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Diversity in Design Teams: A Grounded Theory Approach

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ABSTRACT

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Recent workforce trends have virtually guaranteed that employees need to be able to work effectively with a diverse group of colleagues. First, US workforce demographics have changed dramatically; the population is now 16.4% Hispanic or Latino, 11.7% Black or African American, and 5.5% Asian. Women now make up 46.8% of the labor pool (BLS, 2015). A second trend is the widespread use of interdisciplinary teams to tackle cognitively demanding tasks, as well as to spur creativity and innovation (Cooke, Salas, Cannon-Bowers, & Stout, 2000; Fay, Borril, Amir, Haward, & West, 2006; Salas, Cooke, & Rosen, 2008). Taken together, it is clear that understanding diversity in teams is an issue that needs to be at the forefront of research and practice.

In the science of teams, diversity has been labeled a double-edge sword (Chi, Huang, & Lin, 2009). Diverse members offer a wider range of expertise and ideas from which the team can draw (e.g., Watson, Kumar, & Michaelsen, 1993). According to information processing theories (e.g., van Knippenberg, De Dreu, & Homan, 2004), this leads to team behaviors (e.g., constructive debate) that result in higher quality team processes (e.g., decision making; Horwitz & Horwitz, 2007) and performance (e.g., creativity; McLeod, Lobel, & Cox, 1996). Alternatively, similarity-attraction (Byrne, 1971) and social categorization (Hogg & Turner, 1985) theories posit that diversity leads to subgrouping based on perceived similarity, and ultimately to bias, reduced social integration, and increased conflict that can act as barriers to realizing the team-level benefits of diversity (Stahl, et al., 2010).

Indeed, the influence of diversity on team process and outcomes is anything but straightforward. In fact, empirical evidence has failed to find consistent relationships (e.g., Webber & Donahue, 2001), highlighting the importance of potential moderators (*see* Table 1 for a sample of these factors). Towards this end, a series of meta-analytic investigations have been conducted that emphasize the importance of team type, task difficulty, task type and inter-industry factors such as competition (Bell et al., 2011; Bowers, Pharmer, & Salas, 2000; Joshi & Roh, 2009). Clearly, context matters, and understanding the diversity-performance relationship requires a deeper dive into a specific context of interest. Qualitative inquiry is one tool through which this can be achieved.

Toward this end, qualitative research allows for an inductive approach to the relationship between diversity and team performance under specific contexts, and recent efforts (e.g., Shachaf, 2008) have shown that while diversity affects similar team processes (e.g., communication), the way this effect unfolds uniquely differs by context. Therefore, in line with these efforts, the current investigation takes a structured and systematic grounded theory approach (Strauss & Corbin, 1990) to look closely at a context where creativity and innovation are demanded from today's workforce, namely, design teams.

In an attempt to shed light on persistent equivocal findings in both the team diversity and team conflict literatures, I put forth: (1) a temporally-based framework of diverse design team performance using the Input Mediator Output Input model (IMOI; Ilgen, et al., 2005), (2) an integrative theory, and a (3) set of testable findings. I argue that in engineering design teams, diversity on assertiveness, previous experience, and demographics (and the underlying cultural dimension of collectivism/individualism) can either positively or negatively influence

communication behaviors (i.e., information exchange and elaboration; Van Knippenberg et al., 2004) through the avenues of frequency, timelines, equality, and comprehension of exchange.

Furthermore, and in line with meta-analytic findings (Stahl et al., 2010), it is proposed that the nature of diverse teams and the engineering design process itself suggest the diversity-task conflict relationship will be strong. While previous research has largely looked at task and relationship conflict in silo (Behfar, et al., 2008), I suggest that these strongly correlated states (de Wit, Greer, & Jehn, 2012) are inextricable linked and often develop together. Furthermore, the underlying mechanism that is responsible for task conflict spiraling into relationship conflict is diversity in the directness of conflict expression (Weingart et. al, 2015), a variable associated with both assertiveness and collectivism (Oyserman & Kemmelmeier, 2002). Indeed, members varied greatly in their preference for straightforward, goal-directed expression versus ambiguous, relationship-centered expression. It is argued that heterogeneity in this construct among team members has the potential for expressions to be seen as rude, insincere, or argumentative by those less direct, or as avoidant and passive aggressive by those more direct (Taras et al., 2007), thus triggering the onset of relationship conflict.

In a unique contribution to the literature, the theory then develops further to address many of the limitations cited in the conflict literature related to measurement, failure to consider reciprocal effects between conflict state, and temporal issues (Loughry & Amason, 2014). What follows is a unique look at how conflict-communication cycles unfold across a team's lifecycle, and the team level states (e.g., social integration; O'Reilly, Caldwell and Barnett, 1989) that can act as a buffer against potentially negative effects on team performance.

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CHAPTER 1: Introduction

Importance and Problem State

Recent workforce trends have virtually guaranteed that employees need to be able to work effectively with a diverse group of colleagues. First, US workforce demographics have changed dramatically; the population is now 16.4% Hispanic or Latino, 11.7% Black or African American, and 5.5% Asian. Women now make up 46.8% of the labor pool, and 63% of workers are over the age of 55 (BLS, 2015). A second trend, and one that has been entrenched in organizations for the past several decades, is the widespread use of interdisciplinary teams. This can be attributed in part to the growing complexity and cognitive demand of tasks, ill-defined and stressful environments, and a focus on creativity and innovation (Cooke, Salas, Cannon-Bowers, & Stout, 2000; Fay, Borril, Amir, Haward, & West, 2006; Salas, Cooke, & Rosen, 2008). These teams are often composed of members from disparate educational and functional backgrounds who have each undergone unique training (Hall, 2005). Taken together, it is clear that understanding diversity in teams is an issue that needs to be at the forefront of research and practice.

In the science of teams, diversity has been labeled a double-edge sword (Chi, Huang, & Lin, 2009). Diverse members offer a wider range of expertise, perspectives, and ideas from which the team can draw (e.g., Watson, Kumar, & Michaelsen, 1993). According to information processing theories (e.g., van Knippenberg, De Dreu, & Homan, 2004), this leads to team behaviors (e.g., constructive debate, consideration of alternatives) that result in higher quality team processes (e.g., decision making, problem-solving; Horwitz & Horwitz, 2007) and performance (e.g., creativity, innovation; Ancona & Caldwell, 1992; De Dreu & West, 2001; McLeod, Lobel, & Cox, 1996). In fact, this greater pool of resources has long been recognized as

the key advantage of diversity (e.g., Hoffman, 1959). At the individual level, members often gain new insights and skills as a result of working with diverse others (Tress, Tress, & Fry, 2005).

Unfortunately, however, meta-analytic evidence from Stahl, Maznevski, Voigt, and Jonsen (2010) suggests that diversity can also be disruptive to team process. The authors find that decreased social integration and increased conflict can act as barriers to realizing the individual and team-level benefits of diversity. This evidence is supportive of social categorization theories (e.g., Turner, Brown, & Tajfel, 1979) which posit that diversity leads to subgrouping, bias, and potential discrimination. Toward this end, diversity has the potential to lead to a number of negative outcomes, including lower member satisfaction, commitment to the group, and team cohesion (e.g., Harrison, Price, Gavin, & Florey, 2002; Jehn, Northcraft, and Neale, 1999; Stahl, Maznevki, Voigt & Jonsen, 2010). This has consequences not only for the team's social climate, but for integrating the unique contributions of each member. For example, the valuable breadth of information and perspectives held by members may be discredited or fail to be considered thoroughly by the team (Dahlin, Weingart, & Hinds, 2005). Clearly, the influence of diversity on team process and outcomes is anything but straightforward, and empirical evidence that has failed to find consistent relationships (e.g., Webber & Donahue, 2001) highlights the importance of potential moderators (*see* Table 1 for a sample of these factors).

Towards this end, a series of meta-analytic investigations have been conducted that examine the influence of moderating factors at the task (e.g., difficulty), team (e.g., team type), and organizational levels (e.g., culture). To some extent, these results have helped us understand equivocal findings in the literature. For example, Bell and colleagues (2011) look at the influence of team type. The authors argue that in teams where divergent thinking (as opposed to

convergence and efficiency) is required and outcomes such as creativity are important, diversity may have a stronger influence on performance. Indeed, findings suggest that the strength of diversity-team outcome (i.e., performance, creativity, and innovation) relationships may depend in part on the type of the team being studied. In a similar vein, Bowers, Pharmer, and Salas (2000) look at task level variables that potentially help capture some of the unexplained variance. The authors found a small but non-significant relationship between diversity (i.e., gender, ability level, and personality) and performance. However, task difficulty (i.e., uncertainty, process demands, and response complexity) moderated the diversity performance-relationship such that heterogeneous teams performed significantly better on high difficulty tasks. Task type was also a significant moderator, with homogenous teams realizing higher performance on low cognitive demand tasks. It is argued that difficult, high cognitive demand tasks require more creativity and information seeking behavior, and therefore are better suited for heterogeneous teams. More recently, researchers have begun to look at the top-down influence of higher level factors.

At the organizational level, Joshi and Roh (2009) assert that interindustry variation in factors such as rate of technological change, regulatory pressure, and competition can enhance or constrain the effects of diversity. For example, certain industries (e.g., manufacturing) are characterized by more formalized human resource practices, and therefore may be more likely to provide interventions such as team-based training. Indeed, the authors find that occupation and industry account for significant variance in the diversity-performance relationship, and further suggest that future research look at the influence of specific practices within the organization. Clearly, context matters; the influence of diversity can vary widely depending on task, team, and organizational variables. Understanding the diversity-performance relationship, therefore,

requires a deeper dive into a specific context of interest, and qualitative inquiry is one tool through which this can be achieved.

Table 1. Factors Influencing the Diversity-Performance Relationship

Task Level	Team Level	Organizational Level
❖ Task Routiness (Pelled et al., 1999) ❖ Task Type (Bowers et al., 2000; Bell et al., 2010) ❖ Task Difficulty (Bowers et al., 2000)	❖ Shared Objectives (van Knippenberg et al., 2010) ❖ Team Reward Structure (Homan et al., 2008) ❖ Team Goal Orientation (Pietrese, et al., 2008) ❖ Accurate and Shared Diversity Mindset (van Knippenberg, 2013) ❖ Group Longevity (Pelled et al., 1999) ❖ Team type (Bell et al., 2010)	❖ Occupation/Industry (Joshi & Roh, 2009) ❖ Team Oriented HR Practices (Chi & Huang, 2009)

Qualitative research allows for an inductive approach to the relationship between diversity and team performance under specific contexts. For example, Shachaf (2008) looked at the influence of diversity in global virtual teams (GVTs). The author conducted 41 interviews with Fortune 500 employees and found that cultural diversity had a positive influence on decision making and a negative influence on communication in the GVT environment. Additionally, information and communication technology (ICT) influenced these relationships; ICT mitigated differences between verbal style and language, and enabled the use of unique knowledge. Gillespie, Chaboyer, Longbottom, and Wallis (2010) focused on high reliability context, specifically examining surgical healthcare teams. Findings indicated that disconnected communication (e.g., minimal information exchange, inconstancies, missing information) was a key threat to patient safety. This was underscored by professional independence and dichotomized team roles (i.e., stark differences in authority and patient care responsibilities).

Furthermore, education and teamwork interventions around valuing diverse others were identified as critical to culture change. These qualitative studies have shown that while diversity may affect similar team processes (e.g., communication), the way this effect unfolds and how to improve performance differs with context. Therefore, in line with these efforts, the current investigation will look closely at a context where creativity and innovation are demanded from today's workforce, namely, design teams.

Design Teams

A team is defined as "a distinguishable set of two or more people who interact, dynamically, interdependently, and adaptively toward a common and valued goal/objective/mission, who have each been assigned specific roles or functions to perform, and who have a limited life-span of membership" (Salas, Dickenson, Converse, & Tannenbaum, 1992, p. 4). While this specifies many characteristics a team must have, teams can vary widely on a number of other factors (e.g., skill differentiation, authority differentiation, temporal stability, task design, group composition; Hollenbeck, Beersma, Schouten, 2012; Stewart, 2006). Indeed, teams vary in the tasks they complete and the environments in which they operate, and therefore the factors that influence performance are also distinct (e.g., English, Griffith & Steelman, 2004; Marks, Zaccaro, & Mathieu, 2000). Of particular relevance to this study, Bell and colleagues (2011) find some evidence that the diversity-performance relationship is stronger in design and product development teams, while also noting the small number of primary studies and future research needed in this context.

Design teams have elements of both project/product development teams and decision making teams. They form for a limited amount of time, usually with one overarching performance episode and a final team outcome or production (Cohen & Bailey, 1997). The focus

is often on innovation rather than application of established procedures (Sundstrom, De Meuse, & Futrell, 1990), and the teams can work on extending an existing product or developing an entirely new idea (Ancona & Caldwell, 1992). The task context is often characterized by uncertainty and complexity, creating ill-defined problems and decisions that have no inherent right answer (De Dreu & Weingart, 2003). Finally, these teams are often self-managing (Hackman & Oldham, 1976), characterized as autonomous units with little to no hierarchical structure, with the ability to make decisions (e.g., task assignment) largely within the team. In several ways, these unique characteristics make design teams ideal for studying diversity in teams. Great autonomy and flexible procedures, coupled with the need to integrate member input and make decisions continuously will likely all emphasize the effects of diversity.

In sum, the influence of diversity within teams has proven to be a complex and dynamic phenomena. Furthermore, diversity likely operates uniquely within specific situations, and future research needs to account for context. To address these issues, a qualitative approach that allows investigation into the specific design team context may allow for a clearer understanding of the diversity-performance relationship, and may uncover previously unexplored or difficult to capture factors.

Purpose

Team diversity not only holds great potential for outcomes such as creativity, innovation, and decision-making, but will also continue to be an inevitable issue at front and center of a developing workforce. According to Mannix and Neale (2005), there are two competing views of diversity in teams. On one hand, increasing a team's resources inherently allows for the possibility of greater performance outcomes. However, conflicting ideas, opinions, and approaches to the task can provide the foundation for conflict and social division. Understanding

how diversity operates under specific contexts may help teams avoid the potential pitfalls and capitalize on the benefits. Therefore, the purpose of this effort is threefold, and includes untangling the effects of diversity in design teams by 1) identifying the team processes affected by diversity and the individual, team, and organizational level factors that influence the diversity-performance relationship, 2) developing an integrative theory (i.e., informed by previous research, grounded in the data from the context of interest) of diverse team performance, and 3) delivering a set of findings to be further tested by future research.

Research Questions

The proposed investigation builds on previous theory and quantitative efforts to better understand how diversity affects team process and performance in design teams. While the nature of the qualitative method utilized encourages building theory from the data collected, the science of teams and teamwork provides a framework for investigation. Specifically, models of team performance and team composition (e.g., Ilgen, Hollenbeck, Johnson, & Jundt, 2005; McGrath, 1984; Bell, Villado, Lukaisk, Belau, & Briggs, 2011) were used to develop the following broad research questions:

What affects the diversity-performance relationship in design teams?

- Diversity on what individual traits play a role in diverse design team performance?
- How does team process influence performance?
- What situational factors influence team process and performance?

CHAPTER 2: Literature Review

Team Composition

A long history of team science research underscores the importance of understanding performance from a multi-level perspective (e.g., Klein & Kozlowski, 2000). Emphasis is placed not only on attributes of individual members but also on how these attributes are combined to form the team's composition, defined by Levine and Moreland (1990) simply as the configuration of attributes across the team. The authors assert that research on composition receives significant attention in part because the KSAs of members represent the team's most valuable resource and composition can affect the degree to which this resource is used to benefit team outcomes. Indeed, team composition influences both willingness (i.e., the amount of effort individual members put forth) and ability to successfully engage in interdependent team processes (Burke, Stagle, Salas, Pierce & Kendal, 2006; Lepine, 2003); ultimately, then, composition influences the overall knowledge and skill applied to attaining team goals (Bell, 2007; Hackman, 1983).

Importantly, individual traits must be aggregated or combined in a meaningful way to represent a team-level concept. The way a researcher operationalizes team composition (i.e., the way in which it is expressed in measurable terms) is often influenced by the proposed research questions, the nature of the task, and nature of the individual trait (Bell, 2007; Hollenbeck et al., 2004). The current effort and research questions focus on the influence diversity, and therefore heterogeneity or the distribution of the individual traits of team members is of primary concern.

