Latinx	509	4.4	
American Indian	43	.4	
Multi-Racial American	572	5.0	
Pacific Island American	21	.2	
Grade	11,478	100	0 (0)
6th	1,870	14.9	
7th	1,887	15.1	
8th	1,869	14.9	
9th	1,803	14.4	
10th	1,750	14.0	
11th	1,654	13.2	
12th	1,688	13.5	
Free & Reduced Lunch	11,478	91.7	1,038 (8.3)
Yes	4,120	35.9	
No	7,354	64.1	

Notes. Missing n and % base upon the total sample of 12,512

Research Design

The study utilized a pre-experimental single group, pre and posttest study design to understand the effects of the LA campaign on youth attitudes of mental health awareness, stigma, and help seeking. Figure 3 below displays the timeline of the pretest, implementation of the LA campaign materials and the posttest. As shown in the figure, all youth in the county were permitted to participate in a school-based survey in the fall of 2017. Once the survey was collected, the LA campaign was kicked off through a variety of social media platforms described below. Next, youth were surveyed again the spring of 2018.

Figure 3. LA pre-experimental single group pre and posttest evaluation design.

Group 1 0_{pretest} Look Around Campaign 0_{posttest}

The pre and post subscripts in the Figure I above refer to the sequential order of the observations, this the pretest observation occurred before the LA intervention and the posttest observation occurred in the spring after exposure to LA was provided to the population of students surveyed. The design assess the dependent variable before and after the stimulus, thus in the evaluation of the effectiveness of a community wide campaign in the absence of a control group is the most optimal design approach to determine the

impact of the campaign on youth attitudes and outcomes. Though the design controls for the causal order of time, it does not rule factors (e.g., historical factors, maturation of subjects, testing, regression to the mean) other than the independent variable that may have contributed to the change overtime, and thus is not a causal design.

Implementation Procedures and Reach of LA

The goal of the LA program was to improve secondary school youths' (aged 11-19) attitudes surrounding mental health awareness, reduced stigma or improved acceptance of mental health concerns, and to improve help seeking. To achieve these goals, the LA campaign included a multipronged media campaign across three platforms: Web-based advertisements, social media posts (i.e., Instagram, Twitter, Facebook) and advertisements at local movie theaters.

Ads on all three platforms were limited to the county of focus and geo-framing was used to target students within the geographic boundaries of the county's public middle and high schools. Geoframing or geofencing uses global position systems integrated into mobile phones to create a virtual boundary used by software to trigger a response when a mobile device enters or leaves a particular area. It works like this. Each mobile phone has a unique Radio-Frequency Identification number (RFIDs). These RFIDs are captured when more than 300 RFIDs are detected via satellite in a single location (i.e., a middle or high school). These RFIDs are then used to direct social media content and track exposure to social media content with the RFID is within the geoframe. Table 2 displays the total numbers of middle and high school student RFIDs that were reached via each method.

Table 2. Total Number of youth reached via each LA implementation strategy

Platform	Number of Users Reached*
Web-based advertisement (Google Adwords)	104,140
Social Media	6,042
Movie Theatre	126,946

Notes. Users are not assumed to be unique and may represent multiple persons within and between categories.

As noted in Table 2, these users are not assumed to be unique across platforms. Also, although only displayed in movie theaters in the County, movie theater ads cannot be assumed to have been viewed exclusively by Boone County residents or by only youth—for example, youth may attend a film with parents or a younger sibling. However, efforts were made to display the ads prior to films that targeted the age demographic that was a focus of the campaign. Therefore, based on the highest total reach among the platforms, we can conclude that a minimum of 104,140 users were exposed to campaign messages. However, due to geoframing, we can assume the majority of the users were county residents who were also in the targeted age demographic.

Measures

The survey administered to all 6-12th grade students in this study, the Early Identification System (EIS; Huang, Reinke,

Thompson et al., 2018; Thompson et al., 2018). All items are rated by students using a 3 point Likert-type scale (0 never = *sometimes*, 2 = *often*, 3 = *always*). The EIS has excellent psychometric properties and was developed through a twostep process.

