

Does Chemistry Offer what I Want? Associations of Socio-demographic Background, Perceived Affordances and Field Belonging

Anna-Lena Dicke, Nayssan Safavian, Yannan Gao & Jacquelynne S. Eccles

University of California, Irvine

Abstract:

To address high STEM college attrition rates, it is critical to understand what motivates undergraduates' pursuit of STEM. The current study investigated the association of a diverse socio-demographic background with different types of perceived chemistry career affordances (prosocial, other communal, and agentic) and their association with students' feelings of field belonging. In a socio-demographically diverse sample of undergraduates in a gateway chemistry course, female and ethnic minority students showed a stronger endorsement of career affordances. All three types of career affordances were associated with students' feelings of belonging in the chemical and health sciences field. This study advances our understanding of ethnically diverse students' understanding of the affordances provided in a particular STEM career.

Dicke, A-L., Safavian, N., Gao, Y., & Eccles, J. S. (2019). *Does chemistry offer what I want? Associations of socio-demographic background, perceived affordances and field belonging*. Paper presented at the annual meeting of the American Educational Research Association, San Francisco, CA.

*Analyses are ongoing and manuscript is in draft.

For more information, please contact: adicke@uci.edu

The research reported here was supported by the Institute of Education Sciences, U.S. Department of Education, through Grant R305A170160 to the University of California, Irvine. The opinions expressed are those of the authors and do not represent views of the Institute or the U.S. Department of Education.

1. Objectives and theoretical framework

Science gateway courses are the entryway into the science education-to-workforce pipeline (President's Council of Advisors on Science and Technology, 2012). However, high attrition rates of 30% or more are common in undergraduate science gateway courses and especially in chemistry—with rates being even higher for underrepresented ethnic minority students and first-generation college-going students (Chen & Ho, 2012; Radford, Berkner, Wheelles, & Shepherd, 2010).

To address this issue, it is critical to understand what motivates undergraduates to pursue and persist in their STEM and STEM-related (science, technology, engineering, and mathematics) educational and occupational endeavors. One important factor of consideration is the various personal, occupational, and social goals that students espouse and their corresponding perceptions of how certain careers can fulfill their desired goals (i.e., goal affordances). Building on extensive work on social roles, research on goal affordances has focused on two important goals: agentic and communal goals (e.g., Pohlmann, 2001). Agentic goals describe one's desire for self-actualization through achievement, status and excitement. Communal goals describe one's desire to connect and work with others and help others. Agentic and communal goals have been linked with STEM career interests such that Diekman and colleagues (2010) found that the endorsement agentic goals facilitated undergraduates STEM career interest whereas communal goals inhibited such interest.

Perceptions of STEM career affordances vary meaningfully by students' gender, ethnicity, and socio-economic status. Females report a stronger endorsement of communal goals than males (Diekman & Steinberg, 2013; Morgan, Isaac & Sansone, 2001). Diekman and colleagues (2010) also found that the stronger endorsement of communal goals by females is one potential mediating factor explaining lower levels of STEM career interest reported by females. Communal goals are also more frequently endorsed by first-generation college-going (FG) and underrepresented ethnic minority college students (Smith, Cech, Metz, Huntoon, & Moyer, 2014; Stephens, Fryberg, Markus, Johnson, & Covarrubias, 2012). Hispanics, Native Americans, and FG students especially value giving back to their communities (Fryberg & Markus, 2007; Piff, Kraus, Côté, Cheng, & Keltner, 2010; Thoman, Brown, Mason, Harmsen, & Smith, 2015). However, more research is needed on how STEM career affordances, particularly communal affordances, vary for students from the whole spectrum of ethnicities represented in higher education.

Communal goals are often perceived as inconsistent with the culture of science (Piff et al., 2010; Thoman et al., 2015). Thus, students' perceptions of the communal affordances of STEM careers are particularly important to ensure STEM motivation and career pursuit (e.g., Diekman et al., 2010, 2011; Smith et al., 2014; Thoman et al., 2015). Further research is needed on other mechanisms through which perceived agentic and communal affordances of STEM careers might impact STEM students' success and persistence. Diekman and Steinberg (2013) argue that students are more likely to develop a sense of belonging when their environment is

perceived as congruent with the goals they value. This is especially significant in that students' sense of belonging is predictive of their academic achievement and persistence (Strayhorn, 2012).