While a complete review of the voluminous literature on team composition models is out of the scope of this effort, Mathieu and colleagues (2014) note that previous work encompasses a

number of different theoretical approaches that differ on factors such as the aggregation process and an individual versus team focus. According to the authors, a synthesis of these different perspectives (e.g., team profile perspective, relative contribution perspective) holds the most value for advancing the state of the science. In line with these authors, I argue three points must be considered when studying team diversity. First, the knowledge, skills, and attitudes (KSAs) of individual members may combine in non-additive fashions and be complementary, compensatory, or combustive. Additionally, the specific combination of individual characteristics, or the team's profile (i.e., how characteristics are distributed among members), has a unique influence on team process. Finally, members may have more formal or informal influence within the team, highlighting the importance of the relative contribution of specific roles or positions (e.g., the leader, the boundary spanner). Taken together, the higher-level concept of composition can take on more meaning than simply a descriptive statistic (i.e., a compilational approach; Kowslowski & Klein, 2000).

While much attention has been given to diversity in team composition, consensus on how the concept should be defined, categorized, and measured has not yet been reached. In fact, in the search for a relationship between diversity and performance, taxonomies of diversity abound. Furthermore, it is often brought up for debate, as will be discussed next, whether composition should be considered more broadly or in regards to specific dimensions.

Dimensions of Diversity

In a review of the state of literature, van Knippenberg and Schippers (2007) define diversity as "a characteristic of a social grouping (i.e., group, organization, society) that reflects the degree to which there are objective or subjective differences between people within the group" (p.519). The authors note the generality of this definition, and point out one critical issue

it does not address; namely, the distinction between different types of diversity. Indeed, authors have created several taxonomies of team diversity in attempt to organize the literature, parse apart the differential effects of diversity type, and gain a deeper understanding of the diversity-performance relationship (*see* Table 2).

Table 2. Dimensions of Diversity

Dimensions	Definition	Cite
❖ Job relatedness	Degree to which the attribute captures experiences and skills related to taskwork	Pelled et al., (1999)
❖ Permeability	Degree to which an attribute can be changed, ease of moving between categories	Pelled et al., (1999)
❖ Surface vs. Deep Level	Depth, observability and malleability of attributes	Harrison, Price, & Bell (1998); Milliken & Martins, (1996)
❖ Intra-Personal	Differences within the individual (e.g., narrow specialist, broad generalist)	Bunderson & Sutliffe (2002)
❖ Separation, Variety, & Disparity	Differences in substance, shape, maxima, and implications.	Harrison & Klein (2007)

Diversity can be considered attribute specific (i.e., teams are diverse with respect to a specific factor; Harrison & Klein, 2007). Importantly, perception of differences between members attributes may be just as powerful as objective differences (Jackson, May, & Whitney, 2005). One often cited distinction of attributes is that between job-related (e.g., functional background) and less job-related (e.g., gender) characteristics. Pelled, Eisenhardt, and Xin (1999) define job-relatedness as the degree to which the attribute captures experiences and skills related to taskwork. The authors propose that more job-related differences (e.g., functional differences) will lead to incongruent task perceptions and therefore hold more potential to drive task conflict. They also emphasize the importance of the permeability of an attribute (i.e., ease of changing between categories). Attributes that are highly impermeable (e.g., race, tenure) make it

difficult to identify with someone of a different category, and therefore are more likely to lead to emotional conflict. In a similar vein, Horwitz and Horwitz (2007) assert that while task and demographic diversity may both have a negative effect on social integration, demographic diversity has a stronger relationship as it results in more immediate categorization of others.

In a similar vein, Harrsion, Price, and Bell (1998) categorize diversity by level or depth. Surface level diversity (e.g., age, race) refers to characteristics that are readily observable, unchangeable, and generally can be measured with simple, straightforward metrics. Deep level diversity includes differences in variables such as education, technical skills, attitudes, beliefs, and values. While often deep-seated, these aspects can be malleable, and are communicated through interaction over time. Specifically, Harrison, Price, Gavin, and Florey (2002) claim that collaboration over time may weaken the effects of surface-level diversity on team interaction as a member becomes more familiar with their teammates, but increase the effects of deep level diversity.

In the hopes of explaining equivocal relationships with performance, researchers have taken classification a step further by breaking down higher level dimensions to capture more nuanced differences. For example, in a review of the literature Bundersen and Sutcliffe (2002) propose different forms of functional diversity that differ in both conceptualization and measurement. Dominant functional diversity refers to differences in the functional areas in which team members have spent the majority of their careers, while functional background diversity refers to differences in functional backgrounds. Essentially, these levels range in how central they are to a person's actual experiences on the job. The authors found that dominant function diversity had a negative impact on information sharing and performance. Further, the authors introduce a new category, intra-personal functional diversity, which refers to the degree

individuals are narrow specialists with specific domains, or are more broad generalists. Intra-personal functional diversity showed the opposite pattern; a positive relationship with information sharing and performance. Again indicating the importance of time in the unfolding of the diversity-performance relationship, functional diversity has been shown to lead to lower short-term but higher long-term performance (Hambrick, Cho, & Chen, 1996; Murray, 1989).

Finally, in a seminal article, Harrison and Klein (2007) advance the conceptualization of diversity by delineating three unique types (i.e., separation, variety, and disparity) that vary on several factors, including core attributes included (e.g., whether differences are along a single continuous attribute or categorical), key assumptions and relevant theoretical foundations, and implications for performance. Separation is characterized by differences in lateral position or opinions, beliefs, and attitudes. Separation is likely to negatively affect team processes and goals, and is predictive of negative interpersonal interactions and reduced performance. Variety is characterized by differences in relevant knowledge and prior experience (e.g., educational background); it is associated with the potential positive team-level outcomes including creativity and better decision quality. Lastly, disparity involves differences in desired resources, and is associated with perceptions of competition and withdrawal. Importantly, the way in which these types of diversity are measured (e.g., shape of distribution for maximum levels of diversity) varies. This taxonomy of diversity is underscored by the most prevalent theories in diversity-related research, and centers around two distinct processes: social integration and information-processing.

In fact, some researchers suggest these same process mechanisms underlie performance in diverse teams regardless of the type of diversity in question (van Knippenberg et al., 2004), arguing the current state of the science has yet to reliably uncover a strong differential impact of

diversity types (e.g., Bell et al., 2011; Webber & Donahue, 2001). Put another way, differences in any of the previously mentioned categories may result in unique task-related input, but any perceived difference may also form the basis of social categorization. Therefore, in line with the qualitative approach taken in this effort, I aim to allow data analysis to uncover which individual traits or dimensions of diversity emerge as critical in diverse design performance, and whether similar underlying team processes are affected. More fine-grained research questions include:

- Diversity on what individual traits play a role in design team performance?
- How should these traits be categorized? Do certain dimensions of diversity previously proposed in the literature (e.g., job relatedness) have more or less influence on team process?
- How might diversity on identified traits influence team process? What are the underlying mechanisms through which the effect on process occurs?

Competing Explanations: Theoretical Underpinnings

Diversity is typically understood through three underlying, and often competing, theoretical perspectives: 1) information processing, 2) similarity-attraction paradigm, and 3) self and social categorization (Williams & O'Reilly, 1998). These theories are used to explain patterns of team interaction, and focus on the team processes affected. When applied to the team level, information processing perspectives focus more on the team's task inputs and performance, whereas the similarity-attraction paradigm and social categorization focus more on the team's social climate. However, all three of these theories have implications for team process and individual and team outcomes. As put succinctly by Simons, Pelled, and Smith (1999), different ideas, opinions, and expertise must be integrated at the team level in order to realize the benefits of diversity; failure to achieve this will allow the potential costs of diversity (e.g., decreased social integration and coordination) to outweigh the benefits.

From the information processing perspective, teams can be viewed as information processing units; members work together to encode, process, and store information, and

ultimately to learn (Hinsz, Tindale, & Vollrath, 1997). Diversity gives the team access to a larger pool of knowledge, skills, and perspectives, and therefore diverse teams simply have more resources to apply to the task. Dahlin and colleagues (2005) argue that diverse perspectives also act as filters, not only do they allow team members access to more information, but a greater ability to determine its relevance and future implications for the team's task. In this way, diversity can result in different views of or approaches to the task, and has the potential to drive team processes (e.g., task conflict; Pelled, 1999) that create a more critical analysis of information and consideration of alternatives.

However, teams must be motivated to share and process each other's unique information in order for it to be useful (De Dreu, 2007). Even if members are motivated to share, Cronin and Weingart (2007) suggest certain dimensions of diversity (e.g., educational) can cause members to view and understand the problem differently, resulting in different assumptions and priorities for the task. Additionally, difficulty integrating information may stem from different terminology or norms for communication among members (Hall, 2005). Therefore, diversity offers the potential to improve team process, but barriers to information sharing will keep teams from realizing these benefits. In addition to these task-oriented barriers, social aspects may also present a challenge.

Toward this end, a separate stream of research puts a greater emphasis on the social climate of the team, and on the potential for diversity to cause decrements to team process. The foundation of both the similarity-attraction and the social categorization perspectives is that similarity to others engenders what O'Reilly, Caldwell, and Barnett (1989) term social integration. The authors note the overlap with the concept of group cohesiveness, and cite attraction to the group, satisfaction with the group, and interaction among different members as

key facets. A certain level of social integration may be necessary to make use of the resources (e.g., information) held by other team members (Ancona & Caldwell, 1992). Unfortunately, in diverse teams where similarity to others may be low, decreased social integration has been evidenced (Stahl et al., 2010).

The similarity-attraction hypothesis (Byrne, 1971) holds that people are interpersonally attracted to those who are similar to them. While the theory began by looking at attitudes, it has since been extended to include similarity of personality, physical characteristics, intelligence, education, and social dimensions. Potential reasons for our attraction to similar other include the need for cognitive consistency, social validation, and need for belonging (Berschield & Hatfield Walster, 1985). Importantly, at the team level, evidence suggests this process can result in the formation of subgroups based on perceived similarity or differences between members, and that subgroup interactions can ultimately have a negative effect on team process (e.g., increased relationship conflict and decreased collective effort, information exchange and coordination; Li & Hambrick, 2005; Zellmer-Bruhn, Maloney, Bhappu, & Salvador, 2008).

In a similar vein, social categorization theory also underscores the importance of both attraction to others and of self-validation. Individuals define and categorize themselves by perceived membership in a group, and have a need to maintain a positive self-view (Hogg & Turner, 1985). Therefore, when social comparisons are made to others, there is pressure to differentiate oneself and other members of the "ingroup" as superior. Put another way, similar others are attractive because they reinforce an individual's values, attitudes, and beliefs (Harrison, Price, Gavin, & Florey, 2002). This social grouping can result in ingroup favoritism or bias, which manifests as preference for the ingroup displayed through attitudes and behavior (Turner, et al., 1979). Importantly, bias does not necessarily take overt, formal forms; it is often

displayed through subtle interpersonal forms (e.g., verbal and non-verbal behavior in interactions; Hebl, Foster, Mannix, & Dovidio, 2002). The bottom line for team performance is the same for both similarity-attraction and social categorization theories: perceived similarity causes subgroups to form within the team, and the potentially negative interaction of these subgroups can hold serious consequences for team process.

In sum, information processing and social categorization theories propose that diversity asserts it's affect through different team processes. Moreover, there is ample evidence to support the assumptions of both information processing and social categorization theory (e.g., O'Reilly, Caldwell, & Barnett, 1989; Watson, et al., 1993), therefore causing persistent uncertainty about the diversity-performance relationship. In reality, these two theories likely both contribute to a better understanding of the diversity-performance relationship when considered together (e.g., Van Knippenberg et al., 2004), although integrative theories are scarce. Research questions related to the manner in which diversity affects team process include:

- How do team processes mediate the relationships between traits and performance outcomes?
    - What team processes play a role in design team performance?
    - How do team processes influence individual and team performance?
    - How do these processes interact to drive performance? How do they interact over time?

Joshi and Roh (2009) claim existing theories are to an extent insufficient, emphasizing the importance of the context or situation, and of considering when, where, and how diversity influences team process and performance. The authors put forth a comprehensive framework of macro and micro contextual influences, using Contingency Theory as a foundation. Essentially, relationships between diversity and performance are dependent on task, team and organizational factors. Although originally developed at the organizational level, contingency theory has been successfully leveraged to build theory around teams (e.g., Beersma et al., 2003), and models that

consider team diversity have begun to include the influence of the contextual variables (e.g., Wildman et al., 2012).

The specific contextual variables that influence a design team's effectiveness likely overlap to an extent with established findings. For example, the importance of support variables at the peer and supervisor level is well-known (e.g., Janz, Colquitt, & Noe, 1997). However, the importance of contextual variables specific to design teams remains understudied. Therefore, the following questions are posed:

- What is the influence of the situation or context on design team processes and performance?
    - What specific contextual factors exert a top down influence?
    - How do these factors strengthen or weaken the relationships between diversity, team process, and performance?

In order to more closely examine the diversity-performance relationship and underlying theory, the current effort will turn to in-depth qualitative analysis; namely, a grounded theory approach.

Grounded Theory Approach

Creswell (2007) delineates between five approaches to qualitative research, noting that while there is much overlap (*see* Table 3 for common characteristics), they differ on focus, the type of problem they are best suited to address, units of analysis, data collection methods, and analysis strategies. While there is no one correct structure, grounded theory is well-suited to the present effort in part because it allows for both a deductive and inductive approach to analysis. Therefore, the vast amount of team science literature can first be used to create a provisional model. The model can then be refined based on the grounded data, capturing unique features of the sample and context under study. Additionally, equivocal quantitative results suggest that present theories may be incomplete; grounded theory ensures the researcher is not limited to

previously examined variables or theory. Finally, this approach is especially valuable to understanding complex processes such as teamwork, and allows for the collection of moment-to-moment data.

Table 3. Common Features of Qualitative Inquiry (Adapted from Creswell, 2007)

Characteristic	Definition
❖ Natural Setting	Research is conducted in the field, in the context the investigator wished to study.
❖ Researcher as Key Instrument	Although they may use instruments or protocols, the researcher is actually gathering information themselves.
❖ Multiple Data Sources	Multiple sources of data are gathered (e.g., interviews, observation, video), and themes that cut across sources are identified.
❖ Participant's Meaning	Focus is on the meaning provided by participant's rather than assumptions from literature
❖ Emergent Design	The initial plan for all phases of the process may change as the study develops
❖ Theoretical Lens	Studies are often viewed through a theoretical lens
❖ Interpretive Inquiry	Multiple views of the phenomenon emerge depending on a person's background, prior knowledge, etc.
❖ Holistic Account	Researchers develop a complex, larger picture of phenomenon and related complex interactions

Grounded theory approaches to qualitative analysis were originally developed in the field of sociology. Specifically, Glaser and Strauss (1967) argued that theories should be grounded in data from the field, including the interactions and social processes of others. The purpose of a grounded theory approach, therefore, is to take an inductive approach to identifying theoretical constructs and generating a theory of the phenomenon of interest (Creswell, 2007). Theories are developed during the process of analysis by establishing patterns and themes (grounded in the

data), and the final report is often a framework with accompanying hypotheses to guide future research (Strauss & Corbin, 1990). Methods within this approach vary by rigidity and level of structure. Grounded Theory as proposed by Strauss and Corbin (1990) emphasizes a highly structured method designed to reduce bias from the researcher (it is often referred as the "systematic approach"; Creswell, 2007). While there are variations of this approach that hold value (for example, constructivist approach; Charmaz, 2006), the proposed effort will follow systematic methods of data collection and analyses. It is acknowledged, however, that to some extent the researcher constructs the theory in part through using knowledge, previous experience, and the theoretical lens provided by their previous training (Strauss & Corbin, 2008).

CHAPTER 3: Methodology

Participants

Participants were recruited from an undergraduate summer internship program at a university located in the Southern region of the United States. The sample consisted of 13 total participants; seven from the United States, four from Malawi, and two from Brazil. The sample was 54% male (2 from Brazil, 2 from Malawi, 3 from US). Participants formed a total of four teams (3 teams of four and one team of three). Individually, participants engaged in a series of data collection efforts, including weekly interviews (approximately 15 minutes) and surveys (approximately 10 minutes per survey). Other research-related activities required no additional time commitment. Therefore, on average, the participants dedicated approximately 2.5 hours of time above and beyond normal program requirements, and were given $100 in the form of an Amazon gift card as compensation.

Research Setting

The current research was conducted within a campus facility that enables students from multiple disciplines to collaborate on engineering design projects. The projects in this program were biomedical in nature, and supplied by industry partners. All projects were started from the initial design phase, and were pre-scoped to a level of difficulty appropriate for freshman at the university level. Students carried out the entire design process from concept to delivery to client, including designing, prototyping, and implementing their problem solutions.