Questionnaire development. First, items were selected by the developers through a literature review of epidemiological research suggesting key risk factors which are most predictive of social, emotional and behavioral health problems. A pool of possible items was drafted by the developers that included 41 items. Next, the items were rated for their clarity and accuracy by a group of mental health experts and school social workers, psychologists and counselors. The process resulted in a list of items that were hypothesized to correspond to several factors predictive of poor mental health outcomes: externalizing behavior and emotion regulation, internalizing behavior, peer relations and social skills, and school engagement.

Additional standalone items were added ("I am bullied," "Other kids make fun of me," and I get into fights with others") to indicate risk with low frequency concerns. In addition a final set of items were added to determine youth attitudes or stigma towards mental health and help seeking. Factor analysis did reveal Eigen values over 1.0, significant Kaiser-Olkin Meyer and excellent reliability for combining these items into a scale ($\alpha = .88$).

Data collection procedures. Data were collected via a web-based survey during the 2017-2018 school year. The survey was administered to all students in Boone County at the same time in October during the Fall semester. The posttest survey was administered and collected from all students then again in May of the following Spring semester.

Following the end of the school year, student level demographic and other outcome data were collected via administrative records collected at the school districts within the county that was targeted by the LA campaign. These records included grade, race, sex, participation in subsidized lunch, and disability status as well as office referrals, attendance, suspension and expulsion rates, and state standardized testing results.

Analysis

The goal of our analysis was to examine several research questions. The first related to the impact of the LA campaign on the attitudes of youth grades 6-12 generally. The second question related more specifically to whether these changes were related to the race of youth surveyed; that is, were African American students more likely to experience greater levels of stigma compared to whites. Lastly, we sought to examine whether students with above average levels of stigma had statistically more suspensions, higher screening scores on a mental health screening tool, and poorer attendance compared to those with below average levels of stigma.

To first provide some understanding of the impact of missingness we will first conduct some exploration of the missing data. We will begin these analysis by examining youth included in study compared to the total population surveyed by race and sex categories to determine the difference if any of the youth included in the response rate compared to the total population. Starting with such an analysis will help us understand how generalizable the survey data are to the entire population. To test the assumptions that

missingness was an element of randomness and not related to any systematic observation, we will examine, using a series of two-tailed independent t-tests, if there are any differences between the demographic values of the youth with and without responses. These tests will be appraised at a probability value of a .05 but we will use a Bonferroni corrected probability value (dividing the probability value by the total number of tests conducted) to add robustness to these findings and ensure the results are not spurious due to conducting numerous statistical tests.

Next, in order to test the evidence for the first research question listed above, we relied on a series of paired t-tests with the available whole sample to determine whether there was significant change in self-rated attitudes towards mental health acceptance, stigma, and help seeking from pretest to posttest. These tests will be appraised at a probability value of a .05 but we will use a Bonferroni correction (dividing the probability value by the total number of tests conducted) to add robustness to these findings and ensure the results are not spurious due to conducting numerous statistical tests.

Next, to determine the evidence in the sample as to the second research question, we will use composite scores to determine whether African American and other students of minority political status/color have significantly different scores compared to white students. To determine the significance of these differences, we will use a linear regression model and enter variables in a hierarchical fashion to determine the impact of each batch of variables on the outcome and the percent of variance explained. These models will control for student demographics and pretest stigma and help seeking scores at baseline.

Lastly, to examine the differences between student groups with high amounts of change and low amounts of change from pre to posttest on their stigma and help seeking beliefs, we will divide the sample of students at the mean—first running analyses of the subsamples to ensure equal distributional properties and that standard errors are evenly distributed in the population as well. Next, we will use a two-tailed independent t-tests, if there are any differences between the demographic values of the youth with and without responses. These tests will be appraised at a probability value of a .05 but we will use a Bonferroni corrected probability value (dividing the probability value by the total number of tests conducted) to add robustness to these findings and ensure the results are not spurious due to conducting numerous statistical tests.

