Vocational Anticipatory Socialization of Adolescents: Messages, Sources, and Frameworks That Influence Interest in STEM Careers

Jody L. S. Jahn & Karen K. Myers

By high school, many students have dropped out of the pipeline that will lead to science, technology, engineering, and math (STEM) occupations. We examine the role of vocational anticipatory socialization (VAS)—the types of messages adolescents receive, message sources, and adolescents’ frameworks—on youth’s educational and vocational interests. Adolescents (37 focus groups, N = 229) reported that they received two types of VAS messages: personal fulfillment (advising students to prioritize their well-being) and career detail (advising students about specific aspects of an occupation). Adolescents used three career frameworks (enjoyment, ability, and goal) that filtered and often magnified VAS messages and experiences. We extend VAS research by identifying two primary purposes of the career advice embedded in VAS messages and three career frameworks. Practical implication are that parents can affect adolescents’ beliefs about their abilities and potential enjoyment of STEM careers by supplementing personal fulfillment messages with career detail messages. Individuals in STEM occupations are in the best position to encourage adolescents by offering career detail, discussing how their career can be rewarding and how math and science classes can influence their career attainment.

The research presented in this study was conducted as part of the first author’s Master’s thesis, directed by the second author. An earlier version of this paper was presented to the Organizational Communication division of the National Communication Association in 2010 in San Francisco, CA.

Jody L. S. Jahn (Ph.D. University of California, Santa Barbara) is an Assistant Professor at University of Colorado Boulder. Her research examines communication in high reliability organizations and teams, and organizational socialization. Karen K. Myers (Ph.D., Arizona State University) is an Associate Professor in the Department of Communication at the University of California, Santa Barbara. Myers researches membership negotiation (organizational socialization, assimilation); vocational anticipatory socialization; workplace flexibility and work–life balance issues; organizational identification; and interaction between generational cohorts in the workplace. Correspondence to: Jody L. S. Jahn, Department of Communication, University of Colorado, Boulder, CO, USA. Email: jody.jahn@colorado.edu

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The number of adolescent entrants into the science, technology, engineering, and math (STEM) pipeline remains a concern and opportunity for American industry, parents, educators, and researchers (Harackiewicz, Rozek, Hulleman, & Hyde, 2012; National Science Board, 2010). US universities are not graduating sufficient numbers of students with degrees in STEM disciplines (National Science Board, 2010). The opportunity rests in the well-established fact that many students choose STEM majors early, during their adolescence. A Harris Interactive (2011) survey found that 78% of college students majoring in STEM areas decided to study STEM in high school or earlier. One in five (21%) adolescents made the choice to enter STEM studies in middle school or earlier. Therefore, interaction and experiences before and during adolescence have powerful potential to affect whether students progress through the STEM pipeline by taking advanced math and science classes, select STEM majors, and eventually enter STEM careers.

In recent years, scholars in education, psychology, mathematics, engineering, and computer science have examined various reasons why the STEM pipeline is leaking. Several studies suggest educators are influential in channeling students through the pipeline. For example, they found relationships between students dropping out of STEM and the lack of female and minority role models (Hernandez, Schultz, Estada, Woodcock, & Chance, 2012), lack of classroom application to science and math (Gray & Albert, 2013), and lack of students’ engagement in research (Hernandez et al., 2012). Outside the classroom, research has underscored the role of parents in fostering initial and continued interest in STEM. Knowles (2013) found that mothers play a strong role by motivating their children’s interest in math and science from early childhood through high school. In short, we know that influential others—including teachers (Lewis, Jackson, & Waite, 2010), professionals (Solberg, Howard, Blustein, & Close, 2002), and peers (Levine & Hoffner, 2006)—also can affect adolescents’ interest in various academic subjects, which ultimately affect their career pursuits.

Researchers across disciplines have approached the STEM problem from various angles to generate greater understandings and to offer potential solutions. One common approach to explain adolescents’ educational and career choices is social cognitive career theory (SCCT; Lent, Brown, & Hackett 1994, 2000), derived from social cognitive theory (Bandura, 1986), asserting that individuals’ academic and career interests develop as a result of agency—the perception that one can intentionally influence his or her life circumstances. In turn, agency is forged as a result of felt self-efficacy and expected career outcomes, both affected by interaction with others and environmental barriers. However, SCCT does not explain how messages from influential others might reinforce, undermine or shape adolescents’ perceptions of agency, and ultimately their career choices. A second approach, expectancy-value
theory (EVT) (Eccles, 2009), specifies that individuals take on challenging tasks if they expect to succeed and they value the task or outcome. However, the theory does not explain how students are socialized to value certain tasks or careers.

We argue that common approaches to understanding the leaking pipeline involve communication threads that could be more richly explored with a vocational anticipatory socialization (VAS) approach. According to VAS, individuals develop work-related values and interests through exposure and communication that socializes them to the value and meaning of work, occupations, and careers (Jablin, 2001; Kramer, 2010). If interaction with influential others can affect students’ personal beliefs and values about STEM majors and careers, as well as their familiarity and desire to pursue them, then we can deepen the extensive research on the education-career STEM pipeline by investigating (1) the communication adolescents receive that influence their educational and career choices, and (2) the frameworks that youths may use for evaluating those messages. None of the extensive research on STEM in other disciplines has illuminated the potentially powerful formative forces of VAS communication and adolescent recipients’ framing of its meaning.