Participants were part of a summer internship program developed to provide an intense, seven week design team-based project experience. Students were required to attend the program for eight hours each day. The program was competitive; students were required to have previous

engineering experience and a demonstrated interest in engineering design. Semi-structured interviews were conducted before acceptance, and only the top rated candidates were chosen.

Design

The current approach used a mixed method design; while consisting primarily of qualitative inquiry, quantitative data from surveys was incorporated where appropriate. The design was guided by a framework laid out in Creswell (2003). The author asserts a researcher must answer four critical questions when employing a mixed method design:

(1) What is the implementation sequence of data collection? Data collection was concurrent. Data collection began with a set of quantitative surveys that were designed to capture a pre-training score on experience and stable individual difference characteristics. Implementation of qualitative methods then occurred for the remainder of the seven week program. Finally, quantitative post-test measures were collected via survey at the close of the program.

(2) What method takes priority during analysis? Qualitative data took priority during the analyses. The central approach was a grounded theory method, and therefore quantitative measures were used to further support or explore where appropriate.

(3) What does the integration stage of findings involve? The integration stage used a Concurrent Triangulation strategy (Creswell, 2003). The two methods were used to confirm or corroborate findings within the study. The goal was to overcome the weakness of one method with the strengths of another.

(4) Will a theoretical perspective be used? A specific theoretical perspective was not used apriori, however collection and analysis was guided by previous frameworks of team performance.

Data Sources. I aimed to triangulate measurement by including several distinct data collection methods. However, data was collected with the goal of minimizing interruption to the students and the program. Therefore, the frequency and timing of some of the data collection methods was variable.

Interviews. Weekly interviews were conducted by the primary researcher. Each of the 13 participants was interviewed separately, and interference of important project-related events was avoided. Questions ranged from broad to more specific, allowing participants to give their own viewpoint (i.e., not be guided by the assumptions of the researcher), but also guiding the collection of more specific data as the study progressed and themes emerged (*see* appendix A for question bank). The constructs within the provisional model (Appendix B; for more information, refer to Phase 1 coding) were used to guide the development of initial interview questions. The interviewer used these general questions and probed for more information when applicable. Additionally, efforts were made to make participants feel comfortable and non-threatened (e.g., anonymity and ability to opt out were stressed), and to reduce any inherent power distance between researcher and participant.

Field notes. Research assistants (RAs) were present in the environment throughout the entirety of the data collection effort. When possible, they unobtrusively recorded notes on individuals and teams, as well as teamwork and team functioning. This included identifying individual and collective action (identifying significant processes) and describing the situation and context. Research assistants were given a guide on observational data collection in the field (informed from Angrosino & de Perez, 2000; DeWalt & DeWalt, 2002; Marshall & Rossman, 1989; Merriam, 1998; Wolcott, 2001). While guidance was given on the type of data to collect (e.g., verbal and non-verbal behavior, frequency/duration of interaction), instructions were

necessarily broad so as to avoid any biasing information. At the conclusion of each day or the beginning of the following day, RAs set aside time to elaborate on and type notes as a technique to help mitigate loss or degradation of the data.

Surveys. Individual difference variables of interest in the diversity in teams literature were measured with quantitative surveys. These surveys were administered and collected by the RAs, and were scored and analyzed at the completion of the study (i.e., results were not made known to the researcher during other data collection procedures in an effort to avoid bias). Specifically, each participant completed the following:

Team Orientation. Team orientation was captured with a measure adapted from Mohammed and Angell, (2004). The Likert-style measure included 10 items rated on a 1 (strongly disagree) to 7 (strongly agree) scale. Example items include "Generally, teams are more productive than each member would be working alone", and "I often find that other people make unique contributions that I would not have thought of otherwise." The reliability of the scale reached an acceptable level (Nunnally, 1975) at α= .93.

Personality. Personality was measured with International Personality Item Pool (IPIP) short form. Specifically, extraversion was measured with 10 items rated on 1 (strongly agree) to 5 (strongly disagree) Likert-style scale. Example items include "I feel comfortable around people" and "I don't mind being the center of attention." The reliability for this scale was α= .93. As will be noted later, qualitative analysis pointed to the importance of the assertiveness factor of extraversion, and so this was extracted from the larger overall scale. An example item for the assertiveness dimension was "I have little to say (RS)." The reliability for this scale was α= .70. See Appendix C for the full scale.

Culture. Collectivism/Individualism was measured with scale adapted from Bontempo (1993), Brockner (2001), and Hofestede, (1986). The Likert-style measure included 3 items rated on a 1 (strongly disagree) to 7 (strongly agree) scale. Example items include "When working in a group, harmony should always be maintained" and "It is important to me that I perform better on tasks than others." The reliability for this scale was α= .66. See Appendix D for the full scale.

Performance Measures. Performance measures for the individual and team level were built into the existing program. Performance is defined here broadly as the extent to which a goal or mission is accomplished (Devine & Phillips, 2001). Given the educational setting of this investigation, learning can be considered an individual level performance outcome. Towards this end, both self-report (i.e., skills inventory) and qualitative (i.e., interview) measures of learning were collected. At the team level, the established goal was to create a high quality prototype, and so prototype evaluations were used as a measure of team performance. All measures are typical of the introductory engineering course at this university, and include:

Skills Inventory. The skills inventory was an individual self-report, pre- and post-test measure (i.e., completed at the start and close of the program) of skills related to engineering design process. Specifically, participants rated the degree (i.e., extensive, some, none) to which they had experience with 12 essential engineering design skills (e.g., prototyping, drawing/sketching, computer aided design, molding; *see* Appendix E).

Prototype evaluations. A prototype evaluation was used as a team level performance measure. Evaluations occurred at the conclusion of the program and were scored by two engineering design subject matter experts on a Likert-type scale (*see* Appendix F). Evaluation dimensions include the conceptual/planning phase, the construction phase, testing, and future

development of the prototype. These evaluations were used as a starting point to explore effective and ineffective design team behaviors.

Procedure

Prior to the beginning of the internship program, the study details (requirements, broad purpose, etc.) were carefully explained to participants, and each individual signed an informed consent form. The importance of anonymity was stressed; participants were assured that any personally identifying information would be removed from collected data and left out of analysis or reporting, and that the researcher and research assistants would keep data in a secure location on site. Participants were given the chance during the initial interview to voice any questions or concerns pertaining to the study.

Week 1. Participants were given an overview of the facilities and the program (e.g., safety and internet guidelines, tour of the building, etc.). During this time, the participants also engaged in icebreaker activities as well as a brief introduction to the cultural background of all interns (i.e., 5 minute presentations developed and delivered in teams). They also began an engineering "boot camp" designed to get all participants familiar with each stage of the engineering design process. At the conclusion of week 1, participants met individually with the researcher to complete the first interview.

Week 2. During the second week of the program, participants completed the engineering design boot camp. At this time, all participants were presented with four potential projects, and were given the opportunity to rank order them by level of interest. In total, four teams (Team A, B, C, and D) with three to four members each were formed, and each team was assigned a project. Every attempt was made to match interests, however, some participants received their

second or third choice. Finally, teams were heterogeneous with regards to nationality and gender. Individual interviews continued.

Week 3- Week 6. In weeks three through six, weekly interviews (on Monday and Friday) continued and daily observation was carried out. During week four, teams presented their progress to the lab director, lab assistants, and fellow internship members. Throughout collection procedures, care was taken not to interrupt the natural proceedings of the program or the teams. Therefore, data collection varied slightly from week to week depending on a number of factors (e.g., time restraints, previously scheduled activities), and activities were occasionally replaced by more pressing project-related needs.

Week 7. Data collection procedures outlined in weeks three to six were continued. For the first two days of the last week, teams completed their final prototypes and prepared to present to the group. Final team presentations were held mid-week, and the final two days were used to integrate feedback and prepare the prototypes for delivery to the client. During this time, participants also completed the post-assessment of experience (i.e., skills inventory).

CHAPTER 4: Analysis

Overview

Primary analysis included coding of all weekly interview data (i.e., each of the 13 participants across the seven week period for a total of 91 interviews). A provisional model served as the basis for the initial coding (Appendix B), and the definitions of each variable in the model were considered throughout the process. Broadly speaking, Phase 1 coding served to identify the constructs, using both existing research and field data, to be included in the final model. Therefore, Phase 1 helped answer the following research questions: (1) what individual traits play a role in design team performance? (2) what team processes play a role in design team performance?, and (3) what specific contextual factors exert a top down influence? Phase 2 coding and modeling the data focused more on elaboration of the identified concepts, including identifying patterns or themes and their underlying relationships. In these phases, new tools and techniques to describe, organize, and explain the data (e.g., network analysis, matrices) were introduced. Therefore, these phases helped answer research questions relating to the influence of different primary model components (e.g., how does diversity on identified traits facilitate or hinder team process?) and the influence of contextual variables (e.g., how do contextual factors strengthen or weaken the relationships between individual and team level traits, states and processes, and performance?).

For clarity, analysis is presented as a series of separate components. Importantly, however, qualitative guides emphasize that theory is built progressively throughout the entire coding process (Miles & Huberman, Saldana, 2014). Indeed, while the steps below are outlined chronologically, the process was iterative and analysis regularly moved back and forth between steps. Table 4 provides a broad overview of the analysis process used, developed though

procedures described Strauss and Corbin (1990; 2008), Creswell (2007), and Miles, Huberman and Saldana (2014), as well as through examining exiting qualitative studies (e.g., Klein et al., 2006). The coding procedure emphasized an objective, rigorous, and systematic approach to qualitative data analysis (introduced by Straus & Corbin, 1990). The overall aims were to (1) categorize transcriptions into codes, (2) refine and develop these codes, and (3) identify larger overall patterns/themes. These themes are then investigated more closely to develop a model and overarching theory and associated propositions (*see* Table 4 for an overview of the coding process).

Table 4. Overview of Coding Process

Stage	Processes
1. Develop Provisional Model and Codes	❖ Create provisional model from literature and Subject Matter Experts (SMEs) ❖ Creating a list of initial codes
2. Phase 1 coding	❖ Reading through raw data, and bringing it up to a conceptual level (extracting concepts) ❖ Considering the properties and dimensions of concepts and how they relate
2.1 Open Coding	❖ Identifying major concepts and related quotes ❖ Identifying nomonological network of factors around central concepts ❖ Consider new codes
2.2 Reflective Memoing	❖ Writing records throughout the coding process ❖ Asking questions, making comparisons, noting ideas, brainstorming, noting areas of uncertainty
3. Phase 2 Coding	❖ Refining initial coding ❖ Reducing overall volume of codes for further analysis (i.e., identifying highest quality/richest coding) ❖ Choosing exemplary quotes/thought units
3.1 Pattern Coding	❖ Grouping into a smaller number of constructs, categories, or themes, continuous refinement
3.2 Axial Coding	❖ Identifying relationships between key themes ❖ Elaboration of concepts
3.3 Reflective Memoing	❖ Expanding memos to consider relationships
4. Modeling the data	❖ Generate major categories/concepts for theory generation ❖ Organizing and illustrating the identified conceptual relationships

4.1 Identification of grounded concepts	❖ Identifying and including concepts that have been supported by the data
4.2 Create Construct Tables	❖ Represent variability in constructs/Provide quotes ❖ Aid in theory development
4.2 Model Development	❖ Use network analysis tool in Atlas.ti to develop model
5. Theory development	❖ Generate a grounded theory
6.1 Exploring Relationships	❖ Exploring relationships and intervening variables ❖ Building an evidence chain, considering intervening variables ❖ Compare with conflicting and similar literature

Provisional Model and Codes

In Grounded Theory research, it is not uncommon to begin with a provisional model based on existing evidence (Creswell, 2007). This initial model (*see* Appendix B), importantly, represents only a point of departure based on previous theory and empirical findings. From this starting point, coders put forth effort not to be influenced solely by existing literature or apriori schemas based on experience or training. Rather, to the extent possible, the goal was to reach a more nuanced level of understanding without imposing prior expectations or a firm conceptual framework (Creswell, 2007), and identification of new, understudied, or context-specific factors was expected.

The specific factors within the provisional model were informed by well-established findings from research on teamwork and diverse team performance, and include the perspectives from a broad array of disciplines including industrial/organizational psychology, management, social psychology, and engineering (e.g., core components of teamwork, categorization elaboration model; Salas, Sims, & Burke, 2005; van Knippenberg, et al., 2004). Furthermore, input from Subject Matter Experts (SMEs) in design team performance was included. Two SMEs with extensive experience in teaching and applying the design process rated the included team processes as critical to design team performance.

Phase 1 Coding

The coding process was designed to include both a deductive and indicative approach. A set of initial codes that aligned with the provisional model of diverse design team performance guided this phase of coding. Special attention was paid to understanding diversity as a team composition variable, the influence of diversity on core team processes, and the outcomes essential to performance in design teams. However, representing a more inductive approach, coders remained open to new and disparate factors as they emerged from the data. Changes in the scope or the meaning of existing codes were also considered throughout the process.

Coding each transcript involved the following steps: (1) uploading the transcribed interview document to Atlas.ti, (2) reading through each document, (3) highlighting participant quotes, (4) labeling the quote with an original or new code, and (5) memoing. Importantly, quotes were labeled with a number of overlapping codes or subcodes if the sentence(s) contained rich data (the importance of overlapping codes is considered later). Memoing, or creating reflective or analytic notes, was in itself a coding procedure and captured the researchers thought processes throughout the coding stages. Memos related to any number of factors, including code choices and evolving definitions, emergent themes, concepts, or claims about the data, and any links or perceived connections between constructs (as described in Miles, Huberman, & Saldana, 2014). Memos were embedded in the transcripts; they were linked to specific quotes or codes or served to accumulate overarching thoughts on the data set as a whole.

This initial phase of the analysis, often referred to as "open coding" (Creswell, 2007), was used as a first pass through of the data in an attempt to identify major categories (i.e., "open codes" or families), different properties/dimensions within these categories (i.e., subcodes), and representative quotes. At this stage, the list of codes was "open" in that the coders were

constantly adding/removing, editing, or refining initial codes. For example, "Personality" represented a family code, and "agreeableness [+, -]" and "openness to experience [+, -]" represented different subcodes under the "family" code of personality. Where appropriate, poles were put on each code to indicate either (1) high or low degree of the construct, (2) presence or absence of a construct, or (3) positive or negative valence. Finally, each code was linked directly to a participant quote/piece of the transcript that ranged from just a few words to entire paragraphs.

Transcripts were double coded by the author and a graduate student with expertise in the subject matter. Atlas.ti, a qualitative analysis software program, was used to organize and sort the data, and farther along in the analysis served as an analytic tool (e.g., model conceptualization). Each coder worked through transcriptions separately, using analysis techniques that spurred understanding, idea generation, identification of themes, and relationships between these themes (e.g., asking theoretical and practical questions of the data, comparing to current theory and empirical evidence, making comparisons across different participants; Strauss & Corbin, 2008). Then, coders came together for consensus meetings during which discrepancies in existing codes were resolved and new codes and conceptual disagreements were discussed based on the patterns emerging from the data. During these meetings, coders read through the transcripts a second time together, noting each discrepancy and discussing until an agreement was reached.

As a final step in Phase 1, the codes were developed further into finalized list. This was done using a number of techniques outlined by Miles and colleagues (2014), including: clustering (clumping and organizing certain variables based on conceptual overlap or similarity; e.g., clumping several different types of perceived resources under one code), partitioning where

necessary (unpacking variables that are at too high of a level; e.g., including finer dimensions of personality codes), and counting (considering the number of instances/times a variable was coded, whether the variable occurs in just one team or across teams). The result of this phase was a final set of agreed upon codes (i.e., constructs/variables) that represent the constructs "grounded" in the data (See Appendix G for final code list). The goal was to be as parsimonious as possible while comprehensively representing the phenomena of design team performance. In a sense, this process prepared the coders for more in depth analysis that happened in Phase 2 Coding.

Phase 2 Coding

As is common practice in the literature (e.g, Klein, et al., 2006), the final set of codes was used to take a second pass through the data. Delineated by Miles, Huberman and Saldana (2014), one piece of this phase is pattern coding, or grouping/refining codes into a smaller number constructs or themes (i.e., further refining the original number of codes). The authors note similarity between this step and what quantitative researchers would refer to as factor-analytics techniques, and put forth four main categories (1) themes (e.g., shared mental models facilitate information elaboration), (2) causes/explanation (e.g., differences in personality explain the presence of relationship conflict), (3) relationships among people (e.g., formation of subgroups), and (4) theoretical concepts (e.g., leadership emergence). Pattern coding was an iterative process; in reality, patterns began to emerge in Phase 1, and were updated continuously throughout data analysis.