Results

The total sample included in the pretest analyses included approximately 77% of all 6-12th grade students in Boone County, Missouri (N=8,831 with full responses out of 11,478 students). Thus, 2,647 students (23%) had some missing data and were excluded from the final models. Analysis of missing data patterns revealed no significant associations existed between response patterns and observed respondent characteristics (i.e., sex, race, grade, free and reduced lunch participation, school of attendance, mental health screening scores). Furthermore, those with missing data did not differ from those with full data on demographics. Under these conditions, we assume the missingness in the data to meet the basic criteria for the designation of missing at random (Little, 1988; Little & Rubin, 1989) and all analyses and estimates reported here were generated using a traditional listwise deletion approach. Under this approach, each estimate generated from

Table 3. Sample characteristics of 6-12th grade students and missingness

Factor	B	SE	t (p-value)
Intercept	1.47	.03	50.23 (.00)
Stigma/Help Seeking Pretest	.35	.01	33.57 (.00)
African American	-.61	.01	-4.33 (.00)
Hispanic Latino American	-.11	.02	-0.52 (.61)
Mixed Race American	-.26	.02	-1.35 (.18)
Asian American	-.01	.02	-0.27 (.79)
Sex	-.64	.06	-7.69 (.00)
FRL	-.57	.01	-5.74 (.00)
SPED	-.004	.01	-5.74 (.00)
Grade	-.05	.01	-0.33 (.81)
School	-.01	.02	-0.01 (.93)
R ²	.16		
R ² adjusted	.16		

Notes. FRL = Free and Reduced Lunch; SPED = Special Education Status.

the data uses all responses available (Pigott, 2001). Although the listwise deletion approach does result in a decreased sample size, it has important advantages. First, it abides by the rule of parsimony and offers the simplest analyses facilitating clear understanding and communication of the findings (Kline, 2011) and second, listwise deletion produces unbiased estimates under the missing at random classification (Baraldi & Enders, 2010). All analyses were conducted using SPSS, version 21.

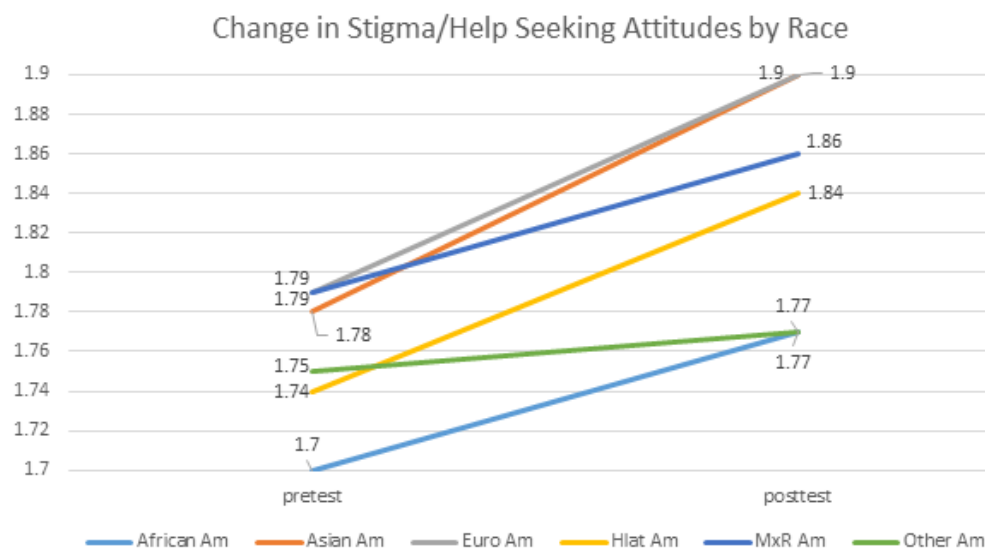
Regarding the overall effect of the LA campaign on student responses to each of the survey question seeking to gauge student stigma and help seeking attitudes, there did appear to be a significant change in posttest responses of student attitudes, compared to pretest response scores before the release of the LA campaign materials. That is, in response to the survey item “it is okay if someone has a problem with their mental health,” test results indicated significant improvements from pre to posttest (N=8831; $t=5.22$; $s.d.=.85$; $95\%CI=.03-.06$; $p<.001$ $d = .45$). In response to the survey item “People like me can have a problem with their mental health,” test results indicated significant improvements from pre to posttest (N=8831; $t=5.02$; $s.d.=.93$; $95\%CI=.07-.03$; $p<.001$ $d = .53$). In response to the survey item “There is an adult I can talk to at school if I need help,” test results indicated significant changes from pre to posttest (N=8831; $t=26.41$; $s.d.=.95$; $95\%CI=.03-.06$; $p<.001$ $d = .78$). Lastly, in response to the survey item “If I had a personal or mental health problem I would ask for help,” test results indicated significant change from pre to posttest (N=8831; $t=4.22$; $s.d.=.65$; $95\%CI=.03-.06$; $p<.001$ $d = .35$).

