
White Lab Coats and Elementary Students' Science Self-Concept and Science Self-Efficacy

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Abstract

Youth often fail to see themselves in the role of a scientist or engineer and they may lack the confidence to believe they can be successful in STEM courses and careers. This study investigated students wearing lab coats as one strategy to build science academic self-concept and self-efficacy in science. Teachers in four elementary schools had their students wear lab coats for ten science lessons. Students (n= 37) were interviewed pre and post to the lab coat experience to document students' perceived science self-efficacy, science self-concept, and perceptions of wearing the lab coat on their views of themselves as scientists. The students reported that when wearing a lab coat, they felt like scientists and felt smart and competent in learning science. Results suggest that wearing a lab coat may be an accessible strategy that can raise science self-efficacy, self-concept, and promote an enhanced sense of relatedness to science and scientists.

Introduction

Education policymakers continue to stress the need to prepare students with the knowledge and skills necessary for supporting both a science, technology, engineering, and mathematics (STEM) workforce and for developing scientifically literate citizens capable of making evidenced-based decisions (National Science Board, 2015; Office of the Chief Scientist, 2016). Even with significant attention given to recruiting and retaining

STEM workers, there are employment shortages in many STEM areas (Chen, 2013). Some researchers have suggested that some youth do not choose STEM careers because they may not see themselves in the role of a scientist or engineer and they may lack the confidence to believe they can be successful in STEM courses and careers (Moakler & Kim, 2014). This research study investigated students wearing lab coats as one strategy to build students' science academic

self-concept, to advance students' self-efficacy in science, and to promote students' interests and motivation to learn science.

Background

Science Career Choice. There are a number of factors that have been shown to influence youth's science course and career decisions. Previous research has shown that mentors (e.g., Schwartz, 2012), prior experiences (Jones et al., 2011), peers

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(Maltese & Tai, 2011), family expectations (Glass, et al., 2013), as well as family resources and habits (Archer et al., 2012 & 2015a) all influence youth as they consider future career opportunities and academic courses. More recent research on career selection has focused on students' visions of themselves as future scientists as well as their self-efficacy for learning science (Mau et al., 2016).

Perceptions of Scientists. When youth are asked about their impressions of scientists and engineers the picture that emerges is not encouraging. For decades researchers have shown that students possess stereotypical images of scientists as white males who are bald, wear glasses, work alone, and lack an interesting social life (e.g., Barman, 1997). These stereotypical images of scientists are held by youth across communities and cultures (Barman, 1997; Fung, 2002; Miller et al., 2015) and still hold true today (Carrier et al., 2020).

In a study of Black students' engagement and participation in science, Archer and her colleagues (2015b) identified the sociohistoric exclusion of minority ethnic groups in science as a form of institutional racism that influences school norms and practices. The researchers noted that many students who expressed an interest in science failed to transfer that interest into careers in science because the students held stereotypical images of careers and science professionals who were different from themselves.

One of the proposed reasons that students do not choose careers in science and engineering is the psychological distance that can exist between a student's perception of his or herself and the perceived traits of a scientist or engineer (Brush, 1979; Hagerty, 1964). Brush argues that students who choose to take science coursework may see themselves more like a scientist than their peers who did not choose science. Furthermore, according to Brush (1979), "(i)f students feel they are hard-working and reliable and that scientists share these traits, it may follow that they feel more comfortable among scientists or more suited to the kind of work done by scientists" (p. 237). This psychological distance is evident

when students do not see themselves as being competent in science or as having the skills and traits of scientists.

Self-efficacy. Being motivated to pursue a career in science is often accompanied by a belief that one can be successful in learning and doing science (Krogh & Anderson, 2013). Self-efficacy refers to people's belief that they can accomplish tasks and exercise control over events that affect their lives (Bandura, 1986). Researchers have shown that students' motivation and performance outcomes in science and mathematics are associated with students' self-efficacy (Britner & Pajares, 2001; Lent et al., 1997). Furthermore, positive self-efficacy has been shown to influence mastery goal orientation (Urdu, 1997), self-regulation (Zimmerman, 2002), and self-concept (Bong & Skaalvik, 2003). Studies have shown that underrepresented minority students in science often lack self-efficacy and this perceived lack of confidence that they can to be successful in science can influence students' interest in engaging in science beyond mandated courses (e.g., Chemers, et al., 2011). Furthermore, self-efficacy has been shown to predict academic achievement and interests (Pajares, 1996; Zimmerman & Bandura, 1994).