During this phase, there was an increased attention paid to the process of memoing, in which the researchers took notes to expand upon concepts and their perceived interconnections, and begin to relate them to future theory (e.g., Creswell, 2007). Memos from Phase 1 were

particularly useful in identifying patterns, and were expanded upon heavily in Phase 2. As an example, there was a running memo for each participant, for each team, and for each construct of interest. Memos often referred to how the data either supported or refuted existing theory.

Additionally, this phase included what Straus and Corbin (2008) term axial coding. While it's noted there is some overlap with pattern coding, axial coding has more of a focus on identifying underlying relationships. For example, it was found that a set of open codes (e.g., personality-assertiveness and domain knowledge) were continuously linked to an individual state (e.g., leadership emergence).

Modeling the Data

Identifying Model Variables. After completion of Phase 2 coding, a list of constructs to be included in the final model was created along with matrices to represent variability in these constructs. Inclusion in the model was determined using three factors, namely (1) frequency of occurrence in the data, (2) emergence across all teams, and perceived impact/magnitude of occurrence on team functioning. It is noted that the final model and included variables represent only a slice of the complex phenomena of design team performance; however, the variables chosen appeared to make the most significant impact for this sample.

Table 5 provides these variables, along with the associated definitions, and attitudes, behaviors, and/or cognitions (ABCs). Discussed next, construct tables were instrumental in describing how these variables were represented within the data set through exemplary participant quotes.

Table 5. Definitions and Example Behavioral Markers

Construct	Definition	Example ABCs
❖ **Assertiveness**	Assertiveness is a finer dimension of extraversion (Costa & McCrae, 1995), and is often referred to making one's wants known to others (e.g., Dickenson et al., 2003). Assertiveness is often characterized by the degree of effort put forth to influence the thinking and actions of others, including the tendency to act forcefully or in a dominant manner, or be decisive, outspoken, and direct (Pearsall & Ellis, 2006; May, 2015; Ott-Holland, 2014).	❖ Appearing to tell rather than suggest [+] ❖ Jumping in to talk for someone or complete someone's thoughts [+] ❖ Being vocal or loud [+] ❖ Setting the direction of the project [+] ❖ Rarely speaking up [-] ❖ Not speaking up when you're behind or don't understand [-] ❖ Putting input in "more quietly" [-]
❖ **Nationality**	Nationality is a demographic variable (i.e., characteristic of a specific section of the population) that refers to the status of belonging to a particular nation by birth or naturalization. Furthermore, it is generally a more overt, easily discernable factor (Ford & Kotze, 2006).	(N/A)
❖ **Directness of Conflict Expression**	Refers to "the degree to which the sender explicitly conveys his or her opposition". Includes articulating there is a problem, making your position clear, and direct expression. (Behfar, Bendersky, & Todorova, 2015).	❖ Confronting others with straightforward language [+] ❖ Stopping a conversation if needed [+] ❖ Making the "right way" clear [+] ❖ Difficulty in reading other's non-verbal behaviors [-] ❖ Framing criticisms as suggestions [-] ❖ Addressing a situation away from the rest of the group [-]

❖ **Team Orientation**	A general tendency to consider the actions of others when working in a team. This team attitude includes an emphasis on shared, superordinate team goals over individual goals and a belief that teams are more productive than individuals (Salas, et al., 2005).	❖ A preference to work in teams [+] ❖ Considering other's goals, and helping them to reach these goals (desired learning outcomes) [+] ❖ Supporting others when they are falling behind [+] ❖ Belief that you can improve (and help others improve) through working together/building off ideas [+] ❖ A preference to work alone [-] ❖ Preference to work at your own pace [-] ❖ Failure to seek input form others [-] ❖ Failure to consider the value of other's input [-]
❖ **Previous Experience/Skills**	Previous experience with the procedural skills (e.g., discrete motor responses, along with decisions on what response to make and sequence of response; Schendel & Hagman, 1982) related to the engineering design process.	❖ References to one's own or a teammates previous education ❖ Claim of expertise ❖ Self-report of experience ❖ Ability to use machinery
❖ **Collectivism**	Collectivism has been defined as a characteristic of a society and social patterns and well as an individual tendency. It is the extent to which a social structure emphasizes belonging to in-groups, rewards collective action and group performance, and prioritizes loyalty, commitment, and conformity. (Hofstede & Bond, 1984; House & Javidan, 2004)	❖ Focus on positive information ❖ Indirect communication ❖ Concern with what others are thinking ❖ Setting communal goals ❖ Focus on maintaining positive relationships

❖ **Communication (Information Exchange)**	The team's ability to exchange and comprehend data, ideas, and knowledge, ensuring that messages are accurately received and understood (Gong, Kim, Lee, & Zhu, 2013)	❖ Listening to each other attentively [+] ❖ Equal opportunity for participation [+] ❖ Informing others of your actions/task progress [+] ❖ Seeking others opinion [+] ❖ Little to no input from one or more members [-] o Failure to solicit input o Failure to provide input ❖ Assuming others are thinking the same thing [-] ❖ Disjointed, poorly flowing, or misunderstood exchange[-]
❖ **Communication (Information Elaboration)**	"Individual-level processing of information, the process of feeding back the results of individual level processing to the group, and integration of information" (van Knippenberg et al., 2004, p.1011). Note this does *not* include disagreement. Put more simply, the exchange, discussion and integration of relevant information (Kooij-de Bode et al., 2008)	❖ Deconstructing a difficult problem with teammates [+] ❖ Discussing things thoroughly [+] ❖ Explaining when others are having difficulty understanding [+] ❖ Asking for explanation [+] ❖ Elaborating at the wrong time [-] ❖ Not elaborating clearly [-] ❖ Not elaborating at fully or at all [-]
❖ **Relationship Conflict**	Conflict over team member's relationships (i.e., personal, not related to work), which includes an awareness of interpersonal incompatibilities and affective factors such as tension and friction (Jehn & Mannix, 2001).	❖ Asserting or implying member's ideas are not valuable ❖ Dismissing others information ❖ Frustration or annoyance with the actions of others ❖ Criticism perceived as "harsh" or unwarranted ❖ Unwillingness' to receive constructive criticism

❖ **Task Conflict**	Conflict or disagreement over the team task (i.e., work-related; Jehn et al., 1999). This must include some form of opposition to move out of information elaboration and into conflict (Weingart et al., 2015). Can be characterized positively by confronting issues, playing devil's advocate, and learning to take different perspectives, or negatively by competition and hostile negotiation (De Dreu & Weingart, 2003; Wittenbaum et al., 2004).	❖ Conflicting approaches over how a specific task should be carried out ❖ Debate over ideas when discussing design criteria ❖ Disagreement over how the project should be planned out ❖ Disagreement over the way an individual was performing a task
❖ **Social Integration**	Degree to which group members are psychologically linked to others in the group. Dimensions capture (1) attraction to the group, (2) satisfaction with team members and a desire to sustain relationships, and (3) the degree of social interaction (O'Rielly, et al., 1989).	❖ Equal interaction among participants [+] ❖ Bonding with other team members [+] ❖ Lack of participation in team activities [-] ❖ Grouping based on demographic variables [-]
❖ **Individual Learning**	The principles, facts, or techniques absorbed as a result of a training/educational program (Kirkpatrick, 1967).	❖ Perception that participant gained the desired knowledge and skills [+] ❖ Perception that skill increased from beginning to end of the program [+] ❖ Perception that learning goals were not met [-]
❖ **Team Performance**	Extent to which a goal or mission is accomplished (Devine & Phillips, 2001). At the individual level, this refers to learning the designated material.	❖ Perception that the team has made progress, that they will reach a high fidelity prototype [+] ❖ Perception that the product has met the client needs [+] ❖ Perception that there was only so much that could be done [-] ❖ Perception the product won't look good [-] ❖ Perception the product won't be complete [-]

Creating Construct tables. Construct tables are a means of representing the variability or range in central constructs (Miles, Saldana, & Huberman, 2014), and are helpful for displaying exemplary participant quotes. Each construct that is identified in the final model (and is not a surface level, readily observable variable) has a corresponding construct table below (Tables 6-14). In the current effort, this analytic tool was used to *describe* and *understand* the construct from a qualitative standpoint, and to provide quotes associated with different level codes (i.e., high vs. low, present vs. absent).

Table 6. Construct Table: Team Orientation

Individual Characteristic: Team Orientation	
Level	**Supporting Participant Quotes**
High [+]	❖ "If you're solving a problem as a group, you do it faster than doing it as an individual, because if you're an individual, you're kind of like limited in the way that you think." ❖ "But then if you have a group that's quieter sometimes then you have to pull someone in, both because you have to split the work but then also because everyone is here because they want to, so you want for everyone to get the experience."
Low [-]	❖ "I'm definitely more inclined to work alone….I don't like working on a task with someone. I'd much rather we say like "here you type up this whole document and just get it done." ❖ "For me that was a waste of my time because I was like, I don't need this, I'm not getting anything from it, and we're spending an hour on something that I'm not contributing to."

Table 7. Construct Table: Assertiveness

Individual Characteristic: Assertiveness	
Level	Supporting Participant Quotes
High [+]	❖ "I usually say 'when we get in the morning, I'll tell you guys everything' and then we do that and they ask [participant] and I have to jump in and say all the stuff." ❖ "I feel like [participant] and I were the most vocal and the others were a little less loud." ❖ "I would say [participant] is the most assertive and or loudest, he makes sure he gets the point across." ❖ "I guess the way I phrase things is more of like a 'let's do this' and the way he says it is more of a suggestion. That's usually right. So, I kind of put it 'here's the command' and he puts it as a suggestion."
Low [-]	❖ "He will speak up and say something but he won't do it often so it is me and [participant] most of the time." ❖ "We don't notice sometimes when he's behind. And he won't say it sometimes." ❖ "[Participant] and [Participant] are both quieter so I can't say whether they get confused and just don't say anything." ❖ "[In speaking about not taking a leadership role] I do not really care about that, I think it is good for them since they want to do that. It works and I am not going to complain against that. It is working well so I am not going to say 'Oh we should do that.'"

Table 8. Construct Table: Communication

Communication		
Dimension	**Level**	**Supporting Participant Quotes**
Information Exchange	Low (-)	❖ "It's not really a discussion of what has to happen and [participant] is fine I think." ❖ "I'd ask [participant] 'what do you think'…and they would just smile and nod." ❖ "We'll be talking about something and then 5 minutes later when we've moved on to another topic and [participant] will talk about that topic…sometimes it's weird, it sort of interrupts the flow of our conversation."
	High (+)	❖ "We all listen to each other." ❖ "We go around and periodically share what we found researching…so everyone shared pretty equally." ❖ "If you say something, somebody has to listen…we are given a chance to participate."
Information Elaboration	Low (-)	❖ "[Participant] will put forward a brainstormed idea that I don't understand what he intended by it…and then won't explain it well." ❖ "Sometimes there is a lot of misunderstandings."
	High (+)	❖ "So he stopped and drew something else to illustrate it and explained it until it made sense" ❖ "One good thing we did last week is separate the ideas and explain how each thing is. So everybody in the group is thinking the same way."

Table 9. Construct Table: Conflict

Team Process: Conflict		
Dimensions	**Level**	**Supporting Participant Quotes**
Task	Low (-)	❖ "I don't think we had a major argument. It never came to that point." ❖ "Not really, we haven't really had any conflicts…I'm sure there's been something small, but I don't think there's anything."
	High (+)	❖ "We've had sometimes, maybe many times, where we have two conflicting ideas". ❖ "I feel like we've had a lot of moments where we just don't agree. I don't even remember specifically any situation, but a lot of little things we're just like… Just not agreeing on like what path we should take."
Relationship	Low (-)	❖ "There are no personal disagreements, maybe we disagree on a design choice and talk about it but nothing heated"
	High (+)	❖ "So my approach to people is, I try the best I could to approach them in a way that they don't feel offended. So some people, they don't really care about that. So you could do something, maybe you're doing it wrong, they will laugh at you. So for me, I'm not really comfortable with that. I'd rather someone tell me nicely, come up, "I don't think you're doing it in the right way," rather than making - trying to make fun of me. So I've noticed that in sometimes we'll work with my team members, which for some few minutes you know I'll be upset." ❖ "I do not like negative people. It is really annoying to me when people think everything is going to fail because anytime I do something I try my best to make it work and if people start telling me "it is not going to work" before testing then it is challenging for me to talk to these persons since I do not like negativity."

Table 10. Construct Table: Individual Learning

Team Outcome: Learning	
Level	**Supporting Participant Quotes**
❖ High [+]	❖ "But as part of the process, me and the other teammate, did not have a lot of CAD experience coming in but we are learning through him as he works, and he teaches us too. So it has been a good learning experience in that sense." ❖ "I learned a lot here that I didn't before. I'd say technical knowledge and Arduino, and 3D printing were things I didn't have contact with before. I learned a lot about it and the whole design process and I could practice more interacting with people doing public speeches and presentations."
Low [-]	❖ "[Participant] and I were like 'we'll do the project, we'll like start the presentation'. Because we've both done two presentations. So we kind of knew how the PowerPoints worked. So that, formatting wise we kind of just did it, we knew what we were talking about. And then… So maybe like learning experience wise that wasn't necessarily the best." ❖ "As much as I've completed my project, there's more I wanted to learn… For us, much of the equipment they have here we don't have back at home. For example there was a workshop where we had to use Arduino (a program we use to control machines) so something I wished we spent more time on that and I wish my project was about that."

Table 11. Construct Table: Team Performance

Team Outcome: Performance	
Level	**Supporting Participant Quotes**
High [+]	❖ "I feel like as far as the prototyping is going and how close we are to making a solution that works… we are pretty rapidly prototyping and feel we are on track to finish it in the summer." ❖ "We are feeling really good, actually if it was not for waiting for the orders I am sure that by today we would have something made, we would have had a complete solution." ❖ "Since last week to this week it has gone really well. In the beginning it was kind of slow, all of this scoring and matrixes, its important, but after like prototyping and seeing how the thing is going to be it got better".
Low [-]	❖ "So I think we won't be able to make a fully functional thing. Mostly because…device testing now… testing is very complicated so we won't be able to test it on women in labor." ❖ "I do not think we took enough time planning big picture wise"

Table 12. Construct Table: Contextual Variables

	Contextual Factors: Perceived Resources	
	Level	**Supporting Participant Quotes**
Client Interaction	High [+]	❖ "One of the things I like most about our project, or that has made us a bit able to do more things is because…spending the time with our client. Our client really gave us the good base information." ❖ "The interview was in the morning, it was very, very useful…we got a good amount of useful information."
	Low [-]	❖ "Well it, just for the function of the problem, we've had no contact with our client. Which is actually really upsetting." ❖ "There is no better way to test it then to bring it to the actual client, which unfortunately is not something we can do that often."
Support (Help from others)	High [+]	❖ "[Speaking about RAs] I feel free to ask everything from them and they are always really helpful with me, trying to help." ❖ "We were kind of limiting ourselves. We were just looking at one side of things, but then [program director] suggested that we take a step back from that…"
	Low [-]	❖ "It definitely would have been useful to have an expert…part of is that we do not know the sensitivity we need to have." ❖ "That meeting we had with [program director, RAs] was very helpful. So if we had another one now, in the middle, that would have been helpful"

Table 13. Construct Table: Specialization

Team Cognition: Specialization	
Level	**Supporting Participant Quotes**
High [+]	❖ "Everything we need is at our disposal, if we need help and especially within our team members. We have different skills between team members." ❖ "[Participant] probably has the biggest coding ability. So he often spearheads those conversations. And then not actually coding but more physical electronic stuff is definitely [participant's] expertise… [Participant] did the illustrator workshop so he's good for doing the laser cutting stuff."
Low [-]	❖ "I don't see a whole lot of task division." ❖ "We just all do everything a little bit. We've been working pretty…we haven't really split off our work. So it's not like one person will go do this… Or one person has like role that they'll always do. Um, it's not like one person is responsible. It's OK one person will do this sometimes, the other person will do that at other times."