To analyze the moderating effect of the LA campaign on African American youth attitudes compared to others, we first combined the four survey items described above into a single composite. Prior to combining the items, we examined the underlying factor structure of the items using factor analysis (FA). To appraise the quality of FA models, we followed common statistical cutoffs. Factors with eigenvalues equal to or exceeding 1.0 were retained, item loadings were expected to be .35 or greater, and scree results were expected to reveal a clear distinction between unique factors and correlational noise. In addition, we expected

the model would have simple structure (i.e., no cross loadings of items on more than one factor) and that overall model tests would indicate statistical fit of the data to the hypothesized factor structure (i.e., Kaiser-Meyer-Olkin [KMO], Bartlett's; Costello & Osborne, 2005; Tabachnick & Fidell, 2001). All FA models were tested using SPSS 21.0. The FA model indicated there was a single unitary factor with all four items in the 1110del as evidenced by scree plot results revealing a single, simple structure factor and with all items loading between .41 and .78 and a Kaiser-Meyer-Olkin test result = .86 and Bartlett's test of sphericity of $\chi^2=16658.292$, $p=.001$. As such, we had a high degree of confidence the 4 items were reflective of a single composite item reflecting mental health stigma and help seeking attitudes.

Next, we conducted a regression analysis using the above described composite to examine changes in youth responses from pre to posttest. The model controlled for all available student level characteristics (e.g., sex or gender, free and reduced lunch participation, grade level, special education status). All race variables were dummy coded to be 0 or 1, dependent upon the category with European American or white students serving as the reference category. All associations in the model were appraised at a p value of .05. The regression model results are shown in Figure 4 below.

Figure 4. Pre and posttest scores by race on Stigma/help seeking



Examining the coefficients from Table 3, we can see that there appears to be a differential or moderate effect of change from pre to posttest attitudes surrounding stigma and help seeking for African American youth compared to all other racial categories and with European American or white youth used as a reference category. The R² and Adjusted R² values indicate that the model explains 16% of the variation in the outcome changes at posttest ($SS=214.448$; $df=10$; $F=153.517$, $p=.001$). Figure 2 below reveals the mean pre and posttest differences for all racial categories. As shown in the figure, there appears to be less change in African American students compared to others over time, in that those students started lower and also ended lower than other racial categories.

Lastly, post hoc follow up analyses used a series of Bonferroni corrected t-tests to examine if there were any significant differences between students with above average change versus below average

change on attendance, achievement, grades, mental health screening scores, office referral rates, and suspension and expulsions for serious disciplinary actions. Results indicated there were some differences in these groups around self-rated mental health screening scores ($N=8,831$; $\bar{x}=4.67$, $sd=2.9$, $t=-2.91$, $p=.003$), teacher rated mental health screening scores ($N=8,831$; $\bar{x}=3.08$, $sd=5.77$, $t=-3.49$, $p=.001$)—both tests suggesting youth and teachers with less change indicating they have higher ratings for risks markers surrounding social, emotional and behavioral health functioning.

Discussion

The present study was an evaluation of the LA program a social media campaign in one Midwestern county with the intent of reducing the stigma surrounding mental health and improving help seeking among youth in grades 6-12. Using a pre and posttest survey of all youth in the county, analyses show that the campaign successfully reduced youth stigma and improved attitudes around help seeking. The present study findings are similar to those observed in other studies of public health messaging campaigns to reduce smoking among similar aged groups. For example, Hu (2008) and Flay (1997) reviewed a number of efforts to change behavioral health in California using a range of social media programs and public service messaging and were able to show that these efforts not only reduced smoking behavior but also improved youth health over time.