Building upon previous research and addressing existing research gaps, the current study aims to investigate the association of a students' gender, ethnicity, immigration and socio-economic status with their perceptions of career affordances (prosocial, other communal and agentic) and, in turn, their feelings of field belonging. Using an exceptionally diverse sample of undergraduates enrolled in a gateway chemistry course, we pose the following research questions:

RQ1: How is students' socio-demographic background (i.e., gender, ethnicity, immigration and socio-economic status) associated with their perceived career affordances (prosocial, other communal and agentic)?

RQ2: How are chemistry students' perceived career affordances (prosocial, other communal and agentic) and their sociodemographic background associated with their feelings of field belonging?

2. Methods and Data Sources

The current study used data from students enrolled in a ten-week gateway chemistry course at a large public university in Southern California. Students were surveyed about their attitudes online at the beginning of the course. Students received \$5 for the completion of the survey. The current study utilizes data from 498 students (66% female, 42% Hispanic, 42% Asian, 9% Caucasian, 58% FG) enrolled in three sections.

Measures:

Career affordances. Students' perceptions of affordances of a career in the chemical and health sciences were assessed using an adapted instrument from Johnson (2002) and Thoman et al. (2015). The item stem "I expect that a career in the chemical and health sciences would allow me to..." was used to assess three types of affordances: *prosocial*, *other communal*, and *agentic affordances*. *Prosocial* affordances measured the extent to which the career allowed students to help others (7 items, $\alpha = .96$, e.g. "give back to my community"), *other communal* affordances measured the extent to which the career allowed students to make a connection with others (2 items, $\alpha = .92$, e.g. "develop a connection with others"), and, lastly, *agentic* affordances measured the extent to which the career allowed students to fulfill independent motives (7 items, $\alpha = .88$, e.g., "earn a good income"). Items were assessed using a 7-point Likert scale (1= "Not at all", 7= "Very much").

Field belonging. Field belonging assessed students' feelings of belonging in the field of chemical and health sciences using a 5-item Likert scale ($\alpha = .70$, e.g., "I identify with the

chemical and health sciences.”). The response scale ranged from 1= “Not at all true” to 7= “Very true”.

Gender. Students’ gender was dummy coded (1=Female).

English as first language. English as first language was used as a proxy for students’ recency of immigration (generation in the U.S.). Students were asked to report whether English was their first language (1= yes).

Socioeconomic status (SES). Three different measures were used to assess students’ socioeconomic status holistically. Students’ reports of parents’ education level were recoded to capture whether student were *first-generation college going* students (1= Parents did not complete Bachelor’s degree). *Family income* was assessed using a single item (“Please indicate what your family’s income was when you were in your last year of high school”; 1= < \$15,000, 8= > \$150,000). Students’ *perceived social status* was assessed using the following item: “Think of this scale as representing where people stand in the United States. At 10 are the people who are the best off – those who have the most money, the most education, and the most respected jobs. At 1 are the people who are worst off – who have the least money, least education, and the least respected jobs or no job. The higher up you are on this scale, the closer you are to the people at the very top; the lower you are, the closer you are to the people at the very bottom. Where would you place yourself on this scale?”.

Ethnicity. Student-reported ethnicity was recoded to identify the largest ethnic minorities: 1= Caucasian, 2= Hispanic, 3= Asian, 4= Other (including Black, American Indian, Middle Eastern, Pacific Islander).

To investigate our research questions, two sets of ordinary least squares (OLS) regression analyses tested the associations between constructs of interest. The association of students’ gender, ethnicity, immigration and socioeconomic status with perceived career affordances (*prosocial, other communal, and agentic*) were modeled separately for each type of career affordance. In addition, each of the three SES measures were modeled separately as multicollinearity was of concern. Field belonging was regressed on career affordances while controlling for students’ sociodemographic background separately for each type of career affordance to assess the associations of perceived career affordances and field belonging. Specifically, field belonging models were examined separately for each perceived career affordance and each of the three SES measures. The FIML approach in MPlus 7.1 was used for missing data (Muthen & Muthen, 1998-2013).

3. Results

Descriptive statistics and correlations can be found in Tables 1 and 2, respectively. Students showed moderate to high endorsement of all three types of career affordances. All three types of career affordances were highly correlated ($r = .73-.83$) and also correlated with field belonging ($r = .21-.26$). Correlation patterns reveal that Hispanic students were more likely to be FG college-

going, and more likely to report lower family income and perceived SES relative to Asians or Caucasian students.

Findings regarding our first research question investigating the association of students' sociodemographic background with students' perceived career affordances can be found in Table 3. Previous findings were corroborated as female students were statistically significantly more likely to endorse all three types of career affordances than male students. Students' ethnicity was associated with endorsement of affordances with Hispanic, Asian and students of other ethnicities reporting stronger endorsement of *other communal* affordances than Caucasian students. Hispanic students also reported stronger endorsement of *agentic* affordances. Due to small sample sizes (e.g., $n = 43$ for Caucasian students), the findings regarding students' ethnicity need to be regarded as preliminary. Continued data collection in the near future will facilitate a closer investigation of the role of ethnicity in the endorsement of career affordances as the sample size is increased. Future analyses will allow for subgroup analyses within distinct ethnic groups (e.g., Southeast Asian vs. East Asian) to explore the distinct cultural differences in perceived career affordances.

Findings regarding our second research question examining associations of perceived career affordances and sociodemographic background with perceived field belonging can be found in Table 4. All three types of perceived career affordances (*prosocial*, *other communal*, and *agentic*) were positively associated with students' field belonging (i.e., higher perceptions of affordances provided through a career in the chemical and health sciences). Considering students' socio-demographic background, field belonging was associated only with students' subjective perceptions of their social standing.

4. Scientific significance

The findings of the current study corroborate and extend previous findings in important ways. Our study replicated the finding that females report higher levels of prosocial and other communal affordances than males. However, at the same time, they also reported higher levels of agentic affordances. This finding contradicts some of the previous work showing similar levels of agentic affordances reported by males compared to females. This might indicate a shift in paradigm. This finding is particularly interesting as the sample under investigation was comprised of a socio-demographically diverse sample including only 9% of Caucasian students and representing a wide variety of ethnicities that have not been studied extensively yet. The found gender difference for agentic affordances might, thus, also be connected with the specific ethnic background of our sample. In addition, the preliminary findings with regards to ethnicity show that perceived affordances vary by ethnicity. Continuing data collection will allow for an even more nuanced investigation of the associations of ethnicity and perceived career affordances, potentially allowing for the investigation of interactions of gender, SES and ethnicity. Understanding how different cultural backgrounds relate to students' understanding of

the possibilities provided in a chemistry career will help us understand the reasoning behind STEM career decisions made by a student group at risk for dropout.

Lastly, all three types of affordances were significantly associated with field belonging. This indicates that perceiving a career as fulfilling to any type of goal leads to higher feelings of belonging. This might be particularly noteworthy when it comes to supporting the student populations most at risk by highlighting how personal and social values can be fulfilled through the pursuit of a STEM career. Future research will now need to look into how these initial beliefs influence the development of students' feelings of belonging and their long-term success and persistence.

References

- Chen, X., & Ho, P. (2012). STEM in postsecondary education: Entrance, attrition, and coursetaking among 2003–04 beginning postsecondary students (NCES 2013-152). Washington, DC: National Center for Education Statistics, Institute of Education Sciences, U.S. Department of Education.
- Diekman, A. B., Brown, E. R., Johnston, A. M., & Clark, E. K. (2010). Seeking congruity between goals and roles: A new look at why women opt out of science, technology, engineering, and mathematics careers. *Psychological Science*, 21, 1051–1057.
- Diekman, A. B., Clark, E. K., Johnston, A. M., Brown, E. R., & Steinberg, M. (2011). Malleability in communal goals and beliefs influences attraction to stem careers: Evidence for a goal congruity perspective. *Journal of personality and social psychology*, 101(5), 902.
- Diekman, A. B., & Steinberg, M. (2013). Navigating social roles in pursuit of important goals: A communal goal congruity account of STEM pursuits. *Social and Personality Psychology Compass*, 7(7), 487-501.
- Fryberg, S. A. & Markus, H. R. (2007). Cultural models of education in American Indian, Asian American, and European American contexts. *Social Psychology of Education*, 10, 213-246. doi: 10.1007/s11218-007-9017-z
- Johnson MK. (2002). Social origins, adolescent experiences, and work value trajectories during the transition to adulthood. *Social Forces*, 80, 1307–1341.
- Morgan, C., Isaac, J. D., & Sansone, C. (2001). The role of interest in understanding the career choices of female and male college students. *Sex Roles*, 44(5-6), 295-320.
- Piff, P. K., Kraus, M. W., Côté, S., Cheng, B. H., & Keltner, D. (2010). Having less, giving more: The influence of social class on prosocial behavior. *Journal of Personality and Social Psychology*, 99, 771-784. doi: 10.1037/a0020092
- Pohlmann, K. (2001). Agency- and communion-orientation in life goals: Impacts on goal pursuit strategies and psychological well-being. In P. Schmuck & K. M. Sheldon (Eds.), *Life*

Goals and Well-Being: Towards a Positive Psychology of Human Striving. (pp. 68–84).
Seattle, WA: Hogrefe and Huber.

President's Council of Advisors on Science and Technology. (2012). *Engage to Excel: Producing One Million Additional College Graduates With Degrees in Science, Technology, Engineering, and Mathematics*. Washington, DC: Author.

Radford, A. W., Berkner, L., Wheelless, S. C., and Shepherd, B. (2010). *Persistence and attainment of 2003-04 beginning postsecondary students: After 6 years* (NCES 2011-151). U.S. Department of Education. Washington, DC: National Center for Education Statistics. Retrieved from <http://nces.ed.gov/pubsearch>

Smith, J. L., Cech, E., Metz, A., Huntoon, M., & Moyer, C. (2014). Giving back or giving up: Native American student experiences in science and engineering. *Cultural Diversity and Ethnic Minority Psychology*, 20, 413-429. doi: 10.1037/a0036945

Stephens, N. M., Fryberg, S. A., Markus, H. R., Johnson, C. S., & Covarrubias, R. (2012). Unseen disadvantage: How American universities' focus on independence undermines the academic performance of first-generation college students. *Journal of Personality and Social Psychology*, 102, 1178-1197. doi: 10.1037/a0027143

Strayhorn, T. (2012). *College Students' Sense of Belonging*. New York: Routledge.

Thoman, D. B., Brown, E. R., Mason, A. Z., Harmsen, A. G., & Smith, J. L. (2015). The role of altruistic values in motivating underrepresented minority students for biomedicine. *BioScience*, 65, 183-188. doi: 10.1093/biosci/biu199

Table 1. *Descriptive Information of Relevant Variables.*

	Min.	Max.	Mean (SD)	N
Ethnicity				494
Hispanic				206
Asian				206
Caucasian				43
Other				39
Gender				498
Female				328
Male				170
College-going Status				493
First Generation				288
Continuing Generation				205
English as first language				493
No				200
Yes				293
Family income				474
<\$15,000				40
\$15,001 - \$25,000				57
\$25,001 - \$35,000				55
\$35,001 - \$50,000				80
\$50,001 - \$75,000				65
\$75,001 - \$100,000				70
\$100,001 - \$150,000				59
>\$150,000				48
Perceived SES	1	10	5.31 (1.74)	485
Prosocial Affordance	1	7	5.66 (1.26)	496
Other Communal Affordance	1	7	5.55 (1.31)	497
Agentic Affordance	1	7	5.45 (1.11)	496
Field Belonging	1	7	4.17 (1.14)	498

Note. SD = Standard deviation. SES = Socioeconomic status. FG = First-generation college-going students. CG = Continuing-generation college going status.

Table 2. *Bivariate Correlations between Relevant Variables.*

	1	2	3	4	5	6	7	8	9	10	11	12	13
1. Hispanic	1												
2. Asian	-0.71***	1											
3. Caucasian	-0.26***	-0.26***	1										
4. Other	-0.25***	-0.25***	-0.09*	1									
5. Female	0.09*	-0.06	-0.05	-0.01	1								
6. FG	0.39***	-0.26***	-0.16***	-0.07	0.13**	1							
7. Family Income	-0.36***	0.19***	0.21***	0.10*	-0.08	-0.52***	1						
8. Perceived SES	-0.36***	0.20***	0.18***	0.11*	-0.06	-0.40***	0.58***	1					
9. Eng. as 1 st lang.	-0.23***	0.06	0.17***	0.13**	-0.07	-0.21***	0.23***	0.12**	1				
10. Prosocial Aff.	0.11*	-0.08	-0.06	0.01	0.21***	0.08	-0.06	-0.07	0.03	1			
11. Other Comm. Aff.	0.06	-0.02	-0.11*	0.05	0.12*	0.07	-0.03	-0.04	0.02	0.78***	1		
12. Agentic Aff.	0.10*	-0.06	-0.09*	0.03	0.13**	0.08	-0.04	-0.01	0.02	0.83***	0.73***	1	
13. Field Bel.	0.05***	-0.08	0.02***	0.04**	0.06	-0.03***	0.04***	0.08**	0.05***	0.25***	0.21***	0.26***	1

Note. FG = First-generation college-going students. SES = socioeconomic status. Eng. as 1st lang. = English as first language. Aff. = Affordance.

Bel. = Belonging. *** $p < .001$. ** $p < .01$. * $p < .05$.

Table 3. Regression Results of Socio-demographic Background Predicting Affordances.

	Prosocial Affordances			Other Communal Affordances			Agentic Affordances		
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
Female	0.20***	0.20***	0.20***	0.11*	0.11*	0.11*	0.11*	0.12**	0.12**
Eng. as 1 st lang.	0.08 [†]	0.07	0.07	0.05	0.05	0.05	0.06	0.05	0.05
FG	0.04			0.04			0.05		
Family Income		-0.02			0.00			0.00	
Perceived SES			-0.02			-0.01			0.04
Hispanic	0.15 [†]	0.16 [†]	0.15 [†]	0.19*	0.21*	0.20*	0.18*	0.20*	0.22*
Asian	0.05	0.05	0.05	0.16*	0.17*	0.16*	0.11	0.11	0.12*
Other	0.06	0.06	0.06	0.14*	0.14*	0.14*	0.10 [†]	0.11 [†]	0.11 [†]

Note. Caucasian used as reference group for ethnicity; Eng. as 1st lang. = English as first language. FG = First-generation college-going students. SES = socioeconomic status. *** $p < .001$.

** $p < .01$. * $p < .05$. [†] $p < .10$.

Table 4. *Regression Results of Career Affordances Predicting Field Belonging.*

	Model 1a	Model 1b	Model 1c	Model 2a	Model 2b	Model 2c	Model 3a	Model 3b	Model 3c
Prosocial Aff.	0.24***	0.24***	0.24***						
Other Communal Aff.				0.21***	0.20***	0.21***			
Agentic Aff.							0.25***	0.25***	0.24***
Female	0.02	0.01	0.02	0.04	0.04	0.04	0.04	0.03	0.04
Eng. as 1 st lang.	0.03	0.03	0.04	0.04	0.04	0.05	0.04	0.04	0.04
FG	-0.07			-0.07			-0.07		
Family income		0.06			0.06			0.06	
Perceived SES			0.11*			0.11*			0.09*
Hispanic	0.01	0.01	0.03	0.01	0.01	0.03	0.00	0.00	0.02
Asian	-0.07	-0.07	-0.06	-0.09	-0.09	-0.08	-0.09	-0.08	-0.08
Other	0.02	0.02	0.02	0.00	0.00	0.00	0.01	0.01	0.01

Note. Caucasian used as reference group for ethnicity; Aff. = affordance. Eng. as 1st lang. = English as first language. FG = First-generation college-going students. SES = socioeconomic status. *** $p < .001$. ** $p < .01$. * $p < .05$. † $p < .10$.