Table 14. Construct Table: Collectivism

Individual Characteristic: Collectivism	
Level	**Supporting Participant Quotes**
Collectivism	❖ "So, of course now I'm trying to get to understand the inches, the feet, all that…I have to use that, that's how my friends communicate ideas." ❖ "We are all students and as students we are like "please respect this student." ❖ "To be a good leader has to relate with people, understand different people, should be able to study people, communicate with them, be in their shoes, and being able to cooperate every one of every form or of every different way of understanding it and all that. And you should be able to love the people you are leading and being with them at all times."
Individualism	❖ "I'm a very independent person, so I think I'm really going to enjoy- I am rooming with friends, but I have a car and an apartment and so it's going to be nice being more independent." ❖ "One of them said today was a waste of time. Yeah, and it was like, 'What do you mean? That's not a waste of time. We're learning how it works. We're learning, like the computer, and she already knew that, how to work with computers."

Model Development. The concepts that were identified for inclusion in theory generation were then organized and illustrated. The model (or network display) provided an overarching visual organization that depicted the interrelationships between concepts (Straus & Corbin, 2008). It can be thought of as a series of nodes with links (i.e., lines and arrows) between them, representing potentially causal relationships over time (Miles, Saladana, & Huberman, 2014). However, it is strongly noted that while causal relationships will be proposed in the following theory based on the data, the nature of qualitative analysis itself does not allow for true significance tests of causal relationships.

Atlas.ti was used to create the final model using the network editor tool (Atlas.ti 7 User Manual, 2015). The program allowed for the inclusion of codes and subcodes (i.e. Personality as a code, Personality-Agreeableness [+,-] as a subcodes), memos, and direct participant quotes. The model was created in two ways: (1) program generated links and (2) researcher defined

relationships. Specifically, the program automatically populated relationships between codes, quotes, and memos that were linked in the transcripts (i.e., co-occurring codes). The researcher then went into the model graphical user interface and manipulated (e.g., drag and drop) boxes and created and named links with specific relationship (e.g., "is associated with" "is part of" "is cause of"). In this sense, the network editor was a conceptual level tool, and this step was essential to future theory building and hypothesis generation. The program also had a number of other analysis tools that allows for the exploration of frequency and co-occurrence in the data.

Theory Development

Exploring Relationships and Intervening Variables. Miles and Huberman (2014) lay out several methods meant to help move the researcher from descriptive analysis of existing data to generating theory behind the phenomena of interest. This phase broadly includes noting relationships (how X effects Y, considering competing explanations), searching for intervening variables (i.e., analyzing inconclusive relationships for third variables), and building an evidence chain (e.g., considering factors that occur before others, vary with others, or have an effect on others). It is noted that while there is an emphasis on documentation, this is not entirely unlike the process used to develop theory through quantitative methods. The authors put forth more specific tools that can be useful, many of which are matrices or tables used to aid in organizing and explaining.

To be able to appropriately use these tables, however, it was essential at this point to provide more structure to the data. Specifically, Atlas.ti allowed coders to label primary documents (i.e., the transcript of each individual interview) in a number of ways, and then cluster these documents into groups called families for analysis. Toward this end, each document in the current study was labeled with participant number, team number, and time period the interview

was conducted (i.e., Week 1-Week 7). This allowed the data to be examined from a variety of perspectives (e.g., within individuals and teams, between individuals and teams, and longitudinally). Organizing the data in this way was absolutely essential to be able to effectively engage in within and cross case (team) analysis, a critical step in theory generation (Eisenhardt, 1989).

At this point, when investigation turned to looking at the data more closely, the use of matrices to facilitate analysis became essential. Specifically, matrices were used as a means of *understanding* and *organizing* large amounts of data in a condensed format. Variations of the below tools will appear throughout the entirety of the following section. They are presented here initially for clarity:

Conceptually clustered matrices. Additionally, conceptually clustered matrices bring together several constructs (in this case, parsed out by participant/team) for an at-a-glance picture of the data. This was especially useful for investing the configuration or profile of the team and the pattern of team processes across time, as well as for comparing the results of quantitative analysis and qualitative analysis.

Explanatory Effects Matrix. Explanatory effects matrices are tables that help the researcher understand why certain outcomes occurred, and what caused them (i.e., the underlying explanatory mechanisms. This chart is then used in conjunction with looking back over the original data (e.g., contrast researcher explanation with what the participant explanation).

In the following chapter, I present: (1) a grounded theory model of diverse design team performance, (2) unique, context-specific theory supported by previous empirical investigations as well as data from the current effort, and (3) a set of testable findings.

CHAPTER 5: Findings

A Temporally-Based Model of Diverse Design Team Performance

The Input Mediator Output Input structure (IMOI; Ilgen, et al., 2005) of team performance was used as an organizing conceptual framework (*see* Figure 1). While there appears to be a linear flow to performance, the model accounts for the recursive, dynamic nature of teamwork; this is especially applicable to design teams who go through several teamwork episodes over long durations of time, and whose knowledge and understanding of the factors affecting their project is continuously changing. Specifically, the authors state that team performance outputs can become inputs for future cycles (i.e., there is a continual feedback loop), and of utmost importance for the current model and resulting theory, reciprocal influences and interactions between team processes can occur over time to drive performance.

An important element of team performance, and one that is often neglected or not a central factor, is that of time. In putting forth a highly influential taxonomy of team process, Marks and colleagues (2001) address this gap in the literature. The authors assert that teams perform in episodes, or cycles of performance driven by the nature of the task and the team's approach to task completion. In the current teams, this cyclical pattern was clearly evident. As for the nature of the task, the overall design process can be considered to have a team work flow, meaning members are highly dependent on each other, and there is a simultaneous, multi-directional exchange (Van de Van, et al., 1976; Saavedra, Earley, & Van Dyne, 1993). However, task interdependence actually takes on a more complex shape; activities may require more member interdependence further along in the process. For example, researching elements of a project is relatively independent whereas brainstorming and completing the Pugh Matrix requires a higher level of member interaction. A similar concept is described Smith & Eppinger (1997),

who explain a tighter coupling between members as iterations of the product are developed. The team's approach to task completion, on the other hand, is a more fluid variable that depends largely on the outcome of the proposed communication-conflict cycle.

The concept of episodic cycles marked by increasingly higher levels of interdependence throughout the team's lifecycle is a key foundation for the proposed model. As will be discussed later, these episodes are driven in part by the design process, which by its nature requires teams to communicate and engage in activities that bring about task conflict (e.g., brainstorming).

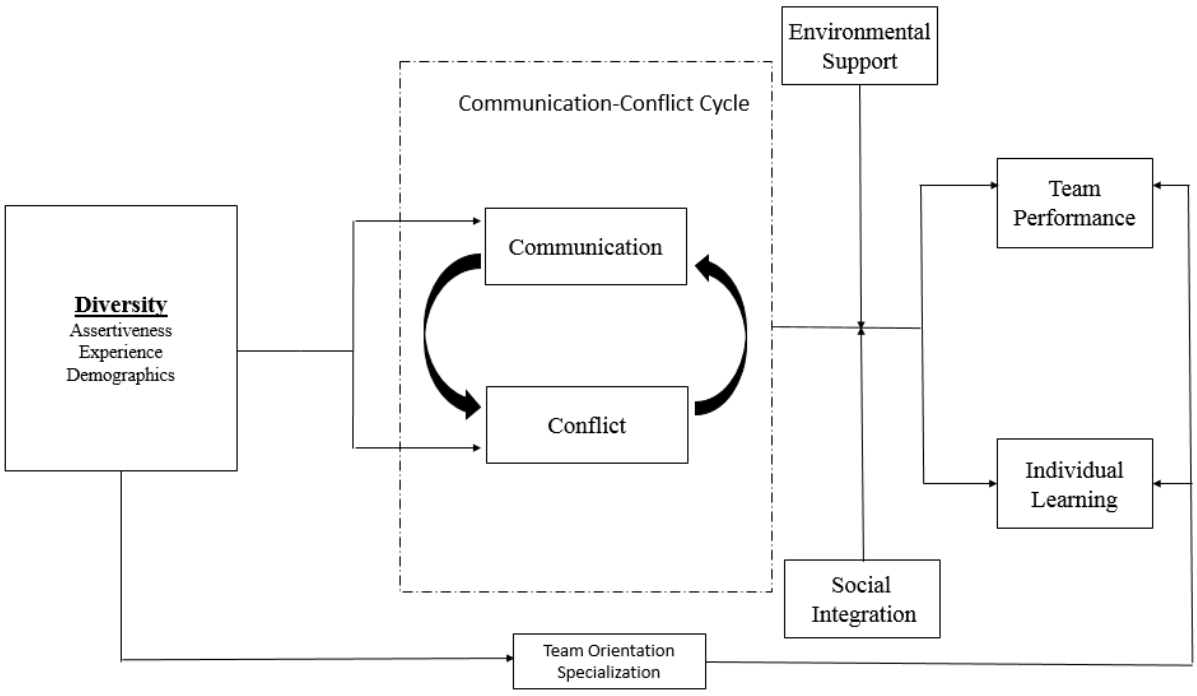


Figure 1. Temporally-Based Model of Diverse Design Team Performance

Throughout both phases of coding, the initial model underwent continuous refinement. Diversity on specific individual difference variables, as well the critical team process diversity influenced, emerged as strongly grounded in the data. Furthermore, certain composition variables were targeted at a more granular level (e.g., assertiveness arose a more specific facet of extraversion), and variables previously not included in the provisional model (e.g.,

specialization) were identified. The roles of some of the initial variables were re-conceptualized (e.g., the importance team orientation and the manner in which it exerts influence on performance). Finally, contextual influences that could potentially change the strength or direction of the process-performance relationship were uncovered.

Identifying model variables. Model variables were identified through three main factors, including (1) frequency in the data, (2) emergence across all teams (allowing for within and cross case comparison), and (3) the perceived magnitude of effect based on the researcher's interpretation. Taken together, the process of coding and model development served to answer the following research questions:

(1) Diversity on what individual traits play a role in diverse design team performance?

Diversity on three individual difference factors appeared as especially salient and grounded in the data, including: (1) assertiveness, (2) previous experience, and (3) demographics. As will be discussed in a later section, demographics (i.e., nationality) serve as a proxy for the more psychologically interesting variable of Collectivism/Individualism (a dimension of culture). Hofestede (1983) indexed 50 countries along four cultural dimensions, finding that the U.S. ranked the highest in individualism. Alternatively, both regions in Africa and Brazil scored relatively low on this bi-polar scale (i.e., they expressed collectivistic tendencies). Qualitative analysis of the data partially supports these findings; however, levels of collectivism (as measured quantitatively) also varied within culture. In a review of the groups and team's literature, McGrath (2000) called for more research not only heterogeneity, but the pattern or profile of member characteristics on teams. Lending evidence to the importance of team profiles (*see* table 15), the relative attributes of members did indeed play a large role.

Team profiles are presented at a high level so as to ensure the confidentiality of individual participants. Self-report data and survey data are presented separately, and

discrepancies are marked with an asterisk. Participants were grouped according to nationality as domestic (labeled "DOM") or international (labeled "INT"). Finally, the initial assessment of perceived skill is reported as difference in experience (i.e., overall *level* of perceived experience with a skill). From qualitative inquiry, it was also uncovered that domestic participants engaged in more hand-on learning activities, whereas international students had gained more theoretical experience through throughout their education, furthering the gap in *type* of previous experience.

To determine the level of a participant trait (i.e., assertiveness, team orientation, and collectivism; *see* Tables 15-16) through qualitative inquiry, several methods were employed. First, participants were directly asked about a number of individual difference characteristics that have proven influential in the team science literature. Here, the strength of the response was considered. For example, participants responded to the question on team orientation in three very distinct ways: (1) a strong positive preference for teamwork, (2) a preference for teamwork only in certain situations, and (3) a strong preference for individual work. Additionally, this was compared to quotes from a participant's team members on perceived level of the same trait (e.g., team member A referring to team member B). Finally, the attitudes, behaviors, and cognitions that emerged indirectly through participant quotes were also considered. To determine the level of a trait quantitatively, cutoff scores were used by calculating the average across all participants, and then separating participants into Low (at least 1 standard deviation below the average), Average, and High (at least one standard deviation above the average).

Table 15. Construct Table: Team Composition

Team	**Personality**		**Demographics**		**Culture**		**Experience**
	Assertiveness (Self-Report Survey)	**Assertiveness** (Qual Data)	**Sex**	**Country of Origin**	**Collectivism** (Self-Report Survey)	**Collectivism** (Qual Data)	**Perceived Experience**
A	High, Average, Average	High, Average, Low*	3M	2 Dom I Int	Low, Average, High	Low, Average, High	High, Average, Low
B	Average, Low Average	High*, Low, Average	2 F 1 M	1 Dom 2 Int	Average, Average, Average	Average, High*, High*	Medium, Medium, Low
C	Average, High, Average	High*, High, Low*	2 F 1 M	2 Dom 1 Int	Average, Low, Average	Average, Low, Average	Medium, High, High
D	Average, Average, Average, Low	High, High, Ave, Low	2M 2F	2 Dom 2 Int	Average, Average, Average, Average	Average, Average, Average, High*	High, Low, Low, Low

Table 16. Team Orientation

Team	**Team Orientation** (Self-Report Survey)	**Team Orientation** (Qual Data)
A	Low, Average, High	Low, Average, High
B	Ave, High, Average	Average, High, High*
C	Average, Low, Average	Low*, Average*, High*
D	Average, Average, Average, Average	High*, Average, Average, High*

Trait-like individual difference characteristics (i.e., assertiveness and team orientation in this sample) are conceptualized as more stable, consistent tendencies (i.e., not specific to a situation or task; Ackerman & Humphreys, 1990; Steyer, Schmitt, & Eid, 1999). But, the difference between quantitative and qualitative analysis may have occurred for several reasons. First, discrepancies may serve as a possible indicator of the strength of the situation. For example, if an individual who generally perceives themselves as average on assertiveness is placed in a team with low assertiveness members, they may assume relatively more assertive behavior and be seen as such by team members. Alternatively, the discrepancy may be explained by the limitations of self-report data or by cultural differences in the understanding of questions on survey measures.

(2) What team processes play a role in design team performance?

The two team processes identified as most salient in the data were: (1) communication, and (2) conflict. As will be discussed further throughout, diversity along different dimensions (i.e., traits) appeared to influence the same underlying team process. Put another way, there was no clear, discernable difference between the influences of the diversity types proposed in the literature (e.g., less-job related vs. more-job related diversity, surface vs. deep level diversity). However, this may also be a limitation of the qualitative method used.

It should be noted at this point that, social integration did indeed develop as a strongly grounded construct. However, it took on a slightly different role than has been previously proposed. Coding for social integration was a challenging endeavor. As noted later, this may be associated with the cultural dimension of collectivism. While speaking more openly about task-related topics (e.g., conflict), many participants were hesitant to make negative statements

regarding interpersonal liking with others. Therefore, observer notes were used as an ancillary data source to confirm findings gathered from interviews.

(3) What specific contextual factors exert a top down influence?

Finally, a number of different contextual factors greatly influenced perceived performance outcomes. The two most salient were: (1) client interaction, and (2) access to an external network of support. The underlying theme that connected these two factors of work environment support was that they both provided access to needed information. The power of the context to change the direction of the diversity-performance relationship was indeed strikingly clear.

In sum, the design teams were diverse on a number of individual difference variables (e.g., personality, motivation, educational background); however, the three most prominent factors that emerged within and across teams included: (1) assertiveness, (2) perceived experience, and (3) demographics. These factors asserted influence through the two primary team processes of communication and conflict. Lastly, the strength and direction of the diversity-performance relationship was affected by both the emergent state of social integration and environmental support variables.

Finding 1: In design teams, diversity in assertiveness, experience, and demographics, the team processes of communication and conflict, and environmental support and social integration all play a role in diverse design team performance.

In the sections that follow, themes are identified and findings based on grounded data are put forth. Finally, unique theory around team conflict and communication is developed.

Diversity and Team Process

Diversity was evidenced to influence the (1) frequency, (2) timeliness, (3) equality, and (4) comprehension, and (5) consideration of input from others. This can be conceptualized as a "pipeline" or flow of information (*see* Figure 2); information must first be shared by everyone before it is needed or before final actions (i.e., decisions, product changes) are taken.

Furthermore, and in order to be useful at the team level, information exchange must be timely and the content understood by others on the team. Finally, information must be considered with respect to the other team processes (i.e., conflict). In fact, sincere consideration and integration of other's unique and conflicting input is key to realizing the benefits of diversity (Janssen, Van der Viert, & Veenstra, 1999).