The study has obvious limitations limiting its generalizability to other youth and settings. First among these limitations have to do with internal study design. The largest limitation here is that while the study was a pre and posttest analysis of student responses, there is no control or coinparison group. Even though the present study includes 100% of youth included in the sampling population frame that was the target of the intervention (i.e., 100% of all youth had equal chances to respond to the survey), future studies could increase the rigor of evaluation efforts by utilizing a comparison county similar to the implementation sample frame or by using other advanced methods like propensity score methods to draw comparisons.

Because there is not a control condition in the present study—the findings summarized here are subject to a host of internal threats to study design, particularly historical events (e.g., increased national attention and awareness of #metoo, Black Lives Matter, racial stereotyping and bias testing, and increased adoption of mental health first aid training, etc.). As such, other external efforts could have impacted the attitudes of youth and are not controlled for in this study. In addition to lack of internal design threats, there could be instrumentation threats to the findings here. Because youth were responding to a local survey that is administered three times per year, youth responses could be conditioned by instrumentation fatigue. Lastly, because the questions that youth responded to were not formerly validated scales—though factor analysis results indicated that the scale was a valid representation of an underlying factor we call “stigma and help seeking attitudes” here, future studies could use a multi-factored scale that better captures the multifaceted nature

of stigma (i.e., cultural differences, gender/sex differences, etc.) as well as including other relative measures that may impact stigma (e.g., exposure to family with mental health diagnoses, training experiences, student diagnoses and access to care). Such refined measurement of complex concepts will better help isolate the impact of a public health campaign to impact youth attitudes.

Regardless of these aforementioned threats to the study validity, there are important practice, policy and research implications from the findings here. Regarding practice implications, the study findings here show that more efforts need to occur to increase the educator and youth awareness of the signs and symptoms of youth mental health struggles – including whether these signs and symptoms differ culturally and racially. That black youth in this study responded differentially to the LA campaign indicates at the very least that those youth experience some culturally different messaging and attitudes surrounding mental health and messages to improve stigma and help seeking. This issue is compounded by the fact that 80% of teachers in US public schools are from white and middle class backgrounds and complicates the present US teaching cohort's capacity to relate to and have meaningful exchanges with politically minority groups of students who are struggling with mental health issues. Advanced pre and in-service training for teachers in youth mental health signs and symptoms and available strategies can bring increased understanding of these issues to teachers and lessen the adverse impact of these issues on youth. Training and effective practice and policy advances regarding school discipline policy should also be taken into account as well to prevent treating mental health signs and symptoms as challenging behaviors—that is, we need to be better at identifying when youth are experiencing symptoms of mental health problems and respond in supportive and thoughtful ways instead of simply following progressive disciplinary policies, particularly when it comes to supporting youth of color.

Regarding policy implications, more effort needs to be included in educational programs and funding for public messaging to reduce the stigma surrounding mental health and increase not only the willingness to seek help but also the opportunities to access health. Access to mental health services is adversely impacted by a number of barriers (e.g., transportation, cost, cultural attitudes, etc.) and more effort should be made to reduce these barriers. Reliance on public messaging campaigns such as LA can have a desirable impact on youth attitudes similar to prior studies on reducing smoking (Hu et al., 2008; Flay, 1987).

Lastly, research wise, this study's findings suggest a greater effort must be made to better understand the packaging, language, images and messaging that should be used to represent a wide range of ethnic and racially divergent groups in communities. For example, in the wake of the present study, the LA campaign funders have included youth directly in the artwork, messaging, and even the delivery of the messages. Please view more current examples of the LA campaign's effort to include youth in these messages here:

1. <https://drive.google.com/open?id=1AREQKLC1neXeUM3VmPiX3D4EtDiZQitM>
2. <https://drive.google.com/file/d/1J5QeJJeJwKhpZLn-4wxk4D8387FURI/view?usp=sharing>

Time will tell if these messages are received by youth in a favorable manner and if they move the needle on stigma and help seeking in the present sample.