Communication Attracting Students to STEM

Adolescents receive information from a variety of sources that motivate (or discourage) them to pursue advanced math and science classes and STEM-based careers. Parents influence youths’ educational attainment (Medved, Brogan, McClanahan, Morris, & Shepherd, 2006; Strom & Boster, 2011), shape their work ethic (Gibson & Papa, 2000), and guide them about intrinsic and extrinsic rewards (e.g., satisfaction, potential income) associated with various classes (Harackiewicz et al., 2012) and careers (Hoffner, Levine, & Toohey, 2008). Parents also impart broad cultural understandings about the value of work, on how to balance family and work roles, which influence their career interests (Kisselburgh, Berkelaar Van Pelt, & Buzzanell, 2009; Medved et al., 2006), and the value of attaining higher education (Strom & Boster, 2011). They make distinctions between careers and jobs (Clair, 1996), often persuading youths to pursue a career rather than a job (Myers, Jahn, Gailliard, & Stoltzfus, 2011), and at times socialize young people to aspire to blue-collar occupations (Lucas & Buzzanell, 2004). Nevertheless, parents’ advice often is limited to their own knowledge and experiences, and thus, most parents cannot offer advice about what certain careers are like or what it takes to succeed in specific fields (Myers et al., 2011).

Many parents give gender-specific career advice which influences the types of work their children come to value. For instance, parents commonly advise sons to prepare for breadwinning careers and daughters to prepare for family obligations (Medved, et al, 2006). Gender-based role prescriptions also come from other sources such as media portrayals (Hylmö, 2006), advice from friends (Jablin, 2001), exposure to feminists ideals (Leaper, Farkas, & Brown, 2012) or the existence, or more commonly non-existence, of gender-appropriate role models (Perez-Felkner, McDonald, Schneider, & Grogan, 2012) making adolescents more vulnerable to stereotype threat. Stereotype
threat exists when individuals believe they are at risk for conforming to stereotypical characteristics of their group (Steele & Aronson, 1995). One predominant stereotype suggests that boys are better than girls in math and science. Thus, gendered messages have a powerful influence on STEM interest by contributing to role prescriptions and stereotypes about who is (and is not) suited for STEM careers.

Educational institutions are another source providing information about general job requirements (e.g., responsibility), teaching adolescents interpersonal skills, emphasizing the importance of continuing education (Levine & Hoffner, 2006), and preparing them for the transition into higher education or the work force (Solberg et al., 2002). However, adolescents’ experiences at school may impede their interests. For example, a poor grade in a math or science class can affect self-efficacy, thereby dissuading students from taking advanced science and math classes (Leaper et al., 2012). At times, math and science classroom curricula and teachers do not spark interest in STEM (den Brok, Fisher, Rickards, & Bull, 2006). Teachers’ inability to inspire, as well as differences between educators’ and students’ educational and personal priorities, inhibits students’ learning and interaction (Lewis et al., 2010).

Finally, media depictions of work life may be a useful source of career information, especially for disadvantaged youth who have few professionals in their family social networks and less exposure to certain occupations (Hoffner et al., 2006). Media portray work environments, occupational roles, material compensation, and status associated with depicted careers (Signorielli & Kahlenberg, 2001). However, media portrayals lack instrumental information about how to prepare for and pursue those careers.

As the above summary describes, most scholars approach VAS research by first identifying a source and then examining their messages about a selected topic. However, we know little about the overall scope of messages that adolescents receive that may affect their academic and career interests. As a foray into this area, Myers et al. (2011) examined VAS messages and factors that affect those messages. Among the findings, the adolescents reported messages they received from various sources that were intended to provide career direction. They clustered into five themes. Value messages directed students to pursue careers aligned with family or social ideals. Expectation messages conveyed expectations students could have about particular careers (e.g., job stability, standard of living). Prescription messages identified careers that the adolescent should pursue given their interests, talents, and/or the career’s prestige. Opportunity messages guided adolescents to consider careers that are in high demand or that need greater diversity. Description messages provided details about job-specific environments, tasks, satisfaction, and required knowledge.

Their model (VAS Model of STEM) posits reciprocal relationships among experience, personal factors, and messages received from VAS sources that are influenced by gender and socioeconomic status (SES)/culture, all affecting future academic pursuits and career interests. In the VAS Model of STEM, gender is foundational because it affects the messages that adolescents receive which contribute to role prescriptions and stereotypes, and ultimately influences educational and career interests. Students’ expectations are also affected by culture and SES. This element of the model presented some overlap with gender, because gendered messages often were
influenced by family culture. Gender and SES/culture influence three interrelated interaction-based dynamics including individual (1) experiences (discussed in the next section), and (2) personal factors, including self-efficacy beliefs, exposure, enjoyment, and resilience (discussed in the next section); and (3) VAS messages, the various messages that students received from influential sources. Although numerous studies across disciplines point to the power of communication from influential others, little is known about the types of message content that can stimulate interest in STEM, and what kinds of messages might provide instrumental guidance for pursuing STEM careers. Our first research question asks:

RQ 1: (a) What types of VAS message content, recalled by adolescents, influences their interest in STEM occupations? and (b) Which VAS messages and sources provided instrumental information for pursuing STEM occupations?

Next, we examine frameworks (Harvey, 1985) that may influence adolescents’ career choice by informing their perceptions about what STEM careers entail, whether they would find them enjoyable, and whether they think they would be successful.

Adolescent Career Frameworks

In the vernacular, a framework is “a set of assumptions, concepts, values, and practices that constitutes a way of viewing reality” (American Heritage Dictionary, 2009). Frameworks are mental structures developed by past experiences and environments, but they have an important effect on self-concept and behavior (Bahrick, Hall, & Berger, 1996). They serve as filtering and motivating mechanisms that determine how we act, react, and learn, and they ultimately protect our core personality (Story, 1998). Information from the environment, including messages and experiences, are interpreted through an individual’s frameworks.

Harvey (1985) defined interpretive frameworks about educational-career choice as evolving storehouses of knowledge that define pathways to particular occupations and lifestyles. Because individuals’ knowledge differs, the frameworks that students use to evaluate alternatives vary. Harvey found that adolescents drew from their knowledge of self to assess their options and make decisions; that is, frameworks shape what adolescents do to pursue a career path. Specifically, individuals are guided by positively framed “in-order-to” motives, which direct them to take action toward achieving desirable outcomes, while their negatively framed “because-of” motives direct them to act in ways that avoid undesirable situations or states (Schutz, 1932). Harvey’s study was limited to students’ decisions about whether to pursue higher education, rather than careers more broadly.

Gunderson et al. (2013) investigated framework development by examining the relationship between a mother’s communication with her child and the child’s motivational framework. In their longitudinal study, when the mothers used more person praise (affirming the child’s skills and talents), their children were likely to develop fixed-ability frameworks believing that abilities are more or less static and
that success is due to innate ability. In contrast, when mothers gave more process praise (affirming the child’s effort and work), their children were more likely to have incremental frameworks associated with a belief that ability is malleable, and success is attained by hard work and dedication. Gunderson et al.’s (2013) results demonstrate the link between mothers’ communication and frameworks that guide their children as they encounter challenges and eventually make decisions about their education and careers. To build on the framework concept, we define a STEM career framework as a framing device for viewing a STEM-related occupation, encompassing adolescents’ conceptions of the work environment, tasks, and required education.

Frameworks and Personal Factors

Myers et al. (2011) point to several personal factors that influence adolescents’ math and science interests and projected career plans. Personal factors refer to circumstances and predispositions that are unique to individuals, including exposure to STEM occupations (den Brok et al., 2006), self-efficacy beliefs (Bandura, Barbaranelli, Caprara, & Pastorelli, 2001), enjoyment and resilience (VanLeuvan, 2004).

Exposure is a student’s contact with a career resulting from his or her unique set of circumstances (Foskett & Hemsley-Brown, 1999), and refers to information the student encounters by chance. Racial and ethnic culture and economic class (Simpkins, Davis-Kean, & Eccles, 2006) may limit youths’ exposure to and pursuit of higher education and professional careers (Lucas & Buzzanell, 2004). Myers et al. (2011) found that some students’ interests were affected by exposure to STEM careers—contact with the environment and with a STEM professional who can provide guidance on how to pursue the career. We argue that exposure informs a student’s career framework by providing a set of expectations about tasks and work environments.

Additional personal factors such as self-efficacy, enjoyment and resilience in math and science classes contribute to students’ beliefs about whether they would be successful and happy in a STEM occupation. While self-efficacy is foundational to most career development models (e.g., Lent et al., 1994; Myers et al., 2011), Myers et al. also found that enjoyment and resilience affected adolescents’ interests. Not surprisingly, when students enjoyed math and science classes, they were inclined to consider related careers, but seeing others’ enthusiasm for a topic also sparked interest. Resilience refers to an individual’s ability to adapt to stress and obstacles and “bounce back” from failures (Luthar, Ciccetti, & Becker, 2000). Therefore, math and science self-efficacy, enjoyment, and resilience frame how adolescents understand their own abilities and interests relative to STEM careers, thus shaping their career frameworks.

Frameworks and Experiences

Direct experiences with occupations can influence career choice (Levine & Hoffner, 2006; Lubinski & Benbow, 2007). In contrast to exposure, which is non-voluntary,
experiences are opportunities that students choose. Hands-on activities inside and outside the classroom, and chances to observe or job shadow help students understand occupational environments and situate their math and science coursework into broader education and career aspirations (Myers et al., 2011). In Myers et al. (2011) study, these insights occurred by talking with or shadowing career insiders, observing a career insider’s enthusiasm about their occupation, or from viewing STEM-related TV programs (e.g., CSI and House MD). We propose that experiences in STEM career environments contribute to adolescents’ career frameworks, framing how they interpret socializing messages. Therefore, adolescents’ direct experiences with STEM occupational environments can clarify or strengthen their aspirations, connect them with career insiders, and offer instrumental information about how classes relate to a given career.

We seek to better understand the role of career frameworks in adolescents’ educational and career pursuits affecting whether they choose to leave or remain in the STEM pipeline. We examine how they frame and approach their education-career pursuits, and how frameworks affect their use of VAS messages. We ask:

RQ 2: (a) What interpretive frameworks do adolescents use in evaluating STEM-based and other occupations? (b) What is the relationship between experience and personal factors (exposure to STEM occupations, self-efficacy beliefs, enjoyment, resilience) to career frameworks? and (c) How are frameworks related to VAS messages?

Methods

Participants

This project reanalyzed data from Myers et al. (2011) in which interview data were collected from 37 focus groups involving 229 participants from five high schools located in a 200-mile area of California. Demographic data were obtained from a self-report questionnaire completed prior the focus groups. Participants included 107 males (47%), 119 females (52%), and 3 who did not identify their gender. Ethnicities included 94 Whites (41%), 79 Hispanics (34%), 8 Blacks (3%), 43 “other” (19%), and 5 students who did not specify. Students ranged from 14–19 years old, and represented each grade from ninth through twelfth (35 freshmen, 26 sophomores, 49 juniors, 115 seniors, and four students did not specify). According to the participants, 47% of their mothers and 48% of their fathers had a college degree or higher. Focus group size varied based on class size: 23 focus groups contained five to nine students, 10 focus groups had 10–12 students, and four focus groups had 13–16 students. Larger groups resulted in less equal input from all students, but we found no differences in the topics discussed or the participant views offered.

We sampled from math and science classes since these classes directly relate to STEM and often are required. This approach ensures that participants had recent experience on which to comment. Because we aimed to generate discussion among students about their interest in science and math, and in STEM careers, focus groups
were judged to be the most appropriate means of data collection. Most focus groups occurred during the students’ lunch breaks, but at two schools they occurred during class time.

Focus groups have limitations: participants can influence the responses of others, or responses can become polarized with more extreme views than the participants would offer individually (Morgan, 1997). Also, some participants can dominate discussions. However, focus groups encourage participants to offer comments and experiences that may not be shared during one-on-one interviews due to the natural, extended interaction that takes place among participants (Morgan, 1997). In addition, the group members’ responses enable immediate comparison and cross-validation of experiences and ambitions between participants that could not be achieved in individual interviews. Because girls may contribute less when in the presence of boys (Crombie, Abarbanel, & Anderson, 2000), we grouped students by gender.

In about half of the cases, students were given extra credit for their participation. Students were required to obtain parents’ permission on consent forms. An estimated 15–20% of the total students did not return their permission forms, and were not permitted to participate. Teachers did not report any systematic differences between the students who returned parental permission forms and those who did not.

Procedures

Focus groups lasted 20–40 minutes depending on arrangements with teachers. Students were told we were researchers wishing to discuss their career goals and their interest in science and math. We informed students that participation was voluntary and their teachers would not be given access to the recordings or transcripts. We requested that they not discuss the focus group conversations with others. We followed a semi-structured interview protocol concerning the following topics: (1) career interests in general and related to STEM (e.g., How have you learned about careers? Do you think you will study STEM in college? What’s made you interested in those jobs/careers); (2) influential sources of socialization (e.g., Who influenced you in thinking about careers? How? What did they say? Have your parents (teachers, others) suggested particular careers/jobs to you? Do your parents have jobs related to STEM? If so, what do they tell you about it?); and (3) connections between coursework and STEM or other careers (e.g., How do you think math and science classes will prepare you for jobs that interest you? Do your teachers say how math and science classes might help you, maybe in a job? What is important to you when evaluating careers?).

Analysis

Audio recordings of all focus groups were transcribed. The analysis built from Myers et al. (2011) model. The first author employed a constant comparative technique (Corbin & Strauss, 1990) to refine and expand the VAS message themes (RQ1) identified by Myers et al. (2011). Grounded theory (Strauss & Corbin, 1998) was
employed to define the frameworks and their potential development (RQ2) as this
area was previously unexplored. Analyzing the data for both research questions
simultaneously, the first author coded the transcripts in their entirety, initially
making notes related to socializing messages and students’ reactions to VAS. The
data were organized into categories based on content, and with as little interpretation
as possible in order to not impose theoretical frameworks into the analysis at this
stage. Broad coding themes were applied based on: (1) the VAS messages students
recalled, (2) the focus of the advice in those messages, and (3) and students’ reported
evaluations of the messages. The coded data were then re-read and compared with
initial interview notes.

First, VAS messages advised about career selection, academics and other necessary
steps toward careers. Second, sources of VAS messages included who/what provided
students with messages related to careers. Third, content of the messages included
what students reported as valuable career advice. For example, VAS message content
included advice to select careers based on interests or passions, or to select careers
that provide financial independence. The list was organized into five themes
specifying the focus of VAS messages (self-actualization, self-sufficiency, prescription,
opportunity, and career environment). The themes were further grouped into two
broader categories based on the purpose of the advice in the VAS messages (e.g., to
encourage personal fulfillment, and to provide career details). Finally, we investigated
students’ interpretive frameworks that may work as a framing device to make sense
of VAS messages. Interpretive frameworks also are found in students’ reported
responses—attitudinal and behavioral—to the VAS messages. Following Schutz
(1932), transcripts were coded for instances of students describing their positively
framed “in-order-to” motives and actions toward achieving goals, as well as their
negatively framed “because of” descriptions about avoiding unpleasant situations.
These were important indicators of frameworks that may guide their career decisions
and behaviors. We also reviewed for students’ accounts about how those beliefs and
values were formed, a potential indication of framework development (Kinlaw &
Kurtz-Costes, 2007). In addition, the data were examined for explicit and implicit
links between how students made sense of VAS and how they reported using or
dismissing it relative to their interests. For instance, we wanted to know whether
advice “to pursue one’s passion” generated STEM career interest in students who
reported enjoying math or science classes.

In reporting our results, we note the frequencies with which students reported the
VAS messages and frameworks. Following Boyatzis (1998) we enumerate our
qualitative findings in two ways to note comparisons within categories. First, because
gender is an ongoing concern in STEM research, we report the number of times boys
and girls recount receiving VAS messages, and their frameworks. Second, for
messages from multiple sources, we report the number of times the message was
attributed to each source. In both cases, enumeration aids in interpreting the
qualitative findings.

Validation checks are recommended as a means for reducing the chances of
misinterpretation (Bryman, 1988; Maxwell, 2013). Following the data analysis, we
presented details of our findings and solicited feedback from students in a university freshman seminar. Although these students were not part of the original participant pool, the 18 students were similar in age and background to respondents in the study. At the time the data were collected, they too were in high schools in the region. We presented details of our findings rather than refined models which may cause the individuals to “swallow these macro findings whole because these read so ‘scientifically’” (Miles & Huberman, 1994, p. 276). The students indicated that they understood our codings and agreed that our interpretations reflected their experiences. This additional step gave us confidence in our claims (Miles & Huberman, 1994).

Findings

VAS Messages and Sources

The first research question concerned the types of VAS messages that generate student interest (or lack thereof) in STEM occupations and the sources of those messages. In response to RQ1, we found two message types (see Table 1): personal fulfillment messages advised students to prioritize their well being in their occupational plans, and career detail messages advised students to notice and prioritize specific aspects of an occupation.

**Personal fulfillment messages.** Personal fulfillment messages were broad-based messages that advised students to pursue interests, provide for themselves, or use their strengths in targeted ways. They focused on the student’s well being and contained little career information. These messages comprised the majority of VAS content from participants’ parents. Analyses revealed three types of personal fulfillment messages: self-actualization, self-sufficiency, and prescriptions.

**Self-actualization messages:** Self-actualization messages advised students to pursue an education and career path maximizing their talents or interests. These messages were gleaned through observation and experience, or received verbally through advice to

<table>
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<tr>
<th>Table 1</th>
<th>Frequency of responses for VAS messages.</th>
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<tr>
<td>Message focus</td>
<td>Frequency of responses</td>
</tr>
<tr>
<td><strong>Personal fulfillment</strong></td>
<td></td>
</tr>
<tr>
<td>Self-actualization</td>
<td>24</td>
</tr>
<tr>
<td>Self-sufficiency</td>
<td>45</td>
</tr>
<tr>
<td>Prescription</td>
<td>24</td>
</tr>
<tr>
<td><strong>Career detail</strong></td>
<td></td>
</tr>
<tr>
<td>Opportunity</td>
<td>2</td>
</tr>
<tr>
<td>Career environment</td>
<td>28</td>
</tr>
</tbody>
</table>
“pursue your passion,” “whatever you do, do it for yourself,” and “use your talents.” Parents (and close family members) were the sources for 27 self-actualization messages for boys and 24 for girls. In five cases, self-actualization was related to movie themes in which the movie character capitalized on his/her passions. These messages were frequent across the focus groups, and did not appear to be associated with SES backgrounds.

Self-actualization messages were broad and not explicitly linked with particular STEM occupations. While self-actualization messages might be intended to empower, they provided youth with little instrumental information about how to “do what you love.” Instead, students appeared to search for what it would mean to “pursue a passion.” For instance, one girl stated: “We had a psychologist [guest speaker] and the way he spoke about his career—like his passion for it—made me think about my passion [for psychology]. Maybe I will have the same passion he has.” This excerpt suggests that the student observed a career insider’s enthusiasm, which concomitantly revealed a path for realizing the VAS self-actualization message “follow your passion.”

**Self-sufficiency messages:** VAS sources encouraged adolescents to follow paths ensuring financial security or steady employment. These messages also may be gleaned through observation or experience as broader cultural, familial, or gendered values. Self-sufficiency messages were conveyed verbally as advice: “provide for your family,” “find a stable career,” “be financially independent.” These messages occurred 45 times for girls and 21 times for boys. Boys were advised to pursue well-paying careers that “put food on the table;” girls were encouraged to pursue occupations enabling financial independence so they do “not have to depend on anyone else.” Students said parents and other family members emphasized the importance of pursuing a career as opposed to a job, to ensure their financial independence. Many students confirmed that parents encouraged their interest in STEM-related careers that pay well, are relatively stable, and require higher education. A student whose parents coaxed him to enter a financially lucrative career conveyed his impression that people in STEM careers are well compensated: “Usually [STEM] professions are very highly paid, so I am very encouraged to go in that direction.” This statement reflects his personal desire (and parental pressure) to earn a high salary, but also reflects VAS conversations with parents who directed his attention toward types of careers that pay well. Self-sufficiency messages appeared across focus groups regardless of SES.

**Prescriptive messages:** Prescriptive messages identified specific careers corresponding to the receiver’s talents or interests. These messages were directives, such as “you love arguing—be a lawyer,” “look into engineering—don’t waste your math skills,” and “you’re good with animals, you should be a veterinarian.” Prescriptive messages are more pointed than self-actualizing and self-sufficiency messages; rather than offering broad-level advice, they direct the student to enter a particular occupation. Boys reported 24 occurrences while girls reported 27. Parents were sources of prescriptive
messages, but students varied in their receptiveness. Students like this boy demonstrated resistance, “My mom forces the idea of becoming a doctor...Push from her, led me into a different direction.” Other students were receptive to parental career advice; this boy’s astrophysicist father encouraged him to look into astrophysics, “He said go check it out and I said ok. It sounds pretty fun.” Prescriptive messages did not appear to be associated with particular SES levels.

**Career detail messages.** A second focus in VAS messages about STEM occupations included career details. These occupation-specific messages pointed to opportunities in particular careers, details about day-to-day life, and work responsibilities. Information about careers was focal; the individual’s personal attributes and motivations were backgrounded. The majority of these messages came from career insiders, often professionals the student had shadowed. Students at all five schools reported that their school’s job-shadow program required that they make their own contacts with professionals. Thus, career insiders typically were people in the students’ family networks, including extended family members and family friends, but typically excluding parents (whose occupations rarely interested the students). These include opportunity and career environment messages.

**Opportunity messages:** Opportunity messages encouraged receivers to consider education or career paths in sectors that actively pursue gender or ethnic diversity, or have labor shortages. Verbal messages include, “we need more women in the medical field,” or “there’s a shortage of engineers in this country.” Opportunity messages occurred twice in boys’ focus groups and twice in girls’ focus groups, at middle- and high-SES schools. Students reported that opportunity messages came from career insiders with whom they had contact (e.g., extended family members, friends of the family) but not from parents. For example, a male respondent reported: “My cousin wants me to be an engineer. [He said] that engineering is a good field to go into because there is a low rate of math teachers and engineers...and high demand.” A female similarly stated: “My uncle who’s a cardiologist is always encouraging me to follow the medical field because they need more women doctors.”