In the section that follows, diverse composition in regards to three individual level variables (i.e., assertiveness, perceived experience, and demographics) is proposed to influence each stage of communication. However, the design of this study does not allow for exploration of specific causal relationships; as such (and in line with the aim of grounded theory), the findings below set forth a number of potential interpretations to be tested in future investigations. Furthermore, it is important to note that behaviors could not be attributed to any specific dimension of diversity with certainty; therefore, the interpretations are based off of both the data and existing evidence in the literature.

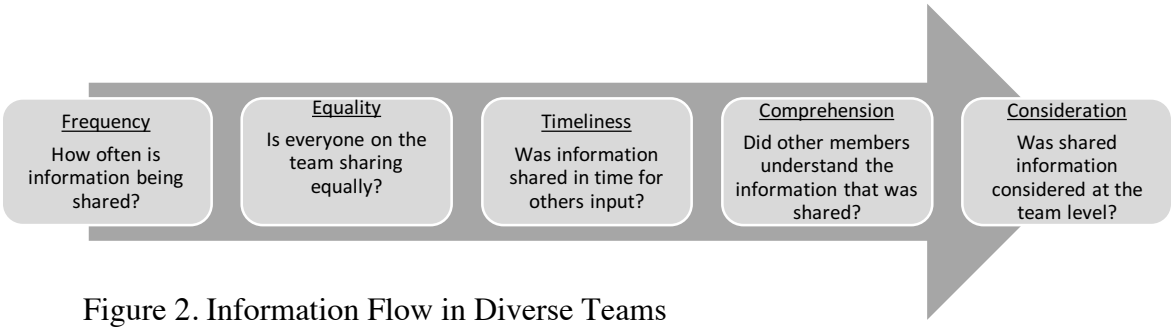


Figure 2. Information Flow in Diverse Teams

Diversity and Team Communication. Communication has received an enormous amount of attention in the team science literature, and as such has been labeled in taxonomies of teamwork as both an important core team process and as a coordinating mechanism for other team processes (e.g., LePine, Piccolo, Jackson, Mathieu, & Saul, 2008; Salas, Rosen, Burke, & Goodwin, 2009; Salas, Sims, & Burke, 2005). Furthermore, there is ample evidence linking

effective communication to a number of team outcomes including performance, cohesion, decision satisfaction, and knowledge integration (Mesmer-Magnus & DeChurch, 2009).

Communication is a broad term, and as such the construct has been operationalized in a number of disparate ways (e.g., uniqueness, openness; Mesmer-Magnus & DeChurch, 2009). However, given that the main benefit of diversity is claimed to be a larger breadth of resources (KSAs) from which the team can draw (e.g., Pelled et al., 1996), the current focus is on exchange and elaboration of this resource (e.g., information, perspectives, and opinions). As noted below, the construct space around the terms used for these pieces of the communication process is somewhat overlapping and in need of clarification. Therefore, Table 17 provides a fine-grained look at how the current effort defines these stages of communication (van Knippenberg, et al., 2004).

Table 17. Stages of Communication

Communication Stage	Associated Outcomes
Exchange	❖ Exchange of data, ideas, and knowledge ❖ Clarification of message if needed
Elaboration	❖ Deeper discussion around understanding ❖ Combining unique information without dissent

Information Exchange. Communication inherently contains the element of information exchange, or the team's ability to share data, ideas, and knowledge, ensuring that messages are accurately received (Gong, Kim, Lee, & Zhu, 2013). As teams are often used when the complexity or difficulty of the task outweighs the capacity of any one individual, sharing knowledge and expertise is paramount to effective team performance (Salas, et al., 2012). Furthermore, the most prominent benefit of diverse teams is unique input from each member, making sharing of unique information of utmost importance. Unfortunately, evidence suggests

that teams tend to share commonly held information earlier and more often throughout the course of discussions, leaving uniquely held information to go unshared (i.e., biased information sampling; Stasser & Stewart, 1992; Stasser & Titus, 1985). In addition, when uniquely held information is mentioned, it may not be seen as salient as commonly held information and therefore not given as much consideration (Cramton, 2001).

In addition to biased information sampling as a general barrier to information exchange for teams, a meta-analysis by Mesmer-Magnus and DeChurch (2009) found that certain factors detract to an even greater degree, and that team diversity was one of these factors. The authors point out that this effect happens despite the fact that diverse teams stand to gain the most from sharing unique information. In line with social categorization theories, the authors hypothesize this is due in part to the fact that members are less willing to share information with individuals they perceive to be different or in the outgroup.

While coming to the same ultimate conclusion, Bunderson and Sutcliffe (2002) offer a different explanation as to why diverse others may be unwilling or unmotivated to share information. The authors argue that team members with different backgrounds and experiences may hold the belief that others will be unlikely to understand. In a similar vein, Cronin and Weingart (2007) suggest members will have a different view of the project based on their own experience, and may find it difficult to communicate with others. Regardless of the underlying reason, the inability, lack of motivation, or unwillingness to engage in information exchange is often cited as a potential downfall of diverse teams.

The current data partially support this assertion, and offers a number of more specific pathways through which diversity on assertiveness, experience, and nationality can have a negative influence on information exchange. First, teams that have a high degree of diversity in

experience, knowledge, or skills may have members that perceive they have the capability to complete tasks on their own, and that input from others is not needed. In turn, these members may then choose to work independently. This can have a negative impact on communication when tasks are completed without obtaining input from other team members (i.e., reducing frequency and equality of exchange), and furthermore when other team members are not updated with new information (e.g., changes made to the project) in a timely or complete manner (i.e., reducing timeliness).

For example, team C had a member high on perceived experience who, although working in the same timeframe, would often complete work individually without soliciting input from team members. In a similar vein, in Team A, a member with a high degree of experience consistently performed individual work at a time the remainder of the team was not available. In both cases, the team was either not informed of the work done (i.e., reduced frequency) or was informed in a manner that was not comprehensive or timely. Taken together, this evidence suggests that members who perceive they have the ability to work alone may do so, and that this has potentially negative effects if the remainder of the team is not asked for input or updated with new information before it is needed.

"[Participant] doesn't tend to ask us for our input when making a change…at that point [participant] has already gone ahead and done it, so everyone is like 'okay, I have nothing to add to add to that because you've done it already."

Secondly, evidence suggests that diversity in team member assertiveness, a facet of extraversion (Barrick & Mount, 1991), can also lead to a loss of valuable task related information and reduced frequency of member input. Across each case, members were able to clearly identify varying levels of assertiveness on the team. This was evidenced not only when directly asked about assertive behavior, but also in the description of member influence on team

interaction.

"I definitely kind of run what we are doing."

"I tend to take over more when we just need to get something done."

The data suggests that in teams with members diverse on level of assertiveness, those high on assertiveness can "overpower" their teammates leading to loss of knowledge, opinions, and perspectives. This is line with the view of assertive individuals as dominant over others (Kichuk & Wiesner, 1998). In every single case (i.e., team), one member was consistently labeled as less assertive by teammates, and did indeed engage in less information sharing behaviors. In considering the situation (i.e. the profile of the other team members), some of these members were only relatively less assertive. In fact, some scored average on the self-report survey measure of the same individual trait. This lends support to the power of considering the profile of the rest of the team.

"The combined forces of me and [participant] kind of overpower…I do it myself and I notice myself doing it."

"It's not really a discussion of what has to happen, and I think [participant] is fine with that."

Interestingly, members of team C asserted that they drove information exchange behavior regardless of their perceived knowledge at the time, suggesting experience and assertiveness have unique and separate implications for subsequent information sharing behavior.

"I know that [participant] and I tend to dominate the conversation all of the time regardless of whether or not we have the requisite knowledge."

Finally, even when members may be motivated and willing to share information, practical language barriers between nationalities may make this difficult. In fact, this barrier was brought up by almost every member of the internship program, and appeared to have an effect across all four teams. Even participants who tended to focus on positive information during interviews with the researcher cited the negative effect of language barriers on communication.

The use of jargon or discipline specific language is often acknowledged as a difficulty in interdisciplinary teamwork (Hall, 2005). The same principle can be translated to the use of different language or measurement systems across nationalities. This can interrupt the pace of information exchange between members and cause communication to appear disjointed. For example, a member unfamiliar with a term may need to stop, put the conversation on hold, or remove themselves for a period of time to look up information. Additionally, if individuals need to convert information between languages or measurement systems, this can cause interference in language retrieval (e.g., Kroll & Stewart, 1994) which may also disrupt the flow of conversation. Ultimately, language barriers based on nationality can lead to difficulty in the timely exchange of information.

"Maybe I'm speaking in a way [my teammates] don't understand."

"I think there is a language barrier a little bit…[participant] takes slower, a different pace. The first day there was a lot of 'Woah, slow down [participant]' or "Whoop, let's let [participant] catch up."

"It's different, it's a little slower explaining some things, not that [participant] doesn't understand but there is a different way of referring to things. When I say tab [participant] participant doesn't think tab means slider. We just want to refer to things in the same way."

"I would say it's a hindrance in that aspect. It's sometimes a problem when we are in discussion and [participant] would pull out his computer."

"Even if you look at the measurements – my teammates will probably be like, from here, 'Oh we should make something, let's say six cubic feet' and I can't picture that, because it's in feet."

'Those [metric measurements] make way more sense to me, but [participant] is like 'no, I can't do metric.'"

"So even for us to read something like an instruction, so we definitely analyze every word to understand better, to actually get a concept of how the thing works."

"When we're talking sometimes I've noticed that there is like, we'll be talking about something and then 5 minutes later when we've moved on to another topic [participant] will talk about that topic."

In sum, diversity in experience, assertiveness, and demographics can negatively affect team information exchange. This occurs through unequal member contribution or overpowering less assertive members (i.e., unequal exchange). It also occurs when input from others is not sought before taking action, the team is not up to date on the latest project-related information, or language barriers disrupt the flow and pace of conversation (i.e., untimely exchange).

However these three individual differences (i.e., assertiveness, perceived experience, and demographics) also led to the use of effective behaviors. Diversity in experience did not always lead to lost information; in fact, it was evidenced to encourage information seeking behaviors from those less experienced. For example, in team B, one team member recalled how he would seek input from a more experienced team member before acting on ideas or making any final decisions; therefore, information was sought in a timely manner before change was made. Specifically, this was done to "run ideas" by others with experience and receive their opinion, thereby facilitating information sharing. Additionally, as evidenced clearly by a member in team D, diversity in experience led to a halt in team action when information is exchange was needed. This member often asked members to stop and clarify or explain ideas and actions to check for understanding. This suggests that diversity in experience can lead to more information seeking behavior.

"So whenever I think of something, I brief it with her and my other teammates to see 'what do you think about this?' So given their points I try to reason through, okay this makes sense."

Interestingly, this behavior may not occur if experience was distributed more equally throughout the team. For example, a team of members who all perceive to have a high degree of experience may not need, or at least believe they need, clarification or more information. Alternatively, a team with uniformly low perceived experience may not believe other members will be able to provide the needed clarification, and may turn to other sources external to the

team. This indeed was the case with team D, and the power of external resources and information are discussed at a later point.

The data suggest assertiveness diversity may also directly result in greater information exchange when assertive members serve to draw out the opinions of members who would otherwise not contribute. This is in line with existing literature from Pearsell and Ellis (2006) that suggests that critical team member's assertiveness, defined as the tendency to communicate with others by sharing ideas clearly and directly, can actually enhance performance. Specifically, assertive behaviors from the leader can facilitate the communication process, and serve to create shared knowledge between members (Pearsall & Ellis, 2006; Smith-Jentsch, Salas, and Baker, 1996). In fact, assertiveness training has been described as part of many successful team training programs, improving both team process and performance (e.g., Crew Resource Management; Salas, Cooke, & Rosen, 2008).

In other words, assertive members in a leadership role can guide less assertive members and get the team "on the same page" as they move throughout the design process by using information soliciting behavior. For example, for Team D in which a clear leader was identified, and furthermore in which the leader was characterized by others as more assertive, the below quote was extracted:

> *"So we would usually just sit and talk and say 'okay so what do you think, why do you think it's best and why do you think that would not work, and then talk through... what I'm not seeing with this and what do you see that I don't."*

Finally, the perceived language barrier between cultures facilitated information exchange to some degree. In a sense, it forces members to clarify their ideas and the specifics of what they are trying to communicate. For example, in Team B a member was forced to look something up, and this information was then fed back to the team and discussed to facilitate understanding.

"The language barrier is almost a helpful thing sometimes… when he is trying to explain what he thinks it is and we have to explain what we think it is, the difference in understandings is actually helpful sometimes by overly clarifying something."

In sum, diversity in experience, assertiveness, and demographics can also positively affect team information exchange. Diversity in experience may result in members checking for understanding and seeking input and feedback before any taskwork is completed (i.e., timely exchange). Assertive leaders may solicit input from quieter members who would otherwise not contribute (i.e., equal exchange). Finally, unfamiliar language may force the team to come together and discuss terms they otherwise would not and to provide additional clarifying information (i.e., frequent exchange).

In sum, the finding that diversity can result in both ineffective and effective communication behaviors is in line with non-significant findings in the literature (e.g., Stahl et al., 2010). Importantly, teams that ultimately realize higher performance share information between members often. Information sharing behaviors occur equally across members on the team. Finally, effective teams share information in a timely manner, obtaining input before completing pieces of the tasks and updating members frequently.

Finding 2: Effective diverse design teams exchange information in a (1) **frequent** (2) **equal**, and (3) **timely** manner.

Information Processing/Elaboration. As previously stated, communication can be conceptualized as a multi-stage process; once team member information is shared, it must then be considered at the team level to influence performance. Towards this end, a number of related constructs have emerged that target the use or application of information at the team level. Dahlin and colleagues (2005) found that increasing diversity positively influenced the range and depth of information use, which are related to the amount and type of information exchanged. However, higher levels of diversity negatively influence *information integration* (i.e.,

consideration of relationships among topics). Similarly, *information elaboration* is defined in part as "individual-level processing of the information and perspectives, the process of feeding back the results of this individual-level processing into the group, and discussion and integration of its implications" (van Knippenberg et al., 2004. P. 1011). Put another way, elaboration is distinct from exchange because it focuses on how new information is managed when brought to the team level.

Evidence suggests that information elaboration fell into two overarching themes across the four teams. First, and as recognized by participants across each team, discussion often occurred simply as means to clear up misunderstandings or misconceptions about the information exchanged. The disagreement, then, is not grounded in the task itself. It is grounded in being able to describe and critique ideas clearly, and being able to interpret the meaning of what other members are saying accurately. Put simply by one participant:

"It's usually just someone wasn't on the same page."

When probed about why these misunderstandings occur, participants responded that often information is overlooked or missing. Alternatively, there was often a focus on the wrong information (e.g., belief that members are referring to one part of the prototype and not another). This highlights an important point proposed by van Knippenberg and colleagues (2004), and recognized by several participants. Namely, elaboration in the sense of building off of each other's expertise may only lead to effective information processing to the degree that members have the ability or experience necessary to effectively engage in this process. As many of these participants were in their freshman or sophomore year at the university, or otherwise did not have extensive experience with hands on prototyping, novice levels of experience would be expected. Furthermore, diversity in experience may have compounded the issue, increasing the

difficulty of understanding a team member with more knowledge or skill. This was in fact perceived by participants:

"At least now, it's not so much like there's 10 different things we have the ability to build, and which one do we want to build. A lot of its like what CAN we build. Baby steps forward. So in that respect it's more of an understanding thing than conflicting ideas."

"The thing is, there are a few differences in what we know, so it would be - sometimes it would be hard for one to understand something, so we have to explain it over and over again so that we are all on the same page"

"Most of the time when we have a disagreement is just someone is interpreting what they are saying wrong from what they meant. It is not like from their standpoint that they are totally right but I might say "let's make this larger" and he might think I was talking about a different part of the piece and ask " why would we make that part larger?" and we go back and forth."

Therefore, in novice engineering design teams, much of the time spent elaborating was directed toward attempts to gain a shared mental model of the task and proposed ideas. Importantly, shared mental models have been demonstrated to be an essential team construct for effective team process (Cannon-Bowers, Salas, & Converse, 1993).

"At some point one understands it in a different way while it means the other or you've just never encountered it before so… yeah that's the part I can say that there could be some - a little communication breakdown…we talk about it and then we ask each other questions and for clarification, everybody understands and we are all on the same page".

Indeed, effective teams spent more time elaborating on information and ultimately came to a more shared understanding of each other's ideas. These teams did not move on without one team member, and instead there was an emphasis on re-explaining when things were unclear.