Conclusion

Due to very unfortunate societal structures, African American students face pressures that negatively impact their mental health. In addition to their suffering, the stigmatization of helpseeking in their communities makes their situations even worse. Moving forward, there needs to be increased effort in reducing stigma and increasing help seeking among African American youth. This can be done via social media campaigns like LA, but efforts to reach these youth may be more successful if directly implementing their voices in these efforts.

References

- Flay, B. R. (1987). Mass media and smoking cessation: a critical review. *American Journal Public Health*, 77(2), 153-160.
- Hu, T. Sung, H. Y. , & Keeler, T. E. (1995). Reducing cigarette consumption in California: tobacco taxes vs an anti-smoking media campaign. *American journal of public health*, 85(9), 1218-1222.
- Livingston, J. D. , Cianfrone, M. , Korf-Uzan, K. , & Coniglio, C. (2014). Another time point, a different story: one year effects of a social media intervention on the attitudes of young people towards mental health issues. *Social psychiatry and psychiatric epidemiology*, 49(6), 985-990.
- McGuire, T. G., & Miranda, J. (2008). New evidence regarding racial and ethnic disparities in mental health: Policy implications. *Health Affairs*, 27(2), 393-403.
- Maibach, E. (1993). Social marketing for the environment: using information campaigns to promote environmental awareness and behavior change. *Health promotion international*, 8(3), 209-224.
- Pinfold, V. , Byrne, P. , & Toulmin, H. (2005). Challenging stigma and discrimination in communities: a focus group study identifying UK mental health service users' main campaign priorities. *International Journal of Social Psychiatry*, 51(2), 128-138.
- Pires, S. , Grimes, K. , Gilmer, T. , Allen, K. , Mahadevan, R. , & Hendricks, T. (2013). Identifying opportunities to improve children's behavioral health care: An analysis of Medicaid utilization and expenditures. Hamilton, NJ: Center for Health Care Strategies.
- Wright, A. , McGorry, P. D. , Harris, M. G. , Jorm, A. F. , & Pennell, K. (2006). Development and evaluation of a youth mental health community awareness campaign—The Compass Strategy. *BMC public health*, 6(1), 215.

Featured Scholar



Amber Bell, PhD
Assistant Professor
Department of Social and Behavioral Sciences
Student Success Coach, Lincoln University Student Success Center
Lincoln University

2006-2007 MU McNair Scholar
 PhD in Social Work from the University of Alabama

My journey into the McNair Scholars Program is unique because aspects of the program were a part of my entire undergraduate experience. Specifically, I received early admission into Mizzou and started to receive many invitations to events sponsored by alumni groups. One event was sponsored by the alumni group in my county, so I attended the event. It was at this event that I met an Associate Dean of the College of Arts and Sciences, Dr. Theodore Tarkow who connected me with the Discover Program, a program that introduces freshmen and sophomore to the McNair Scholars Program and graduate education. Dr. Tarkow also connected me with my mentor, Dr. Joan Hermesen. Participating in the Discover Program inspired me to believe that my dreams of earning a doctoral degree could one day be a reality. Once I was eligible for the McNair Scholars Program, I applied and was accepted in the program as a junior.

The McNair Scholars Program provided a plethora of useful information related to applying to graduate school, professional development, academic research, and professional networking. Additionally, the McNair Staff, Dr. Vicki Curby, Dr. NaTashua Davis, Mr. Jeremy Bloss, and Ms. Darlene Dixon served as a support network. It is difficult to put in to words the impact that the program had on me.

I had the opportunity to participate in multiple research activities during the program. Specifically, under the guidance of Dr. Joan Hermesen I explored the motives that the general public attributed to individuals who decided to become foster parents. This project really introduced me to the world of academic research and the intricacies involved in a research project. Our project was featured in the 2007 MU McNair Journal. Additionally, I attended and presented at academic research conferences, participated in the American Sociological Association Honor's Program and attended the Summer Research Opportunities Program at Michigan State University where I furthered my research into the foster care system. These experiences which were directly related to my participation in the McNair Scholars Program, exposed me to intricacies of academic scholarship, encouraged me to pursue my dreams of earning a doctoral degree, and provided confirmation that I indeed wanted to become a professor. Thankfully, this dream was realized, and the McNair Scholars Program served as a guiding light every step of the way.