**Career environment messages:** Career environment messages conveyed details about job-specific environments, tasks, satisfaction, and required knowledge. Career environment messages came from watching someone perform the job, either in person or on TV. These messages enabled adolescents to project themselves into the work environment, imagining the work and whether they would find particular careers satisfying. Boys’ focus groups revealed 26 career environment messages; girls’ revealed 28. A student described her impressions about the job environment of a pediatrician’s office based on childhood exposure: “[Y]ou’re in an environment where it’s enjoyable, where it gives back, so that’s why I’m tending to follow the steps to becoming a pediatrician.”

Students reported that TV shows about forensic science and medicine affected their career interests. They mentioned CSI (*Crime Scene Investigation*) had inspired them to consider science-related occupations. CSI portrays scientists working in a
Students’ Frameworks and Responses

Research Question Two asked (a) what frameworks adolescents use in deciding whether to pursue STEM occupations, (b) how those frameworks were formed, and (c) how frameworks are related to VAS messages. Frameworks inform career interests by connecting career aspirations with students’ experiences. Analyses identified three STEM career frameworks: enjoyment-based, ability-based, and goal-based (Table 2). Data provide evidence for these linkages, although career frameworks formed as a result of the wide array of students’ VAS.

Enjoyment-Based Career Frameworks

An enjoyment-based career framework was evident when students’ enjoyment of math or science class work stimulated their interest in pursuing a STEM career. The enjoyment-based career framework was the most common across the focus groups (22 occurrences for boys, 24 for girls). In part, this framework appeared to be formed by self-actualization messages. VAS self-actualization messages to “pursue your passion” act as a career frame between students’ experiences and their career interests. The broader implicit messages students incorporated into their frameworks were: “pay attention to what you enjoy in order to find a career that fulfills your

Table 2 Frequency of responses for STEM career frameworks.

<table>
<thead>
<tr>
<th>Framework</th>
<th>Frequency of responses</th>
<th>Percent of total (%)</th>
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<tbody>
<tr>
<td>Enjoyment-based</td>
<td>24, 22</td>
<td>48.9</td>
</tr>
<tr>
<td>Ability-based</td>
<td>8, 9</td>
<td>18.1</td>
</tr>
<tr>
<td>Goal-based</td>
<td>22, 9</td>
<td>33.0</td>
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</table>
passion,” or conversely, “avoid jobs that are related to subject matter you do not enjoy because of potential career dissatisfaction.”

This framework was apparent in a student’s explanation for pursuing aerospace engineering: “I have always loved math. Then I took physics. It is like a math-based science, so of course I really liked physics too. And that field [aerospace engineering] has a lot of math and physics in it.” He made a connection between what he learned in his classes and what he expected in the career. Thus, he was interested in an engineering career in order to continue doing what he enjoyed: math and physics. Another student explained that she became interested in psychiatry because she enjoyed her psychology course: “I had a psychology class last year. It was the only class that really interested me. I like how you get into the mind and human behavior.” These students described their career interests as originating with enjoyment of coursework.

Similarly, lack of enjoyment in math and science acted as a framework that turned students away from STEM careers. After describing that he disliked physics class, this boy stated, “Even though physics is useful because there are some booming industries [in STEM fields], you don’t want to be doing something that you don’t have a passion for—going to work would be a chore. So even though science and tech are good industries, you just don’t want to dive into [doing physics] as a job.” Here, the student’s lack of enjoyment of his coursework made him uninterested in STEM occupations in which he might encounter physics concepts. Thus, enjoyment frameworks appeared to amplify the effect of self-actualization VAS messages to find a pleasurable career and avoid careers that are not.

Personal factors additionally shaped the development of the career framework. Once formed, the framework appeared to filter (or moderate) VAS messages. For instance, having access to occupational information (e.g., through the exposure provided by family or from career environment VAS messages) can socialize students about the realistic positive and negative aspects of a career. Students who said they did not have access to STEM career environments seemed to anticipate their enjoyment of a STEM career solely based on whether they liked their math and science course work. In contrast, exposure to a career environment can inform an enjoyment framework, helping students judge potential career satisfaction based on the job’s actual tasks or environment rather than on impressions about the career that are gleaned from math or science classes. Enjoyment frameworks are also related to self-efficacy, the individual’s belief that he or she is able to exercise influence over aspects of his or her life (Bandura et al. 2001). An enjoyment framework might reinforce VAS messages to “pursue your passion” for students who have positive self-efficacy beliefs and who enjoy school work.

**Ability-Based Career Framework**

An ability-based framework was associated with adolescents focusing on their successes, failures, and aptitudes. An individual had an ability-based framework when his or her aptitude in math or science was the basis for pursuing or not pursuing a STEM
career. Students talked about ability as though it was fixed rather than as a set of skills to be developed. These students may have been subject to stereotype threat, fearing that others perceive them incompetent because of a stereotype (Steele & Aronson, 1995). Some students in every focus group reported that past math and/or science experiences involved struggle or poor performance. Discussion of ability demonstrated a career framework when students said that their ability (or lack of) was the primary driver of their career interests. Such was the case with nine boys and eight girls.

The ability framework functioned as follows: “pursue a particular career (e.g., medicine) in order to capitalize on strengths (e.g., in biology).” The ability framework also informed students’ career intentions when they felt they lacked ability in a subject. For example, when asked why she was planning to be a veterinarian, one girl received a prescriptive message from her mother suggesting that she become a veterinarian because: “I’ve always been really good at biology, understanding cells and stuff.” Conversely, one boy’s parents encouraged him to pursue architecture because he was so interested in designing buildings. However, he described his ability framework when he said, “you need to be somewhat talented in math, more given to understanding it. And I’m not, so I decided [architecture] wasn’t for me.” Hence, his ability framework informed his career interests as follows: “avoid STEM careers because of lack of math (or science) ability.” Of the nine ability frameworks reported by boys, four referred to their lack of ability; for girls, three of the eight ability frameworks referenced a lack of ability.

Goal-Based Career Framework

The goal-based framework centered on specific targets the student knew he or she must reach in pursuit of a desired outcome. Like enjoyment and ability frameworks, this framework incorporated an adolescent’s understanding of a STEM career and their expectations about the knowledge and education required for that career, but the goals were unrelated to talents or enjoyment of the tasks. This framework emerged 22 times for girls and 9 times for boys. Students with goal frameworks discussed their classes as merely part of pursuing a larger STEM career goal—often related to a desired identity. A female student said, “I just know I want to be in medicine. It runs in my family.” A male student said, “I want to do engineering to make good money.” Students with goal frameworks reported that they might face challenges, but understood how to deal with them. One student described potential challenges related to her goal:

Girl: I know [that pursuing a neurobiology career is] going to be much more of a struggle than it is now, but I feel that with the classes that I’ve already taken and the experience that my mom [a microbiologist] tells me about, and taking extra courses outside of school and tutoring, I’ll get comfortable.

This excerpt illustrated the goal-based framework and demonstrates the importance of personal factors in shaping the framework. Her quote illustrated resilience: rather
than viewing challenges as opportunities to fail (as students described in relation to
the ability-based framework), she anticipated how she would prepare to overcome
challenges. Implicit was self-efficacy—that she was able to exercise influence over her
life. The student mentioned that socializing conversations with her mother and
exposure to her mother’s microbiology occupation helped her understand how to
prepare for challenges. Thus, VAS conversations can help students gain familiarity,
which demystifies and makes pursuing the occupation less intimidating. As a result,
students can focus on developing their self-efficacy and resilience, which can
motivate them to persist through difficulty. Therefore, adolescents with goal-based
frameworks appear to associate goal attainment with hard work rather than innate
ability (Gunderson et al., 2013), and might be more receptive to VAS messages that
help them meet their goals.

For students who held non-STEM goals, the goal framework justified their
avoidance of taking challenging science and math classes. This boy explained, “unless
you know you’re going into engineering or you’re going to be a chemist or something
along those lines, you’re probably not going to take an advanced course in, like,
calculus because it’s not going to come in handy.” The student felt he would not need
advanced math and science courses in order to pursue the career that interested him.

Goal frameworks were shaped by exposure and interaction that led to strong
familiarity with an occupation. Occasionally the goal frameworks appeared to be
influenced by self-sufficiency messages, which girls received more than boys (45 and
21 occurrences, respectively). SES may play a role when students set career goals that
help them avoid financial struggles that have affected their families.

Discussion and Implications

This investigation addresses the shortage of US STEM workers by examining VAS
messages and career frameworks that may remove adolescents from the STEM
pipeline. First, results emphasize that students must have opportunities to learn
about STEM careers either through experience, exposure or VAS messages to give
them a context for math and science coursework. However, adolescents report
difficulty in accessing STEM career information unless they have a personal
connection with a career insider. We do not suggest that any one particular VAS
message will convince adolescents to pursue STEM-related careers, nor do we
minimize individual preferences and characteristics in academic and career interests.
However, this study supports the crucial role of socializing agents such as parents,
career insiders, and educators who can cause students—who might not otherwise—to
consider STEM occupations.

Second, we found that students learn surprisingly little about STEM careers from
the VAS sources most immediately accessible to them. Parents—the most cited
source of VAS messages—offer little information about STEM unless they are
themselves STEM career insiders. Science and math courses appeared to generate
interest in STEM careers when students had positive and successful experiences.
Educators and guidance counselors were not mentioned as influential sources. In
addition, negative experiences in math and science classes strongly influenced students to believe that STEM careers were not viable options. Further, students were tasked with personally pursuing and setting up their own job shadowing opportunities. Connections with STEM career insiders were crucial sources for information and mentoring, but many students had to venture beyond parents and everyday experiences to learn about STEM careers, what the career paths entail, and why these careers are rewarding.

Third, we found three career frameworks and evidence about their origination. VAS messages communicating the importance of doing what you love appeared to shape a career framework that prioritized studies and careers in which students found joy. Ability frameworks were developed when students experienced success (or lack of success) in math or science classes or when they learned that they had abilities that could translate into STEM careers. Finally, at times adolescents had been exposed to and set their sights on a particular career, often because they associated it with a desired identity or lifestyle (goal framework). Once formed, the frameworks appeared to work as framing devices filtering and at times magnifying VAS messages and experiences that aligned with their perspectives. For example, goal frameworks appeared to focus adolescents’ attention on VAS messages and experience that would help them attain their goal.

Implications

This research extends VAS research and contributes to the STEM pipeline discussion in several ways. First, the present study extends research on VAS messages by identifying the two primary purposes of the career advice embedded in messages; our data allowed us to make a distinction between messages that emphasized personal fulfillment versus career details. Further, like Myers, et al. (2011) we found prescription and opportunity messages, but further defined value, expectation, and description messages with more precise labels—self-actualization, self-sufficiency, and career environment messages, respectively. Moreover, we extended research that identified primary VAS sources (Jablin, 2001) by linking VAS message types to sources.

Second, we underscored that career frameworks—guiding structures that develop from communication and life experiences (Bahrick et al., 1996; Story, 1998)—influence students toward STEM and other careers. Career frameworks form as a result of VAS messages, personal factors, and experiences, and they have reciprocal influence by shaping the effects of VAS messages, personal factors, and experience. This suggests that parents and others can affect adolescents’ career frameworks and also how their adolescent receives future VAS messages, experiences, and exposures.

Third, these findings also enhance SCCT and EVT. SCCT affirms that academic and career interests originate, develop and form as a result of self-efficacy, outcome expectations, and personal goals (Lent et al., 2000) while EVT claims that individuals undertake challenging tasks when there is a good chance of success (Eccles, 2009). Individually, these models offer distinctive perspectives on developmental processes
and contribute to understanding how adolescents develop academic and career interests, but the role of communication is secondary. Our results indicate that frameworks interact with VAS messages to influence adolescents’ feelings of agency, self-efficacy, outcome expectations, and personal goals.

**STEM Implications and Recommendations**

The study reveals how VAS messages and career frameworks influence adolescent interest in STEM occupations. We offer recommendations to assist parents, educators and others in crafting messages and otherwise encouraging adolescents’ interests in STEM-related studies and careers.

First, parents are powerful sources of VAS, but they often provide personal fulfillment VAS messages, which tell students little about the details of careers. Personal fulfillment messages seem to cause the enjoyment-based framework. One STEM implication of the enjoyment-based framework is that even students who are moderately challenged in math and/or science courses may dismiss STEM careers outright, considering them unpleasant, even though math and science class work may not reflect STEM job tasks (Simpkins et al., 2006). We recommend that parents, particularly those in STEM occupations, supplement personal fulfillment messages with more informational career detail VAS messages. These messages should be given to their children and also to adolescents in their extended families and local areas, because access and information about STEM careers can be limited, particularly in underrepresented communities (see Crisp, Nora, & Taggart, 2009). Math and science educators can provide career detail VAS messages by making more linkages between classes and STEM occupations.

Second, students’ emphasis on their lack of ability in science and, particularly math was a common justification for not being interested in STEM careers. The ability-based framework developed from personal factors, especially self-efficacy and resilience, as students forcefully described that their lack of ability played a key role in their career interests. Our study parallels Gunderson et al. (2013) findings that a focus on inherent ability can create fixed views of one’s aptitudes, which causes students to give up on STEM following struggles in math and science courses. Further, stereotype threat may particularly influence girls who fear that they confirm negative stereotypes about females’ lack of ability in math and science (Steele & Aronson, 1995). Research suggests that students are able to overcome these beliefs when adults explicitly discuss with them that their ability is not innate and that math or science proficiency can be developed (Aronson, Fried, & Good, 2002). These conversations, initiated by parents, educators and career insiders, could be effective at reframing how adolescents view their coursework, and ultimately their perceptions of whether they would be successful in STEM occupations.

Third, goal-based frameworks were based on career detail messages about STEM careers, provided a context for students’ coursework and gave them clear reasons for learning. Having a context for upcoming challenges helped to galvanize students’ interest in the career and motivated them to persist through difficulty in math and/or
science courses. Our goal-based framework echoed Gunderson et al.’s (2013) findings that students who view their abilities as malleable attribute success to hard work and will likely persist in STEM occupations. Thus, messages from career insiders who can contextualize the importance of science and math courses, and who emphasize hard work over ability, can play a key role in alleviating the leaking STEM pipeline. However, career detail messages were difficult for students to obtain. Even students from high socioeconomic backgrounds whose parents were college educated in non-STEM fields indicated that they depended on their connections with people outside of their immediate family to provide instrumental information about STEM careers. Students with insular family networks without a STEM career insider, or students from low socioeconomic communities would likely have less access to information that could generate their interest in STEM careers.

Organizations within STEM fields (e.g., technology firms, hospitals, engineering firms, etc.) should work with high schools to create job-shadow opportunities that specifically provide exposure to job tasks and environments. Students must have opportunities to interact with career insiders who can discuss their educational backgrounds—especially how math and science classes affected their career attainment. It is essential that they emphasize how their career is rewarding or fun to give students motivation to persist through challenging courses.

Conclusions and Future Directions

This study contributes to our theoretical understanding about the foundational role of communication and career frameworks. The investigation links VAS theory to the current STEM crisis by identifying types of VAS messages adolescents receive and common sources of those messages. Our findings reveal that parents, career insiders, and media communicate most VAS messages related to math, science, and STEM-based careers. They socialize by providing career detail or encouraging personal fulfillment. We also identified a missing element of VAS research—the influence of adolescents’ career frameworks. Career frameworks have a powerful effect on career pursuits by moderating VAS messages, experiences, and other personal factors.

Future research should empirically test whether VAS messages with different themes are linked to particular career frameworks, as our data suggest, and investigate whether certain message types are more influential than others. From a communicative perspective, it is important to study how and why the receiver is oriented to future careers and thus how he or she frames VAS messages. Such research should examine the magnitude of adolescents’ particular career frameworks, their susceptibility to particular VAS messages, and whether certain types of messages are associated with factors like gender, socioeconomic status and culture. Results should be compared with current STEM professionals’ retrospective accounts of memorable messages and influences on their choice to enter STEM curricula and careers.
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Notes

[1] Many students were in these classes because of state mandates and college preparation guidelines. Most universities in the state require three years, but high schools recommend four years of math. High schools recommend three years of science.


References