"But there were some times when it's not simple so we had to basically talk through and keep talking until everyone was on the same page."

Finding 3: Effective diverse design teams elaborate on information to develop a shared understanding.

In a separate theme, teams did in fact engage in discussion and integration of disparate ideas, focusing more on weighing the relative merit of each idea rather than simply attempting to

understand each other. This moves the team process out of elaboration or clarification of misunderstandings and into task conflict, characterized by some degree of opposition (Weingart, 2015). In this way, communication and conflict are intricately linked; communication acts as a vehicle for the transmission of task conflict.

Diversity and Task Conflict. Pelled, Eisenhardt, and Xin (1999) argue that conflict may play a powerful explanatory role in the diversity-performance relationship. The authors define conflict simply as disagreement about task issues, which can include anything from overall project goals to the daily decisions and choices of action made throughout the team's lifecycle. Evidence suggests that diverse team members, who may fundamentally view and approach problems differently, do indeed often lack consensus on appropriate strategies for the task (Knight, et al., 1999).

At its core, conflict results from tension caused by real or perceived differences. Jehn, Northcraft, and Neale (1999) make an often cited distinction between task conflict (stemming from different approaches to or views of the teams task/goals) and relationship or emotional conflict (stemming from interpersonal differences in personality, values, etc.). Relationship conflict is almost universally accepted to have a negative impact on performance, but the idea that task conflict can drive further discussion around problem approaches, goals, and decisions, and therefore can improve team outcomes (e.g., decision understanding, commitment, and quality; Olson, Parayitam, and Bao, 2007) has long permeated the literature.

Despite the intuitive appeal of this assumption, meta-analytic evidence from De Dreu and Weingart (2003) suggests a negative relationship (but with considerable variance) between task conflict and both team performance and satisfaction. The authors suggest that conflict of any kind causes stress and increases cognitive load, thereby detracting from the team's capacity for

task-related information processing. It is strongly noted here that this task related information processing is precisely the mechanism that is supposed to underlie the benefits of diversity on performance. Therefore, this is especially problematic for diverse teams.

The results of the DeDreu and Weingart (2003) meta-analysis garnered significant attention, and spurred a vast amount of additional research. More than 80 empirical studies were conducted before a second meta-analytic investigation by De Wit and colleagues (2012); in contrast to the previous results, a negligible relationship between task conflict and performance and a small to moderate negative association between relationship conflict and performance was found. Analyzing a highly overlapping subset of the same literature, O'Neill, Allen, & Hastings (2013) found task conflict had a small (yet significant) negative relationship with performance. An overall summation of the literature concludes that empirical support is at best inconsistent; in reality, it appears task conflict may not be as beneficial as previously believed.

Task conflict in design teams. Specifically in design teams, conflict has been evidenced to be a central team process (e.g., Borrego, Karlin, McNair, & Beddoes, 2013; Karn & Cowling, 2008; Pelled & Adler, 1994). Therefore, setting aside whether or not conflict can be beneficial, it is argued that conflict should be prevalent in design teams. This was in fact clearly evidenced in the data. By week 3, each team had reported at least one instance of task conflict in the form of opposing ideas or approaches to the task, and as time went on the prevalence of conflict greatly increased. This could be expected as teams moved from more individual or neutral activities (e.g., researching, client interviews) into the brainstorming and Pugh matrix scoring stages of the design process.

"*It's very feasible sometimes where we're discussing two ideas, which one should we go with and two people could have very different thoughts on the same idea.*"

Indeed, the nature of the task design teams engage in may breed conflict. Following the stages of the design process, teams engage in divergent processes (e.g., brainstorming) that are intended to bring out differing ideas and opinions followed immediately by convergent processes (e.g., evaluation of solutions) intended to restrict the amount of ideas (Farh, Lee, & Farh, 2010). The potential for differences in opinion on the how the project should move forward is great. Therefore, in line with previous findings in the literature (e.g., Bell, 2011), team type is proposed to be associated with level of conflict, such that:

Finding 4: In design teams, there is a strong positive relationship between diversity and task conflict.

Inside the Black Box of Conflict: Unpacking the Communication-Conflict Cycles

The contingency approach to task conflict. Given the strong positive relationship between diversity and task conflict in design teams, understanding the subsequent effect of task of conflict on team performance becomes essential. As previously stated, meta-analyses of the literature have suggested this relationship can be negative, positive or non-significant (DeDreu & Weingart, 2003; DeWit, Jehn, & Greer, 2012; O'Niell et al., 2013). In attempting to explain these equivocal findings, researchers have turned to elements of the task (e.g., interdependence, routiness, uncertainty) the team (e.g., affect, climate, acceptability norms, team type) and the conflict process itself (e.g., conflict management, conflict resolutions) in what has been termed the "Contingency Approach" (De Dreu & Weingart, 2003b; Jehn, & Bendersky, 2003). While this approach is still strongly represented in the literature (e.g., Bradley, Anderson, Baur, & Klotz, 2015; Martins, Schilpzand, Kirkman, Ivana, & Ivanaj, 2013), it has led to what DeDreu (2008) refers to as an exceedingly narrow set of circumstances or conditions under which task conflict can be functional or beneficial.

Recent reviews (e.g., Amason & Loughry, 2014; Bendersky et al., 2014) have acknowledged this trend in the literature, and suggested that characteristics of the manner in which conflict is assessed (i.e., the measure itself as well as the data collection process) may in large part contribute to equivocal findings. In line with this research, I argue that while the contingency approach is a valuable theoretical perspective that has furthered or understanding of task conflict, it is now time to take a step back from the contingency approach to examine how conflict is conceptualized and measured.

Conceptualizing and measuring conflict. According to Loughery and Amason (2014), methodological issues present in previous studies have added to the difficulty in developing a deeper understanding of the effects of conflict on performance. The authors provide an overview of these issues, including: (1) measurement error (i.e., trying to obtain a "true score" of conflict when there are differing perceptions), (2) failure to capture the reciprocal effects between the conflict types, and (3) temporal issues (e.g., looking at critical team lifecycle points). The longitudinal, mixed method designed used in the current effort addresses each one of these points.

In large part, teams did not have consensus on an overall "true score" of conflict. Previous research has largely looked at the overall or shared level of conflict (e.g., DeDreu, 2006), while ignoring within group differences among members. One notable exception is Jehn, Rispens, and Thatcher (2010); the authors look at "conflict asymmetry" or "the degree to which members differ in perceptions of the level of conflict in their group" (p. 596). Findings suggest that task conflict asymmetry is associated with lower levels of performance, creativity, and individual member satisfaction with the group. By gaining information on each individual's perception of conflict, information that would have otherwise been lost in averages was captured.

In fact, it is argued that capturing these differences is essential to understanding conflict at the team level. Below, you can clearly see the existence of relationship conflict asymmetry:

"They expressed to me that they thought that my suggestions for improvement were too critical. I never knew that they felt that way."

A separate methodological issue is the reciprocal effects between the conflict types. In much of the existing research, the effects of conflict types on performance have been considered in silo or in respect to the different levels of each (e.g., Bradley et al., 2012). The evidence available in this study suggest that the two conflict types are inextricably linked; while not denying the possibility that relationship conflict could develop separately, it appeared here to stem in large part from what initially began as task conflict. This would be supportive of the numerous studies (e.g., Jehn et al., 2010) that have found a strong relationship between these conflict types when measured concurrently. For example, the below quote is extremely difficult to parse apart into separate conflict types:

"Sometimes she just gets frustrated with [participant] and sometimes she can have more of a condescending tone like '…we really need to do this.'"

As a third point, Loughry and Amason (2014) suggest that it is essential to look at temporal issues such as the duration or fraction of the team's lifecycle spent in conflict. The authors argue that too much time spent in conflict could lead task conflict to spiral or spill over into relationship conflict. In a slightly different vein, the evidence here suggests that it is not *how long* the conflict continues on, but *how it is expressed* at the time that initiates spiral into relationship conflict. As a unique contribution, this effort examines not only the conflict episode, but its effect on future team process. It is argued that investigations of the conflict-performance relationship that fail to look at this process temporally, and how it influences other critical process further in the team's lifecycle, will fall short of a comprehensive understanding of this

complex phenomenon. Indeed, it is the communication-conflict cycle, and how it unfolds to affect future communication, that ultimately drives performance.

Indeed, Bendersky and colleagues (2014) assert that measures of task conflict often fail to consider crucial aspects of *how* conflict is expressed and experienced on the team. Put simply, there is more to consider than the presence or absence of perceived conflict. Specifically, the most widely used measure of task conflict (i.e., the measure published by Jehn, 1995) fails to capture crucial conflict features, including the intensity of opposition, the perception versus behavioral manifestation of conflict, and the more subtle nuances (e.g., inquisitive deliberation versus personal advocacy). Perhaps one of the most influential features that has been overlooked is the focus of the current effort; namely, the directness of conflict expression.

Conflict Expression: Directness

Conflict expression is defined by Weingart and colleagues (2015) as an observable statement or demonstration (i.e., verbal or non-verbal) of opposition. Put simply, it is the manner in which conflict is communicated to another team member. The authors include the importance how the receiver experiences this communication; indeed, a wide range of receiver emotions can occur (e.g., frustration, anger, excitement, confusion) from the perception of conflict. One critical element that influences this perception is directness of communication, or the explicit versus implicit display of opposition.

Of importance to the current study, team members varied significantly in the directness of their conflict expression. While directness was not measured explicitly, this facet of communication style is closely associated with COL/IND (collectivism/individualism dimension) of culture (Hofstede, 1980). In a review of the literature, Oyserman and Kemmelmeier (2002) found that a collectivistic tendency is equated with ambiguous and high

context (i.e., how something was said) communication. Additionally, COL was associated with a concern for other's feelings and maintaining positive relationships, as well as avoiding negative evaluation and concern for self-presentation. Alternatively, IND was associated with more straightforward and low-context (i.e., what was said) communication. IND was also associated with a concern for message clarity and goal-directedness.

However, while not denying cross-cultural differences in communication style, Park and colleagues (2012) assert there is also substantial individual variation with cultures. The authors point to numerous dimension of individual differences (e.g., personality) that may alter the effect of culture or socialization on the individual. Put another way, individual traits commonly associated with a specific culture, such as assertiveness with IND (Grimm, Church, Katigbak, & Reyes, 199), can also vary within culture. Therefore, while clear differences in direct statements and behavior were found, they cannot be attributed to either COLL/IND or assertiveness (and likely stem in part from each).

According to the proposed conflict-communication cycle, directness of communication effects how conflict is both expressed and perceived by others. In expressing conflict, those less direct or overt may focus more on maintaining relationships with others (Ohbuchi, Fukushima, & Tedeschi, 1999) or face management (Holtgraves, 1997). Therefore, evidence suggests they may use obliging, avoiding, and compromising styles to a greater extent than their more direct counterparts (Trubinsky, Ting Toomey, & Lin, 1991). Alternatively, according to Ting-Toomey's (1988) conflict face-negotiation theory, direct communication is associated more with a dominating conflict style. Importantly, the author's point out this style may be seen as forceful or aggressive in small group interaction, and may even be viewed as hostile.

Regardless of the source (i.e., collectivism/individualism or assertiveness) of directness, it is argued that heterogeneity in this construct among team members has the potential for expressions to be seen as rude, insincere, or argumentative by those less direct, or as avoidant and passive aggressive by those more direct (e.g., Martin & Anderson, 1996; Taras, et al., 2007). Additionally, directness effects the amount of inference needed to interpret a message, and therefore the possibility of misunderstandings of information or intent when styles do not match. Differences in communication style, and specifically in the directness of communication, can therefore push task conflict into the domain of relationship conflict. The conflict behaviors that indirect individuals engage in (e.g., avoidance of real meaning, withholding information, passive aggressive behavior) are not compatible with the behaviors used by those that are more direct (strong language, explicitly/unambiguously conveying conflict). Importantly, this can be expressed in verbal or non-verbal terms (e.g., eye contact, proximity to speaker).

Clear examples of relationship conflict that emerged when more direct participants were communicating with their less direct teammates can be seen:

"I always tell them. Sometimes their reaction is a little bit bad. The other day [participant] was testing something and I was like 'you know you could do it this way'?, 'she was like 'just let me finish.' I said 'I am sorry I don't mean it in that way'. I just try to help and to them I am criticizing but I am not. I am just seeing there is a better option."

"So whenever someone is doing their own thing, I mean they're working on something, whether I feel it's wrong or not, I don't really criticize them because I know if I criticize them I'm only going to limit that person. Maybe I might even mess up his day. So my approach to people is, I try the best I could to approach them in a way that they don't feel offended. So some people, they don't really care about that. So you could do something, maybe you're doing it wrong, they will laugh at you. So for me, I'm not really comfortable with that. I'd rather someone tell me nicely, come up, "I don't think you're doing it in the right way," rather than making - trying to make fun of me. So I've noticed that in sometimes we'll work with my team members, which for some few minutes you know I'll be upset. I won't be happy about it."

"In the beginning when you're trying to come up with a solution and someone tells you it's not going to work or they don't believe in your solution you lose faith before you even start. That kind of sucked."

"[Participant] really appreciates eye contact, but… when I really want to focus on something, I don't look at someone. I look off to the side and I'll listen to them because that's how I process better. But for her that means I'm ignoring her and staring off into the distance. So it was just like little stuff like that that can really grate on the edges of a team."

"It is really annoying to me when people think everything is going to fail because anytime I do something I try my best to make it work and if people start telling me "it is not going to work" before testing then it is challenging for me to talk to these persons since I do not like negativity."

The above quotes demonstrate how the lines between task conflict and relationship conflict can be blurred, and evidence of high correlations between the conflict types suggests they in fact often do co-occur (de Wit, Greer, & Jehn, 2012). It is argued that task conflict expression can lead to or blend into relationship conflict, such that the two conflict states are often inextricably linked. Theoretical developments in the literature have begun to consider the profile of team conflict (i.e., the configuration of conflict levels on the team; O'Neill et al., 2015); the current effort extends this further by considering how these profiles develop. Specifically, diversity in the expression of task conflict can trigger the onset of relationship conflict. Diversity in the directness of conflict expression is one possible route through which this occurs.

Finding 5: Diversity in task *conflict expression* is positively associated with relationship conflict.

Future Team Process

As previously mentioned, the vast majority of extant literature approaches conflict as a singular event or team state, and largely ignores potentially important temporal issues (Loughry & Amason, 2014). A notable exception to this is Behfar and colleagues (2008); the authors look at specific conflict resolution tactics in 57 autonomous teams, and the effect of conflict resolution on future conflict states. Of the teams that experienced and openly discussed relationship conflict, none reported that this changed or eliminated the conflict in the future. Meta-analytic evidence from DeChurch and Mesmer-Magnus (2013) supports these results;

approaching conflict with open conversation when it is interpersonal in nature results in a strong negative correlation with team effectiveness. Taken together, these results suggest that once the team has reached the stage of relationship conflict, it is unlikely to be addressed in a way that improves future team process or performance.

Taking this line of research one step further, qualitative analyses investigated the link between initial relationship conflict and both future communication and conflict over time (*see* Figure 3). Specifically, patterns were analyzed midway through the internship program (also coinciding with the first project presentations) in week three. The teams were then separated into those that experienced relationship conflict in weeks one through three (i.e., Time 1) and those that did not. Team process was then analyzed a second time and included weeks four through seven.

In line with the previous findings, task conflict continued to increase throughout the lifecycle of all teams. However, in cases where high levels of relationship conflict were avoided Time 1, increases in *effective* communication behaviors were realized at Time 2. The opposite pattern held for cases where high levels of relationship conflict occurred as Time 1; increases in *ineffective* behavior patterns were realized. In sum, relationship conflict had an escalating effect which will be explored further in the following sections.