One way to raise students' science self-efficacy is by observing others like themselves doing science. Britner and Pajares (2006) suggest that students compare themselves to others doing science and "evaluate their own likelihood of success at the same or similar tasks" (p. 487). For example, interactions with female professional role models in STEM have been found to increase female students' self-efficacy toward STEM careers (Cheryan, et al., 2011). Another influence on students' feelings of science self-efficacy, according to Britner and Pajares (2001), is the physiological state of the student including anxiety, stress, arousal, or mood. If a student finds doing science as stressful, performance and beliefs about the ability to do science may decline.

There is evidence that students' self-efficacy can influence their choices for courses and careers (Margolis et al., 2000). Aschbacher, Li, and Roth (2010)

conducted one of the few longitudinal studies of self-efficacy in science by following high school students over the course of two years. They found that as students' identities as a scientist declined, there was a corresponding decline in students' beliefs that they were capable of being successful in science. They maintain that, "confidence in science promotes identification with science, which then further enhances confidence" (p. 861).

Science Academic Self-Concept. Students' perceptions of their abilities within science, known as science academic self-concept, has been shown to influence characteristics such as self-efficacy, academic choices, career aspirations, and academic achievement (Marsh et al., 2016). Researchers have defined science academic self-concept as one's self-perceptions of competence and ability that develop through experiences and interpretations with the environment (Shavelson et al., 1976).

Self-efficacy and academic self-concept are overlapping constructs in the sense that they both describe perceived competency in a specific domain. However, self-efficacy examines perceptions of what one is able to accomplish in the future, whereas academic self-concept examines perceptions of past performance (Marsh, et al., 2016). Factors such as ethnicity, gender, and anxiety level have been shown to influence students' academic self-concept (Cooper et al., 2018).

Additionally, Cooper, Krieg, and Brownell (2018) argue that academic self-concept includes a student's internal comparisons (how the individual sees his or her abilities in different contexts such as math and science) as well as external comparisons (how the student sees him or herself in science compared to the abilities of other students).

Theoretical Frameworks

Similar to academic self-concept, self-determination theory (Deci et al., 1991) also includes an individual's perceptions of him or herself as similar to and different from others. Self-determination theory is a meta-theoretical framework that includes intrinsic and extrinsic

motivation and has been applied in studies that examine career choices (Deci et al., 1991). Within this theory, motivation arises from three innate needs of learners: autonomy (being self-initiating and self-regulating), competency (understanding how to attain outcomes and being effective in attaining them), and relatedness. This last need, relatedness, includes developing secure and satisfying relationships within a social context. In career theory (Lent et al., 2002), relatedness in a science context includes the degree to which individuals see themselves as a “science kind of person” and how others (e.g., parents, teachers, or peers) see the individual as a “science kind of person.”

Although self-efficacy, academic self-concept, and self-determination theory have some overlapping components of relatedness, they are distinctly different constructs (Marsh et al., 2016). In the present study, we draw from constructs of self-efficacy, academic self-concept, and self-determination theory’s construct of relatedness to understand how youth view themselves in the context of science. We examine perceptions of past competencies in science (science self-concept), confidence to be successful in future science work (self-efficacy), and the degree to which one perceives a relationship to others who do science (self-determination theory).

The Lab Coat: A Symbol of Science.

One of the most common components found in images of scientists and doctors is the presence of a white lab coat. The lab coat image has been shown to be a powerful symbol of who does science and medicine. As noted previously, Barman’s (1997) research with the Draw A Scientist Test found that over half of all students drew a person in a lab coat in their depiction of a scientist. While the lab coat has been identified as limiting students’ images of the work of scientists who do not wear lab coats (e.g., field biologists, astronomers), educators can acknowledge the limitations of these stereotype images with students and still build students’ self-perceptions as themselves as scientists.

Other research has found that the white lab coat is associated with properties

of work such as attentiveness, carefulness, responsibility, and a scientific focus (Adam & Galinsky, 2012). Similarly, studies of physicians wearing lab coats have revealed that the lab coats are associated with patients’ perceptions of physician characteristics. For example, a study of physicians’ clothing found that physicians wearing white coats were perceived as more authoritative and somewhat more trustworthy than physicians without a coat (Brase & Richmond, 2004). The potential for a piece of clothing to elicit different perceptions of roles and careers has encouraged research on this phenomenon.

Research is emerging that shows clothing, such as the lab coat, influences perceptions and behavior of people in a variety of contexts. Within educational contexts, students’ clothing has been shown to influence peers and teachers. When youth were shown images of students wearing dressy clothing (suits and dress shoes), they were rated as more intelligent than students in images wearing faded jeans, t-shirts and tennis shoes (Behling & Williams, 1991). Other research has shown that teaching assistants who dress more formally are seen by students as more intelligent than teaching assistants that dress more casually (Morris et al., 1996).

Early childhood educators and researchers have long recognized that children are motivated by opportunities to “dress up” and try out different roles of people in their community (Zucker, et al., 2006). Dressing up and engaging in play can allow children to explore the world of work safely while learning about tools and skills that are needed for different jobs and professions. Recent research from the field of psychology has shown that the benefits of dressing in professional clothing go beyond simple play and can influence how an individual thinks and solves problems (Adam, & Galinsky, 2012; van Stockum & DeCaro, 2014). This new theory of *enclothed cognition* (Adam, & Galinsky, 2012) has shown that the clothing an individual wears can influence an individual’s perceptions of him- or herself as well as how others perceive them.

According to Adam and Galinsky (2012) enclothed cognition includes the

symbolic meaning of clothes and the physical experience of wearing them. These researchers conducted a series of studies where undergraduates were asked to wear a white coat and the researchers examined sustained attention. In the first experiment, undergraduates at a university were assigned to one of two conditions: wearing a lab coat or wearing their own clothes. The participants were given an attention task and those participants who wore lab coats were significantly more attentive to the experimental task. In additional experiments, the researchers examined other roles associated with the perceptions of the white coat. The researchers told some participants the white coat was a doctor’s coat and others it was an artistic painter’s coat, and they also found greater sustained attention on attention-related tasks among participants when they were told it was a doctor’s coat compared to those who were told it was a painter’s coat.

The present study examined whether wearing lab coats can enhance children’s perceptions of themselves as scientists as well as enhance students’ perceived science competencies (science self-concept) and perceptions of successful future science experiences (science self-efficacy). Prior educational research involving lab coats has examined the presence of lab coats in students’ perceptions of stereotypes about scientists (Barman, 1997; Farland-Smith et al., 2014). The present study sought to co-opt this commonly held stereotype of scientists, not to perpetuate the “lab coat” stereotype, but rather to provide an opportunity for students to “try on” the role of a scientist through wardrobe. In leveraging this wardrobe characteristic, students may be able to see this signature feature of being a scientist with themselves and peers. Though the path to shifting science self-concept is complex (Cooper et al., 2018), we hypothesize that the experience of wearing a lab coat may provide students with an opportunity to see themselves and others like them in the role of a scientist.

Methods

The present study is the qualitative component of a larger study on elementary

students' perceptions and experiences related to wearing lab coats (see Jones et al., 2019). Interview data were collected to examine the impact of wearing lab coats for 10 science lessons on fifth grade students' (aged 10-11) science self-concept, perceived science self-efficacy, and their perceptions of themselves as scientists. The following research questions guided the data collection and analyses:

- 1) How does wearing a lab coat during science instruction influence students' perceptions of their science competencies (science self-concept and science self-efficacy)?
- 2) How does wearing a lab coat during science instruction influence students' perceptions of themselves as scientists?

Participants

Teacher volunteers for the study were sought from four elementary schools in a rural/suburban community in the south-eastern region of the United States. All of the schools were identified as low performing (an overall mean of 34% of students performing at grade level on the state's achievement tests) and were identified as low income (an overall mean of 61% of the students eligible for free/reduced cost lunch). Four teachers who taught fifth grade students participated in the study. There were 37 students who volunteered to be in the study and completed both pre- and post-intervention interviews. Students self-identified as: African American (n=17), white (n=16), Hispanic (n=3), and Other (n=1); female (n=18) and male (n=19).

Study design. This qualitative study used interviews to examine the perceived effects of wearing a lab coat on students' science self-concept, perceived science self-efficacy, and their perceptions of themselves as scientists. Elementary teachers who taught science classes at the same grade level were recruited for the study. Participating teachers (n=4) were asked to have their students wear lab coats for 10 science lessons (approximately 40 minutes in length) but to otherwise teach the class the same. Teachers

were encouraged not to change anything about their lessons. The 10 lessons were based on the state's science curriculum. Topics taught at these grade level include forces and motion, properties of matter, energy, earth systems, and ecology.

In the state where the study was conducted, elementary teachers typically teach science 2-3 times a week, and the study took place over 8 weeks. Students were interviewed individually by a science education researcher pre and post to the 10 lessons to examine any changes in students' science academic self-concept, science self-efficacy, and perceptions of wearing a lab coat on their views of themselves as scientists.

Interview protocol. A semi-structured interview protocol (Table 1) was developed with questions that built on self-determination theory (with a focus on relatedness) (Deci, et al., 1991), self-efficacy (Bandura, 1986), and science academic self-concept (Cooper et al., 2018). The interview protocol was designed by science education researchers and was examined for validity by an expert panel composed of two science teachers, two researchers, and two university science teacher educators. The interview protocol was pilot tested four times with individual children in grades 4 and 5 to ensure that students understood and could answer the items as well as to determine if the items elicited information about the targeted constructs.

The pre- and post-intervention interviews asked students about their views of themselves as a science kind of person (science self-concept) and their perception of how peers and family view them as a science kind of person (relatedness). Students were asked questions that addressed engaging in science activities by choice (autonomy), self-efficacy for doing science across a range of activities and topics, and perceived images of scientists. The post-intervention interview protocol also included questions about changes in students' self-efficacy and science self-concept that they attributed to the experience of wearing a lab coat. Questions were also asked about students dressing up for non-science activities (art and school ceremonies).

Data and Analyses

Interviews were recorded using field notes. Field note transcriptions were read and reread by two researchers for themes and patterns that emerged from the data. Frequencies of responses were determined and codes were developed by theoretical construct to capture information across items. The theoretical construct codes included: *science self-efficacy* (beliefs in competence and ability to be successful in science in the future), *science self-concept* (view of self as scientist and in doing science based on past experiences), *relatedness* (including views by others of the student as a scientist or science person, perceptions of self within a community of science), and *attitudes and behaviors related to clothing* (included the perceptions of the lab coat, perceptions of the symbols of scientists). The experience of wearing the lab coat and changes in attitudes and behaviors as a result of wearing the lab coat were examined (see Table 2 for examples of codes). Frequencies and percentages of responses for each code were calculated. Twenty percent of the transcripts were selected at random, coded independently by two researchers and compared to establish interrater agreement (96%).

Limitations

This was a qualitative study and as such is bounded by the specific contexts and participants in this study. It is also important to note that the data represent the reported perspectives and beliefs of the participants and the degree to which the reported data match the actual behaviors and attitudes of the participants is not known. The study did not have a control group who did not wear the lab coats but instead students' perspectives were compared from pre to post-instruction. Furthermore, we did not observe instruction and only have teachers' reports that they taught their classes as they normally taught them.

Results

The Experience of Wearing A Lab Coat in Science

Students were asked if they liked wearing the science lab coat, and 34 (91.9%) reported they liked wearing

Table 1. Interview Protocol Questions and Theoretical Constructs

Interview Question	Theoretical Constructs
<i>Did you like wearing the lab coat during science class? How did it make you feel?</i>	Science Self-Concept
	Relatedness
	Attitudes and Behaviors Related to Clothing
<i>Did wearing the lab coat change your view of yourself as a scientist?</i>	Science Self-Efficacy
	Science Self-Concept
	Relatedness
	Attitudes and Behaviors Related to Clothing
<i>Do you think you took your work more seriously when you were wearing the lab coat?</i>	Science Self-Concept
<i>Some painters wear a white coat to cover their clothes. If you wore a painter's coat would it make you feel more like a painter?</i>	Attitudes and Behaviors Related to Clothing
	Attitudes and Behaviors Related to Clothing
<i>Do you think it (wearing a painter's coat) would make you feel more artistic?</i>	Attitudes and Behaviors Related to Clothing
<i>Do you think if you dress up like a doctor, would you feel more like a doctor?</i>	Self-Efficacy
	Attitudes and Behaviors Related to Clothing
<i>If you dress up for a school ceremony, do you think it changes how you act?</i>	Science Self-Efficacy
	Attitudes and Behaviors Related to Clothing
<i>Do you think how you dress changes how you think about yourself?</i>	Attitudes and Behaviors Related to Clothing
<i>Do you see yourself as a science kind of person?</i>	Science Self-Efficacy
	Science Self-Concept
	Relatedness
<i>Do people in your family see you as a science kind of person?</i>	Science Self-Concept
	Relatedness
<i>Do your friends see you as a science kind of person?</i>	Science Self-Concept
	Relatedness

the lab coat and 3 (8.1%) said they did not like wearing the coat. The three that did not like the coat reported it was hot or uncomfortable.

When asked how they felt wearing the lab coat, 29.7% of the students reported positive affective responses. Students' comments that the wearing the coat made them "happy" included statements such as: "It made me feel special," and "It feels good because I never wore a lab coat and this was my first time wearing a lab coat." Other responses from students suggested that wearing the lab coat made them feel smart (18.9%) as

evidenced in the comments from students who said the lab coat "makes me feel like a scientist," and "like I was smart." One student reported that wearing the lab coat did not change their self-perception saying "wearing it was not different from not wearing it."

Over half of the students embraced how wearing the lab coat made them feel like a scientist (51.4%). For example, students commented, "It made me feel like a real scientist," "It made us feel like real scientists and more fancy," and "It made me feel more like a scientist, not like a kid."

Students were asked if they took their school work more seriously when they wore the lab coat and 23 (62.2%) responded yes and 14 (37.8%) said no. When asked to explain, one student stated, "The coat made me smarter and [made me] push myself." Most of the students who said no, explained that they already took their work seriously.

Seeing Oneself As A Scientist: The Intersection of Science Self-Concept and Self-Efficacy

During the post interview students were asked if wearing the lab coat changed their view of themselves as a scientist; over half (59.5%) of the students said yes, and 40.5% of the students said no. Those who said yes described how the lab coat elicited different feelings about their science self-concept and their confidence in doing science. For example, students noted, "I felt more determined - it made me think harder." Another student commented, "It made me feel kind of smart and intelligent that I could pretty much do anything my science teacher could do."

In some cases, students reported that the experience of wearing the lab coat changed their perceptions of their self-efficacy for science. For example, one student reported, "It made me proud. Because it feels like I have the potential to be a scientist." Another noted, "I felt like I could do science better [while wearing the lab coat]."

For some students the lab coat made them feel like a scientist as seen in this response, "Learning science in a lab coat felt fully like [I was] a scientist." Another student said, "I felt deep down that wearing a lab coat brought out the true scientist in me." The lab coat also made one student feel an affinity to doing science as being part of a larger group, as described in this response, "When I was wearing the lab coat with my peers it was like a group of scientists working together and it would make me think of working harder to look like the other people." Students were aware of this shift in their perceptions of science as a result of the lab coat as seen in this female student's response, "[The coat] made me feel important because I felt like I was in somebody's else's shoes, it felt really good."

Table 2. Examples of Transcript Codes

Construct Codes	Selected Transcript Examples
Science Self-Efficacy	“It feels like I have the potential to be a scientist” “I felt like I could do science better”
Science Self-Concept	“Like I was smart” “It made me feel kind of smart” “It made me think harder” “My friends have seen my grades and they are not that good” “It made me feel like a real scientist”
Relatedness	“I feel like I am a young scientist” “When you dress up as a job it makes you feel more like that [job]” “Yes, [I would feel like a scientist] because I like to do things in science” “My friends see me as someone who likes science” “My parents see me as a person who likes science... I like science... I conduct experiments for my family”
Attitudes and Behaviors Related to Clothing	“It [doctor’s coat] would feel like pretend and I don’t want to operate on people” “If I am dressed nicely, I mind my manners better” “It [lab coat] made me feel special” [The lab coat] “is just a piece of cloth; It can’t change you” [The painter’s coat] “would make me feel like I could paint the Mona Lisa”

Seeing Oneself As A Science Kind of Person: Relatedness

Additional questions examined students’ academic self-concept as viewed by themselves and others. Participants were asked, “Do you see yourself as a person who likes science?” Most of the participants (83.8%) said yes in the pre lab coat interview and the number increased after wearing the lab coats (94.6%). The reasons for saying yes most often included statements that they liked being actively engaged in science such as this student, “Yes. It’s very interesting, fun and interactive. I like experiments.”

The interview protocol also presented students with scenarios designed to gain an understanding of students’ interests in playing the role of a science person both before and after the lab coat intervention. For example, participants were asked “Your school is putting on a play. Which character do you want to be: artist, writer, scientist, banker, or mayor?” Before wearing the lab coats, 35.1% of students indicated they would want the role of the scientist. After wearing the lab coats, 50% of students indicated that they preferred to be the scientist. This result suggests that the experience of wearing the lab coat had a positive impact on the students’ perceptions of the role of being a scientist.

When asked if students’ family and friends see them as a person who likes

science, most of the students reported positively with an increase from pre 70.3% to post 78.4%. There were some students on the post interview who said they saw themselves as a science kind of person but felt like their family (16.2%) and friends (24.3%) did not see them as a science kind of person. These data suggest that for some youth, there is a mismatch between their internal science self-concept and their perceptions of how others view them as science-related people.

Attitudes and Behaviors Related to Clothing: Lab Coats, Painter Coats

To examine the impact of the lab coat as a science specific experience, as compared to the role of wearing a white coat for other tasks, we asked the students during the post interview if they would feel more like a painter if they wore a painter’s coat. Seventy-three percent indicated that they would feel more like a painter if they wore a painter’s coat. One student commented in the post interview, “Yes [I would feel more like a painter in a painter’s coat], because when you dress up as a job it makes you feel more like that.” A majority of students reported that they would feel more artistic if they wore a painter’s coat. For example, one student felt artistic talent would improve, “Yes - it would make me feel like I could paint the Mona Lisa.” The majority of the students (67.6%) reported

they would feel more like a doctor if they dressed up like a doctor.

To assess the degree to which different clothing might influence students’ perceptions generically, the participants were asked if dressing up for a school ceremony would change the way they acted and 70.2% of the students indicated yes. For example, one student commented, “Yes, if I wear nice clothes I would act more calm because it’s something important.” Several of the students who replied no gave the reason that they would behave the same regardless of how they were dressed. Students were also asked whether or not how you dress changes how you think about yourself, 45.9% of the students said yes. Students indicated that by being dressed up, they felt a different set of expectations as evidenced by the following comment from a student: “Yes, [when I] wear school clothes I feel more responsible for myself and my actions.” When students said no, they explained that they are themselves regardless of what they wear.

Discussion

The results of this study showed that wearing a lab coat during science instruction made students feel “good,” “smart,” and “like a scientist.” The findings are especially meaningful because wearing lab coats for these students (most were minority students from low income backgrounds) impacted their perceptions of themselves as scientists. These data suggest that for some students wearing lab coats may be an effective strategy for enhancing science self-concept and ultimately promoting science learning as early experiences have been identified as critical in developing young students’ interest in science (Carlone et al., 2014).

Science Self-Efficacy

Science self-efficacy has been shown to be related to science career choices and interests (Betz & Hackett, 1981). There were students in the present study who reported that wearing a lab coat made them feel they could be more successful in learning and doing science in the future. This finding could influence students’ willingness to engage in science and to persist when learning science

may become challenging. If the enhanced self-efficacy suggested by these students can be sustained over time, lab coats may broaden students' potential to see themselves as scientists and impact longer-term interests and career goals.

Science Self-Concept

One of the questions of interest in this study was whether or not wearing the lab coats would enhance students' science self-concept and their perceptions of themselves as scientists. Over half of the students (59.5%) reported that their views of themselves as scientists changed as a result of wearing the lab coat. When asked if they saw themselves as a person who likes science, the majority of students said yes, with an increase from pre to post. Likewise, there was an increase from pre to post in the percentage of students who were interested in playing the role of the scientist in the school play scenario. Wearing the lab coat may have expanded students' opportunity to not only try on the role of the scientist, but also see themselves as a scientist. This shift in self-perception from pre to post indicates that wearing the lab coat may have played a role in shifting the way students feel about *who* they can be. This shift in self-perception is notable because, as students make decisions about their futures, the ability to see oneself in the role is a critical hurdle (Moakler & Kim, 2014).

The majority of students also reported that their family saw them as a person who likes science and that their friends saw them as a science kind of person. These data support findings by Archer et al. (2015a) that while many students enjoy science, fewer see themselves pursuing science as a career. Interestingly, some students in the present study reported that, although they saw themselves as a science kind of person, their families and friends did not. Studies are needed to better understand how students resolve this mismatch of the individual's science self-concept perceptions and those held by others.

Embodied Experiences

The results of this study suggest that a closer look at the theory of enlothed

cognition may provide a way to promote elementary students' self-efficacy and positive science self-concepts. Adam and Galinsky (2012) defined enlothed cognition as including the symbolic meaning of clothes and the physical experience of wearing them. The results of this study suggest that students perceived the symbolic meaning of the clothes as contributing to their perceived competence in science through their reports of feeling "more like a scientist," "smart," and "being good at science." Students reported that the physical experience of wearing the clothes made them feel like they could "do science better," and "think harder." These results support Adam and Galinsky's premise that clothing can influence behavior and perceptions of oneself within a role.

Additional research is needed to examine whether wearing lab coats has a differential impact on students depending on their original self-efficacy and science self-concept. For those students with low science self-concept, wearing a lab coat and embodying the symbol of science could enhance the salience of science, ultimately leading to a stronger science self-efficacy for learning science in the future. Before these findings can be generalized, additional studies are needed with different students, in controlled studies, and for longer periods of time.

Implications

Lab coats may prove to be a valuable tool to aid teachers in their ability to enhance students' self-concept and potentially their interest in science. The coats are relatively inexpensive, take up very little storage space, and require no additional teacher training on their use. Youth in many communities have limited access to science role models and lab coats may be an effective tool to change the way more students, in a variety of settings, see themselves in relation to science and scientists—creating an enhanced sense of relatedness to science. It would be particularly valuable if lab coats could encourage women and minorities to see themselves as future scientists, potentially helping to increase the underrepresented groups in science fields. Furthermore, it is

important to provide students with models of scientists who do not wear coats such as marine biologists or geologists working in the field, so in addition to clothing may be impactful to expose students a range of tools used in science (pH kit or pick hammer) to stimulate students' connections to science and scientists. It is not known whether or not possessing a tool would have a similar influence on a students' science self-concept or self-efficacy.

This study was with elementary students who traditionally enjoy expressing their imagined careers with uniforms and clothing (e.g., Turner, 2016). Future research that investigates the impact of clothing is needed to determine whether older students would report the same benefits from wearing lab coats.

The students in this study reported changes in their perceptions of their science self-concept and science self-efficacy. If these findings can be replicated, the lab coat may prove to be a cost-effective tool worth using to build perceived competence for science and potentially promoting students' interest and engagement in science.

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