The instruction and tools I received during my time as a McNair Scholar prepared me for the hurdles I faced during my graduate studies. Additionally, the program staff continued to serve as a support network during the various stages of my extended path to degree completion.

As of this fall, I am now an Assistant Professor for Lincoln University Missouri, in part thanks to the McNair Scholars Program.



Amber Bell
For Love or Money:
Attributing Motives to Foster Parents
 Joan Hermesen, PhD, Mentor
 Department of Sociology

Amber is a senior majoring in Sociology and is a native of Malden, MA. She is very active in volunteering. This year she participated in Alternative Spring Break and volunteered for several local organizations. Amber is the recipient of the Alfred and Grace Moon Scholarship and Diversity Scholarships and she spent this past summer at Michigan State University as a summer research scholar. Upon graduation next spring, Amber intends to pursue a doctorate in Sociology and eventually become a professor.

Fosterhood is a normative part of the adult experience in the United States. Most American men and women eventually become parents (United States Census Bureau, 2007). Because of the widespread experience of parenthood, parents are seldom asked why they chose to become parents in the first place. It is assumed that people parent out of a love of and concern for children. The same cannot be said for foster parents: the popular press, television and movies, and some academic writings speculate that foster parents engage in parenting for non-instrumental reasons, especially financial gain. In this paper I explore the parenting motives that the general public attributes to foster parents.

Foster Care in the United States
 The U.S. foster care system involves four main parties: the children, their biological parents, child protective services agencies, and foster parents. The U.S. Administration on Children and Families reports that over 50,000 children are in the foster care system. One half of these children reside in non kin placements or in what is known as traditional foster care. There are only 17,000 licensed foster homes nationwide (NCJRS, 2006), and in most states, there is a shortage of licensed foster homes (Killey, 1997).

A foster parent is a "resource that provides care for children in state custody" (ACF, 2006) and actively plays the role of a secondary parent with the state being the "ultimate parent" (Swartz, 2003). According to the National Foster Parent Association, foster parents are not paid for their services (O'Connell, 2002) part of the foster care system. They are made visible mostly only when claims of abuse and neglect are made public to the press (Swartz, 2003). This portrayal of foster parents extends to television dramas and comedies that share the latest message that foster parents are corrupt. Storylines use abusive and neglecting foster parents as the catalyst for the actions of other characters. Foster parents are often presented as bad parents who take in children for monetary reasons only (Killey, 2006; Swartz, 2003). Academic studies show that even though the foster parents get paid of the state for the adoption of the foster system, they are generally good, and state regulations provide an entire level of protection for the children in care (Hendrix, 2001; Kiehl, 2006; Meehan, 1985; Swartz, 2003; Wisniewski, 2003).

Why would anyone want to be a foster parent? Studies have found that individuals become foster parents for several reasons. Explanations include, for example, inability and a desire to parent, to increase family size, to continue the generational practice of fostering, to provide care to a child in need, and for financial gain (Barnes, 2001; Cole, 2005; O'Connell et al., 2004; Swartz, 2003; Anderson, 2003).

These motives are often characterized as selfish (e.g. inability, money) or altruistic (provide care to a child). Swartz (2003) argues that this dichotomy between selfish and altruistic motives is too simplistic: multiple reasons underlie the decision to foster, and for many foster parents "fostering a child's life" and financial compensation are joint motives. Since the typical foster parent in the United States is also a member of the working class, often local research often encourage these individuals to foster (Anderson, 2001; Cole, 2005; Swartz, 2003). Without the pay Swartz (2003) argues, many foster parents simply could not take on the responsibility of fostering.