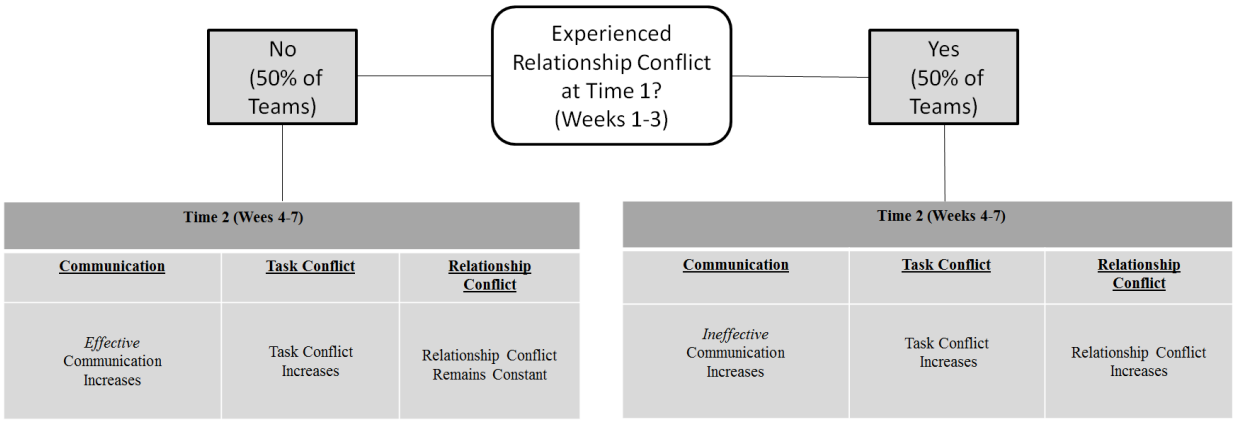


Figure 3. Effects of Relationship Conflict on Future Team Process

Future Communication. Moving forward, analysis isolated the teams that experienced relationship conflict at Time 1, which was previously argued to develop from differences in task conflict expression. Unfortunately, the data suggest that teams are unable to regain effective communication after the onset of relationship conflict. Instances of ineffective communication and information elaboration increased after open conflict, indicating teams may have been failing to share information altogether or to have discussion around information after it was shared. This process may have unfolded in a manner similar to the example below (*see* Table 18).

Table 18. Future Communication (Example)

Conflict Expression (Sender's Perspective)	Conflict Expression (Receiver's Perspective)	Future Communication (T2) (Accommodating)
"I'm just seeing there is a better option."	"So one thing I've noticed is that element of 'My idea is better, it is stupid to do it that way'."	"So there are moments when I would bring in my idea…But since it's a two against one thing, I just, sometimes I give up.

The intensity of ineffective communication behaviors also increased. Member's "tuned out" of conversations, disregarded the input of others, and engaged in personal advocacy. This

can be broadly characterized as personal advocacy, forcing behaviors and accommodating behaviors (see Table 19).

Table 19. Accommodating, Forcing, and Personal Advocacy Behaviors

Ineffective Behavior	Definition	Participant Quote
Accommodating	Giving into other's ideas (Jansen et al., 1999)	*"So there are moments when I would bring my idea, where my two teammates they have an idea which they think is [best], but for me I still think no, it's not there yet. But since it's a two to one thing, sometimes I just give up…"*
Forcing	Pushing the ideas of one or the majority on others (Jansen et al., 1999)	*"So someone like [participant] who is like "let's do brainstorming" we say "no we have to do design criteria". It is a lot easier having two people on that. You can handle one off the book person vs. three". C*
Personal Advocacy	Failure to be receptive to information that does not reflect one's (Bendersky et al., 1999)	*Even so if you tell them, they won't take it openly. They will think what they have done is good, even if we are doing scoring they will back up their points because they are the ones that work on them."*

Consensus on a conflict resolution strategy did little to ameliorate the issue. One plausible explanation for this it was not possible for teams to discuss interpersonal issues removed from emotion. In fact, these conversation were interpreted by some as airing what members "didn't like" about each other. Borrowing from the extensive leadership on feedback (DeNisi & Kluger, 2000; Kluger & DeNisi, 1996), it is well-established that feedback is more likely to cause harm than good when directed toward the person instead of the task or behavior in question. This is particularly important for negative feedback, which can lower self-esteem or threaten a person's self-concept (and indirectly detract one's motivation, effort, and focus towards a task performance).

"We started, like, a 25, 30 minute conversation about everything we do, like, we didn't like it about each other. Like other people said to me in how we are treating each other."

An alternative explanation put forth by Jehn and Bendersky (2003) is that task interdependence acts as an amplifier of the conflict-performance relationship, such that increased amount and intensity of interaction will boost the positive effects of task conflict on performance. However, the author's assert that this necessary interaction will also magnify the negative effects of relationship conflict when members are forced to continue to interact. Indeed, task interdependence did appear to be salient; ineffective behaviors increased in the second half of the team's lifecycle when interdependency requirements rose and tighter coupling was needed to complete team tasks. In sum, after a team experienced higher levels of relationship conflict in the first half of the project lifecycle, ineffective communication behaviors became more frequent and often increased in magnitude. Overall, the interpersonal nature of relationship conflict may be difficult to resolve, and compound over time, Additionally, rising requirements for team member interaction may have amplified the effects of relationship conflict.

Finding 6: Relationship conflict at T1 will lead to an increase in the (1) **frequency** and (2) **intensity** of ineffective communication behavior at T2.

Future Conflict. The data also suggest that instances of both task and relationship conflict continued to rise. However, conflict-related behavior became less direct after open communication. This was evidenced in a number of ways. First, participants were surprisingly more open as time went on with statements about perceived task and relationship conflict during interviews. While these members were no longer bringing issues up amongst themselves (or to a lesser extent), they were using an alternate route. This suggests that the target of task conflict expressions changed to a more indirect route via a third party, but that it was still clearly present (Weingart et al., 2015). Second, analysis turned to observer records to corroborate findings for a more robust argument. Indeed, both observers recorded behaviors that could be considered conflict, including: interrupting members while they were speaking during meetings, withdrawal

and reduced interaction with the team, dominating team pitches and presentations, being pushy or overbearing with task delegations, completing tasks separately from the rest of the team's members, leaving member's out of impromptu meetings with external sources of support (e.g., research assistants), assigning team member's shorter speaking parts, and passive aggressive jokes.

In sum, task conflict was often expressed via third party, and the behaviors engaged in were less direct and open, albeit more frequent. After open discussion, conflict was less direct, but was clearly boiling under the surface. Finally, observer records indicated that these behaviors increased in intensity over time.

Finding 7: Relationship conflict at Time 1 will lead to an increase in the (1) **frequency** and (2) **intensity** of relationship conflict at Time 2.

The Role of Social Integration: Avoiding Relationship Conflict

O'Neill and colleagues (2015) argue that a conflict profile consisting of high task conflict and low relationship conflict represents a team-centered approach. More recent meta-analytic evidence supports this assertion, with task conflict and performance being more positively related when the presence of relationship-oriented conflict was weak (de Wit, Greer, & Jehn, 2012). In the proposed theory, this profile would be facilitated by engaging in task conflict in way that does not develop into disagreement that is more interpersonally-based. This was evidenced by teams who either (1) avoided relationship conflict altogether (or experienced very low amounts), or (2) found an outlet or alternative way to express this conflict that did not damage personal relationships. For example, the use of joking and teasing as a means to convey conflict in friendly manner was a readily apparent strategy:

"I don't say it as nicely. I think they know I'm joking around. Like if [participant] misses something I would be funny, be like 'You had one job, one job!'…If I break it, they will be like "What the heck!"

The conflict literature would suggest this team-centered approach is a difficult state to achieve, and occurs only under a very limited set of circumstances (DeDreu, 2008). Therefore, conflict researchers have in large part moved away from looking for direct relationships between conflict types and performance, and into these specific contingency factors (Behfar et al., 2008). For example, Bradley and colleagues (2012) suggest a psychologically safe climate as one condition that actually allows the benefits of task conflict to be realized. It is noted that this is a relatively new shift in the literature, and meta-analyses of the team conflict literature (e.g., de Wit, Jehn, & Greer, 2012) have not yet begun to include team level states. Towards this end, a pattern that emerged from the data, or the common thread that set the teams that experienced escalating relationship conflict versus those that did not apart, was a high level of social integration.

Social integration (SI) may in fact stop relationship conflict from occurring even in the face of task conflict and heterogeneity in directness of communication style. SI is defined by O'Reilly, Caldwell and Barnett (1989) as "the degree to which group members are psychologically linked to others in a group" (p.22). The authors note the multi-dimensionality of the construct, with factors that capture (1) attraction to the group, (2) satisfaction with team members and a desire to sustain relationships, and (3) the degree of social interaction. Harrison, Price, and Bell (1998) investigate the affective dimension of SI. The authors stress the importance of time in the unfolding of SI; over time, teams have the opportunity to share experiences and learn interpersonal information about members (e.g.., similarities and dissimilarities).

However, having the opportunity to learn more about other members can result in one of two distinct outcomes. First, a positive effect is supported in the data by higher levels of social integration between team members who had prior familiarity (i.e., who have spent time learning about each other and have shared experiences) or who perceived to *share* personal attributes with team members.

"There was a common thing. We all love school, innovation, and learning."

Alternatively, if members go on to believe they truly do not have a lot in common, SI may fail to develop. When perceived differences arose, decrements to social integration followed. Over time, team members may also discover or perceive that they do in fact not have a lot in common with their team members, or that there are stark differences between them. According to Harrison and colleagues (2002), the passage of time may actually strengthen the effects of perceived deep-level diversity on teams. This occurred very clearly in one of the cases where team members were diverse in what was labeled the personality dimension of deliberateness, which is a dimension of conscientiousness and is associated with patience and impulse control (Roberts, Chernyshenko, Stark, & Goldberg, 2005). Three weeks into working with the team, one of the members had identified this difference. Further, assumptions can then be made regarding unrelated variables.

"So, generally, we do not have a lot in common."

"[Participant] is a laid back person, and I do not hang out with those people because it does not mix well with the type of person I am. So generally, we do not have a lot in common."

"I've worked with type Bs in the past and that has been very difficult for me because I feel as if they are not as invested in the project as I am, even if they are because they are not moving at my pace."

Affective Integration. Parsing apart participant data by attraction to the group and satisfaction with team members and a desire to sustain relationships proved difficult, likely

because a high degree of overlap between these dimensions. Therefore, these were examined together as positively referring to team members and team interaction.

"I really like my team so we are working well together"

"I'm really happy with both the teammates."

"I feel like we all have a lot of fun, we bond…playing music while brainstorming and stuff like that."

Social Interaction. The amount of time spent in conversation around non-task related topics was used as an indicator for the last dimension of social integration, degree of social interaction. The team tasks inherently had some pieces that required less attention and allowed for team socializing. Teams that took advantage of this likely developed an even stronger attraction to the group, whereas members that did not failed to develop high levels of social integration

"People do talk a lot about personal stuff, share stories, or even listen to music."

"I really like talking about other thing that is not work. We can be working on one thing but talking about other things, but it seems they cannot do that. I can talk about other things and work, but they cannot do that but it is fun."

In sum, social integration was evidenced by time spent talking about things outside the task, a high degree of perceived similarity, and in general positive reference to other team members. It is argued that minor annoyances or disagreements rooted in relationship conflict were less likely to develop into larger disputes when members were socially attracted to the team; members were more motivated to work through any differences in an effort to maintain positive relationships. Importantly, relationship conflict did exist, but it never exceeded the threshold where it would be required to be openly addressed. In this way, social integration acts as a buffer variable against the development of relationship conflict, and allows for the development of the team-centered approach.

Finding 8: Social integration acts as a buffer against the development of relationship conflict.

Individual Learning Outcomes

Participant learning was affected through several primary mechanisms. First, exposure to the design process, machines, and software programs led directly to learning. Team projects varied in the types of skills required (e.g., 3D printing, electronic prototyping), and therefore participants had differential exposure based on the parameters of each project. Importantly, if there was a discrepancy between what participants initially expected to learn and what they were exposed to throughout the program, perceptions of learning were low:

"As much as I've completed my project, there's more I wanted to learn…for us much of the equipment they have here we don't have back at home. For example there was a workshop where we had to use Arduino (a program we use to control machines) so something I wished we spent more time on that and I wish my project was about that. The guys on the other project were really focused on that and using the Arduinos so every time I thought "those guys are really benefitting, I wish I was on their team" because with that knowledge I could take it back home and do something for myself or start a company with that knowledge. Since I haven't achieved that and it was something I really wanted to do, it would have been helpful."

Peer-to-Peer Mentoring. Outside of mere exposure, informal peer mentoring was a primary method of learning for participants. Previous research would suggest that in heterogeneous teams with a wide range of variability in experience or ability, the high experience and low experience members tend to form a teacher-learner relationship (Webb, 1989). As was evidenced in the data, relative experience or ability in the group predicts who takes on this teacher role (Webb & Kenderski, 1984); members do not necessarily need to perceive themselves as highly experienced to lead the team in learning. As leadership emergence was strongly associated with previous experience; these mentoring behaviors primarily came from the identified team leader.

Lending support for the importance of the learning environment, Hernandez (2002) puts forth and instructional design principle titled "team learning". Team learning involves building

cooperative structures into the course to facilitate active learning. Many of these structures were present in the internship program, including mid- and end- of semester peer reviews and initial team-building activities to encourage learning behaviors. Additional program characteristics that likely supported peer-to-peer learning behavior include a lack of formal assessment (i.e., participants were not concerned with individual grades) and a supportive reward structure (i.e., compensation was not based on performance). Examples of peer learning behaviors were found in each case:

"If we had something that had no time constraint and we needed a simple part made, [participant] would do it and explain it step by step to [participant"

"But as part of the process, me and the other teammate did not have a lot of CAD experience coming in, but we are learning through him as he works. And he teaches us too. So it has been a good learning experience in that sense."

"After a while I got the hang of it, I made 9 models or 10… I keep trying to teach them what I learned."

"So we have been doing the mechanics for the 3D printing, [participant] has been taking the lead role on that and been teaching it to us."

"Just the engineering design process; even though we already went through it in the previous classes, when you help other people understand it you learn it better yourself too."

In sum, to the extent there is diversity in experience on a team, teacher-learner mentorship roles are likely to emerge. In considering the team profile, the member with the most experience relative to others will lead the team in learning behaviors. However, these learning behaviors must be supported by the conditions under which the team operates; conditions should promote accountability to others and reinforce cooperative behavior through evaluation and reward structures.

Finding 9: In diverse teams, peer-to-peer mentoring is a primary mechanism through which individual learning occurs.

Team Orientation. Team orientation has been labeled as one of the "Big Five" of teamwork by Salas, Sims, & Burke (2005), and is defined and measured as a general tendency to consider the action of others when working in a team (e.g., Mohammed & Angell, 2004; Salas, Sims, & Burke, 2005). Examined as a team level composition variable, it is positively related to cooperative team behaviors (Eby & Dobbins, 1997) and putting team goals above individual goals (Day, Gronn, & Salas, 2004). Additionally, members with a team orientation are more likely to improve their own individual performance through interaction with the team (Driskell & Salas, 1992). I argue that this concept extends to a consideration not only for team goals, but for the learning goals of individual team members:

"Everyone is here because they want to, so you want for everyone to get the experience."

"And again even if we divide then some would work on soldering and some basically on the other thing, it doesn't mean that the one on soldering they should always be on soldering and all. And like… everybody should be able to learn each and every method how to work on it."

"I understand they want to learn it and have that skill."

"But then if you have a group that's quieter sometimes then you have to pull someone in, both because you have to split the work but then also because everyone is here because they want to, so you want for everyone to get the experience."

Alternatively, a low team orientation can lead to a focus on the self and goals related to the self, and therefore a lack of consideration for the learning goals of others. When members have a low level of team orientation, efficiency of team process is put above individual learning goals. For example, team members often said things were easier if they "just did it" themselves, and that delegating tasks to less experienced members was a "waste of time". The situation may be compounded when team members perceive stressors in the environment (e.g., time pressure), and when members are high on performance goal orientation, defined as a motivation to demonstrate competence relative to others and to receive favorable evaluations (Farr, Hofmann, & Ringenbach, 1993; Harackiewicz et al., 2002). Those high on performance orientation spoke

more frequently of performance related goals; building a high fidelity or accurate prototype was labeled the top priority.

"For me that was a waste of my time because I was like, I don't need this, I'm not getting anything from it, and we're spending an hour on something that I'm not contributing to."

"But if we say "Oh we just want to adjust the size of this" we could have [participant] sit down and do it and give him half an hour and he would probably get a very simple change, but it would take me 30 seconds and it would just be a waste of time."

"Mostly because I am pretty good at straps and thinking in 3D and stuff, so it's usually just easier if I do everything."

In this way, team orientation facilitates learning of individual members, such that members high on this individual characteristic consider the learning goals of their peers. Specifically on diverse teams, this may be evidenced through actions such as letting members test out ideas even when in disagreement, spending time re-learning information for the benefit of a teammate, and avoiding task delegation based on previous experience. As previously stated, individual learning was determined in part through the task requirements of each team project (i.e., the projects each required distinct engineering skills). