Applying Research and Theory to Your Outreach, Recruitment and Retention Activities For Girls & Women in Engineering

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Potential Theoretical Frameworks

- **Self-efficacy**
  - e.g. Bandura, 1997, Betz & Hackett, 1981; 2006

- **Social Cognitive Career Theory**
  - e.g. Lent et al., 1993, 2003, 2005, 2007; Trenor et al., 2008

- **Identity**
  - e.g. Pierrakos, et al., 2009; Beam, et al, 2009; Stevens, et al., 2008; Chandra, et al., 2008; Tonso, 2006; Chachra et al, 2008; Matusovich et al., 2008

- **Motivation**
  - e.g. Eccles, 2005

- **Social Capital**
  - e.g., Trenor, 2008, 2009

- **Student Engagement**
  - **e.g. Astin, 1999**

- **Stereotype Threat**
  - e.g. Aronson, Quinn & Spencer 1998; Spencer, Steele & Quinn, 1999; Steele and Aronson, 1995; Aronson, Fried & Good, 2002

Self-Efficacy

- Bandura, A. (1997). *Self-efficacy: The exercise of control. New York: Freeman.*
- Betz, N. E., & Hackett, G. (1981). The relationship of career-related self-efficacy expectations to perceived career options in college women and men. *Journal of Counseling Psychology, 28(5),* 399-410.
- Betz, N. E., & Hackett, G. (2006). Career self-efficacy theory: Back to the future. *Journal of Career Assessment, 14, 3-11.*

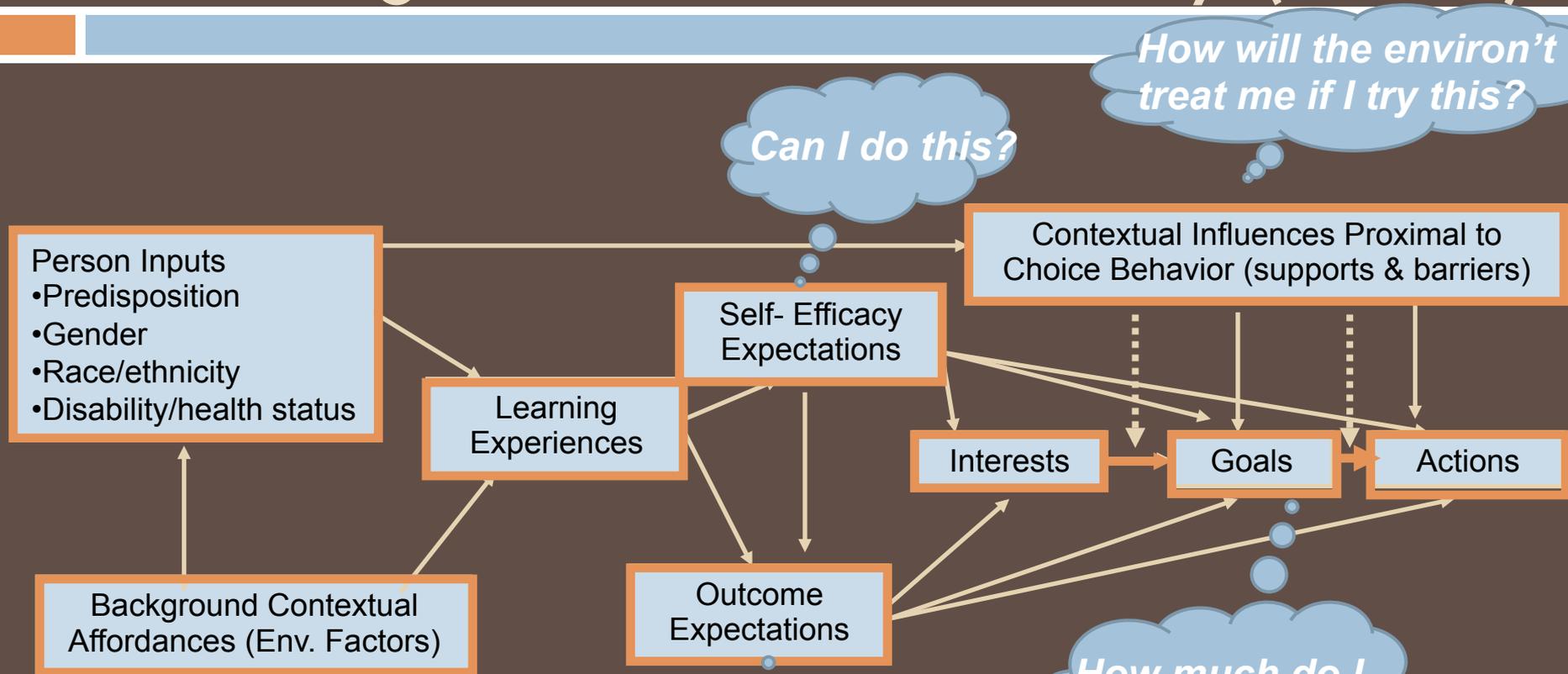**Past performance accomplishments**

Vicarious learning

Social persuasion (Encouragement and support)
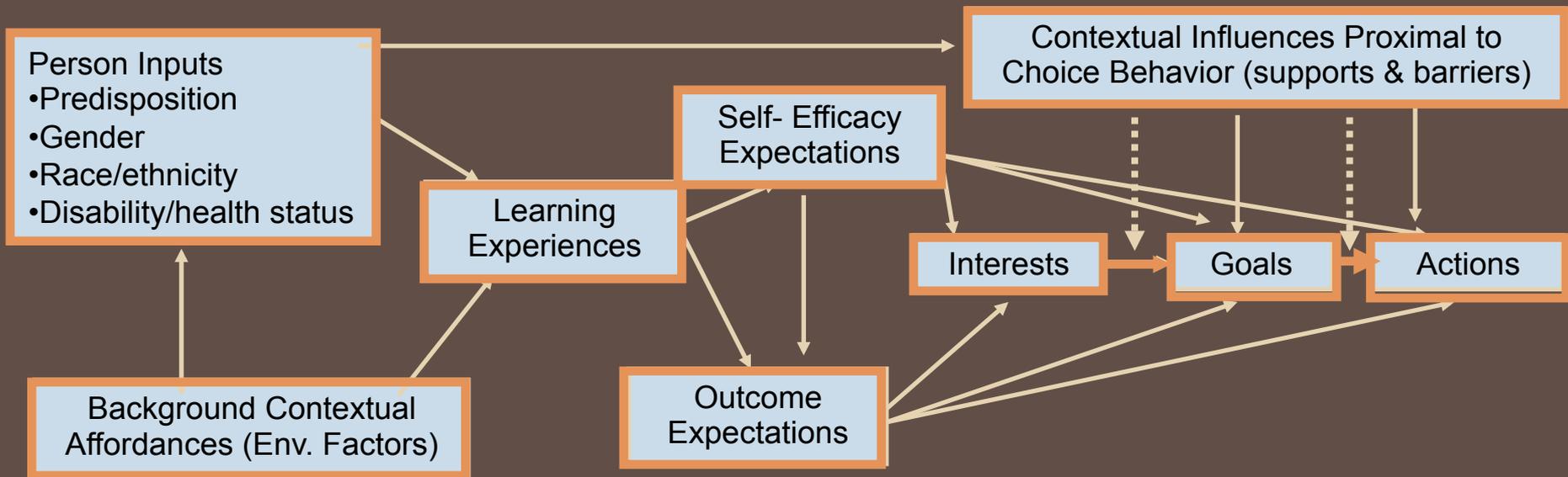
Physiological arousal (and affective reactions)

Self Efficacy

Social Cognitive Career Theory (SCCT)

How will the environ't treat me if I try this?

Can I do this?

Person Inputs
•Predisposition
•Gender
•Race/ethnicity
•Disability/health status

Contextual Influences Proximal to Choice Behavior (supports & barriers)

Self- Efficacy Expectations

Learning Experiences

Interests

Goals

Actions

Background Contextual Affordances (Env. Factors)

Outcome Expectations

How much do I want to do this?

If I do this, what will happen?

• Lent, R.W., S.D. Brown, and G. Hackett. 1994. Toward a unifying social cognitive theory of career and academic interest, choice, and performance. *Journal of Vocational Behavior 45 (1): 79–122.*
• Lent, R. W., Brown, S. D., Schmidt, J., Brenner, B. R., Lyons, H., & Treistman, D. (2003). Relation of contextual supports and barriers to choice behavior in engineering majors: Test of alternative social cognitive models. *Journal of Counseling Psychology, 50(4), 458-465.*
• Lent, R. W., Brown, S. D., Sheu, H.-B., Schmidt, J., Brenner, B. R., Gloster, C. S., et al. (2005). Social cognitive predictors of academic interests and goals in engineering: Utility for women and students at historically Black universities. *Journal of Counseling Psychology, 52(1), 84-92.*
• Lent , R., et al.,(2007) Relation of social-cognitive factors to academic satisfaction in engineering students, Journal of Career Assessment, Vol. 15, No. 1, 87-97.

Thinking About Girls & Women in Terms of Social Cognitive Career Theory

Person Inputs
- Predisposition
- Gender
- Race/ethnicity
- Disability/health status

Background Contextual Affordances (Env. Factors)

Learning Experiences

Self- Efficacy Expectations

Outcome Expectations

Contextual Influences Proximal to Choice Behavior (supports & barriers)

Interests

Goals

Actions

Lent's Interventions Derived From SCCT

- ☐ Expanding vocational interests, esp. in high aptitude areas
- ☐ Clarifying career goals
- ☐ Strengthening self-efficacy beliefs
- ☐ Instilling realistic outcome expectations
- ☐ Managing environmental barriers
- ☐ Building environmental support systems

http://dels.nas.edu/bls/more/Lent.pdf

Network Theory of Social Capital

- Resources embedded in social networks
- Functions of Social Capital
  - Enhances the flow of *information*
  - May *influence* individuals with decision-making power
  - May offer necessary or desirable *social credentials*
  - Offers *reinforcement* of an individual's identity and recognition

"Whereas economic capital is in people's bank accounts and human capital is inside their heads, social capital inheres in the structure of relationships"
(Portes, 1998)

Network Theory of Social Capital

Availability	→	**Access**	→	**Activation**

- Heterogeneous networks are advantageous because they provide more variety and quantity of resources
- Inequalities based on:
  - Gender
  - Ethnicity
  - Socioeconomic status
  - Family educational background
- Network redundancy

- Lin, N. (2000). Inequality in social capital. *Contemporary Sociology, 29*(6), 785-795.
- Lin, N. (2008). A network theory of social capital. In D. Castiglione, J. v. Deth & G. Wolleb (Eds.), *Handbook on social capital* (1st ed., pp. 50-69). New York: Oxford University Press, Inc.
- Lin, N. (2001). *Social capital: A theory of social structure in action*: Cambridge University Press.

Social Capital in Career Decision Making

- Family social capital varied with parental education and occupation and was related to the roles that family (particularly parents) played in students' college major decisions.

- When family capital was absent, students often relied on school personnel at the pre-college or college level for initial awareness of engineering, and information about choosing engineering as a college major. Engineering outreach, recruitment, and retention programs and personnel were key sources of information and support.

- Students' educational experiences and perceptions of support varied with accessed social capital. Peer groups played important roles in students' perceptions of their educational experiences and supports.

- Under-represented minorities and first generation college students were more likely to describe tenuous pre-college connections to engineering-related social capital, but yet found a way to access and activate social capital to varying degrees in making decisions to enter and persist in engineering at the undergraduate level.

Social Capital in Career Decision Making

- ❑ Students' decisions to select and persist in engineering are influenced by available resources in their social networks, activation of resources.

- ❑ Under-represented students may utilize different mechanisms for developing & activating social capital.

•Trenor, J. M. (2009). A phenomenological inquiry of the major choice processes of an overlooked demographic: First generation college students in engineering. *Proceeding of the 2009 Research in Engineering Education Symposium.*

•Trenor, J. M., Yu, S. L., Grant, D. S., & Fleming, B. A. (2009). Family roles in engineering students' academic and career choices: The influence parental educational attainment (in preparation).

•Trenor, J. M., Yu, S. L., Waight, C. L., & Zerda, K. S. (2008b. Influences for selecting engineering: Insights on access to Social Capital from two case studies. *Proceeding of the 38th Annual Frontiers in Education Conference, 2008.*

•Trenor, J. M., Yu, S. L., Waight, C. L., Zerda, K. S., & Sha, T.-L. (2008a. The relations of ethnicity to female engineering students' educational experiences and college and career plans in an ethnically diverse learning environment. *Journal of Engineering Education, 97*(4), 449-465.
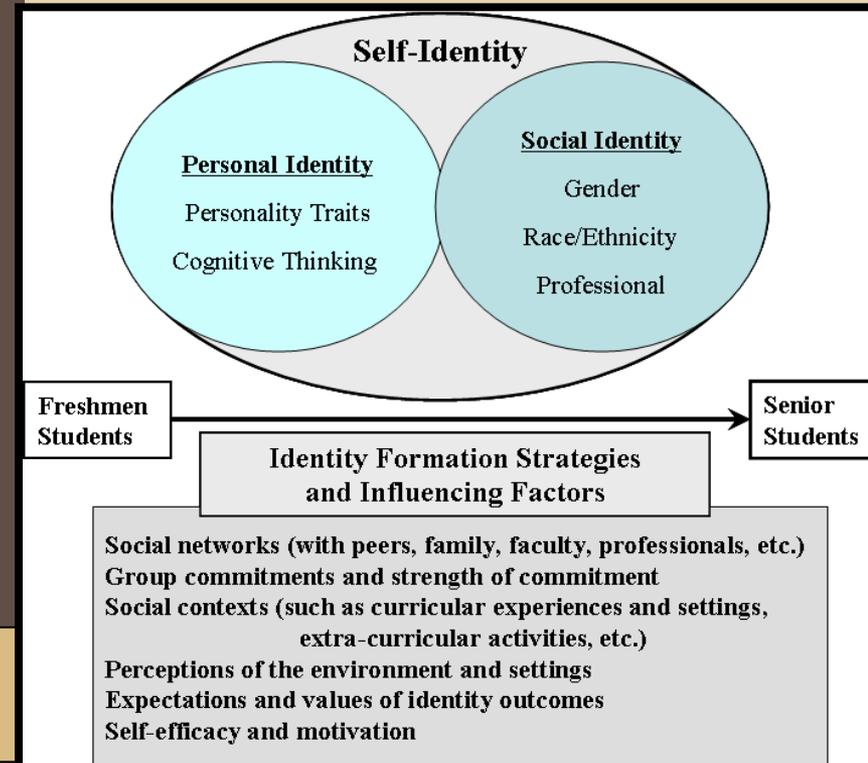
Interventions Based on Social Capital

- Research in progress- don't have all the answers yet!
- Opportunities for students to develop large and heterogeneous social networks with specific embedded resources pertinent to engineering academic/career decisions

- Opportunities for students to develop and mobilize <u>sustained</u> social capital rather than <u>isolated</u> interventions are preferred
- *However*, isolated interactions/interventions can "fill holes" in network and be key to academic & career decision making

Identity Theory

- People have multiple identities – [Stryker, Burke, Tajfel, Turner, etc.]

- People tend to choose behaviors whose meanings are congruent with their own self-meanings – [Burke, 1991]

- Social context determines group membership - A majority member might automatically form a strong sense of belonging, whereas the minority member instantly notices his/her minority status – [Spears, Doosje, Ellemers, 1997, 2002]

- Personal identity - "characteristics and behaviors that the person finds self-descriptive"

- Social identity - "roles or membership categories that a person claims as representative"

There are two layers of identity: personal and social. - Deaux [1993]

Self-Identity

Personal Identity
Personality Traits
Cognitive Thinking

Social Identity
Gender
Race/Ethnicity
Professional

Freshmen Students → Senior Students

Identity Formation Strategies and Influencing Factors

Social networks (with peers, family, faculty, professionals, etc.)
Group commitments and strength of commitment
Social contexts (such as curricular experiences and settings, extra-curricular activities, etc.)
Perceptions of the environment and settings
Expectations and values of identity outcomes
Self-efficacy and motivation

Identity Theory

"A complete picture of how students develop an engineering identity is complex" – [Chandra et al., 2008]

Female students were more likely to regard themselves as similar to other female students and less as science students, whereas male students were more likely to regard themselves as science students and less as males - [Lee, 1998 and 2002]

The majority of the engineering identity labels referred to males only and tended to be derogatory when referring to females – [Tonso, 2006]

Identity has been shown to play a large role in interest in engineering, thus contributing to perseverance – [Stevens et al., 2008]

Men and women express their degree of identification with engineering with a slightly different set of activities.– [Chandra et al., 2008]

Interventions Based on Identity Theory

- Engineering not having a strong presence in K-12 education seems to be a critical factor in students not having a strong identity to engineering

- The first year is critical in educating students on the breadth of the engineering profession and what it means to be an engineer

- We should educate students on the diverse aspects of engineering so they can see ties b/w engineering and other professional interests/roles

- Engineering students have multiple identities and interests, so offering diverse and numerous engineering opportunities would be ideal

- Gender differences in how students identify with engineering and what activities aid in shaping identity formation

Slides content compliments of Olga Pierrakos
- Pierrakos O., Beam T.K., Constantz J., Johri A., Anderson R. (2009). On the development of a professional identity: Engineering persisters vs engineering switchers, The 39th Annual Frontiers in Education Conference, San Antonio, TX.
- Beam T.K., Pierrakos O., Constantz J., Johri A., Anderson R. (2009) Preliminary findings on freshmen engineering students' professional identity: Implications for recruitment and retention," *ASEE Annual Conference & Exposition*, Austin, TX.

Student Engagement

- Astin, A, (1999) . Student involvement, A developmental theory. *Journal of College Student Development, 40 (5): 518–29.*
- Astin, A. W., & Astin, H. S. (1992). *Undergraduate science education: The impact of different college environments on the educational pipeline in the sciences. Washington, DC, National Science* Foundation.

- ☐ Quality of learning environment & level of student involvement is critical connection

- ☐ Excellent learning environment promotes high level of student involvement

- ☐ *Student engagement:* amount physical and psychological energy a student devotes to academic experience
  - ☐ Amount of energy devoted to studying
  - ☐ Amount of time spent on campus
  - ☐ Amount of participation in student organizations
  - ☐ Amount of interaction with faculty
  - ☐ Amount of interaction with other students

Motivational Theories: Eccles et al. Expectancy Value Model of Achievement-Related Choices

- "People will be most likely to choose a major that they think they can master and that has high task value for them"

- 4 categories of subjective task values:
  - Interest value - the enjoyment one gets from engaging in the task or activity
  - Utility value - instrumental value of the task or activity for helping to fulfill another long or short term goal
  - Attainment value - the link between the task and one's sense of self-identity
  - Cost - defined in terms of either which may be given up my making a specific or the negative experiences associated with a particular choice

- "Critical issues…are the relative personal value of each option and the individual's assessment of his or her relative ability and potential at the time the decision is being made."

- Eccles, J. S. (2005). Studying gender and ethics differences in participation in math, physical science, and information technology. In J. E. Jacobs & S. D. Simpkins (Eds.), Leaks in the pipeline to math, science, and technology careers (pp. 7-14). San Francisco: Josey-Bass.
- Eccles, J. S. (2007). Where are all the women? Gender differences in participation in physical science and engineering. In S. J. Ceci & W. M. Williams (Eds.), Why aren't more women in science? Top researchers debate the evidence (pp. 199-210). Washington, DC: American Psychological Association.
- Matusovich et al. (2008) Will I succeed in engineering? Using Expectancy-Value Theory in a longitudinal investigation of students' beliefs, Proceedings of the American Society for Engineering Education Conference, Pittsburgh, PA.

Stereotype Threat

- Psychological burden of stereotypes related to race, ethnicity, gender, physical appearance may affect actual performance by self-conforming to a negative stereotype of about one's group (i.e. "girls can't do math")
- Aronson, Quinn, & Spencer, 1998:
  - Arises from situational pressure, not actual acceptance of the validity of the stereotype
  - Those most affected are most concerned with poor performance in the domain
- Many studies have shown academic underperformance based on stereotype threat

Theoretical Elements of Stereotype Threat

□ 3 theoretical elements (from Aronson, Quinn, & Spencer, 1998)

Self threatening nature of negative stereotypes

Effect of self-threat on intellectual performance

Tendency to dis-identify with chronically threatened domain

Undermine performance and motivation of women and minorities

- Aronson, J. & Quinn, D. (1998) Stereotype threat and the academic underperformance of minorities and women. In J.K. Swim and C. Stangor (Eds.) Prejudice: The target's perspective (pp. 83-103). Dan Diego: Academic Press.
- Spencer, S., Steele, C. & Quinn, D. (1999) Stereotype threat and women's math performance. Journal of Experimental Social Psychology, 35 (1), p. 4-28
- Steele, C. M. & Aronson, J. (1995). Stereotype threat and the intellectual test performance of African Americans. Journal of Personality and Social Psychology, 69 (5), 797-811.
- Aronson, J. Fried, C.B. & Good, C (2002) Reducing the effects of stereotype threat on African American college students by shaping theories of intelligence. Journal of Experimental Social Psychology, 38 (2), p. 113-125