Amber Bell's Fall 2007 MU McNair Journal article where she states she wishes to eventually become a professor

2018 - 2019 Research Topics

Scholar	Major	Title	Mentor
KeLa Allen	Human Development and Family Sciences	"Color Me Stressed: The Influence of Skin Tone on African-American and Latino College Students' Psychological Well-Being"	Antoinette Landor
Rebecca Cameron Anderson	Psychology	"Explorator Study on Food Insecurity, Social Stigma Mental Health and Externalizing Behaviors among Adolescents"	Mansoo Yu
Amanda Bennett	Psychology and Spanish	"Associations Among Adverse Childhood Experiences, Social Support, and Adult Mental Health and Abuse"	Kristen Hawley
Tishaura Brown	Anthropology	"Impact of the Silk Road on Disease Transmission"	Lisa Sattenspiel
Sonia Clark	Health Sciences	"The Effects of the Missouri and Mississippi Rivers in the Epidemiological Spread of the 1918 Influenza Epidemic"	Carolyn Orbann
Denton "Cole" Diggins	Soil Science	"Cover Crop and Biofuel Crop Effects on Hydraulic Properties for Claypan Soils"	Steven Anderson
Levi Doyle-Barker	Psychology	"A Confirmatory Analysis of the Early Identification System"	Keith Herman
Kiana King	Psychology	"Positivity in Sibling Relationships and its Influence on Mother-Older Child vs. Mother-Younger Child Relations"	Nicole Campione-Barr
Shawndrea Magee	Health Sciences	"Look Around, It's Not Just You: The Effectiveness of School-Based Public Health Interventions for African American Youth"	Aaron Thompson
Zahria Moore	Theatre and English	"#MizzouMade: An Autobiographical Play Analyzing One African American Woman's Undergraduate Experience at the University of Missouri Localized in Fall 2015"	Claire Syler
Mirnes Mustafic	Civil Engineering	"Fatigue Life Enhancement for Steel Girders using Ultra-high Modulus Carbon Fiber Reinforced Polymers"	Hesham El-Emam and Hani Salim
Tawnie Nelson	Psychology	"Long-Term Prognosis of Anorexia Nervosa Patients' Perspectives on Compulsory Inpatient Treatment"	Virginia Ramseyer Winter
Faramola Shonekan	History	"The Historical Significance of the Identity and the Political Thoughts of Claudia Jones during the 20th century and her reverberating Political Influence Today"	Jay Sexton
Jaquaylah Taylor	Sustainable Agriculture	"Capital Impacting the Distribution of Food among African Americans"	Mary Hendrickson
Cosette Tomita	Chemistry	"Synthesis and preparation of a selective sigma-2 receptor radioligand"	Susan Lever
Naya Sutton	Psychology and Human Development and Family Sciences	"Tinted Love: Understanding the Interactions of Within-Group Discrimination, Skin Tone and Love"	Antoinette Landor
Alexis Wilkinson	Psychology	"Avenues and Obstacles toward Authenticity among African American Adults"	Laura King
Rebecca Winkler	Biology	"Characterization of the novel maize <i>carbohydrate partitioning defective</i> mutant <i>P135-21B</i> "	Rachel Mertz and David Braun
Amanda Wood	Bioengineering	"Aptamer-based imaging of disease associated receptors on the cell surface"	Donald Burke-Aguero

2018-2019 McNair Scholars



Front Row: Tishaura Brown, Tawnie Nelson, Rebecca Winkler, Shawndrea Magee, Sonia Clark, Johanna Milord (Graduate Assistant)

Second Row: Natalie Downer (Associate Director), Kiana King, Jazmin Simms (McNair Guest)

Third Row: KeLa Allen, Alexis Wilkinson

Fourth Row: Amanda Bennett, Faramola Shonekan, Zahria Moore, Jaquaylah Taylor

Fifth Row: Cosette Tomita (Summer 2018 Scholar), Amanda Wood, Rebecca Cameron Anderson, Jeremy Bloss (Program Coordinator)

Back Row: James Hamilton (Program Assistant), Mirnes Mustafic (Summer 2018 Scholar), Denton "Cole" Diggins.

Not Pictured: Levi Doyle-Barker, Naya Sutton, NaTashua Davis (Program Director)



10 Arts & Science Building
Columbia, MO 65211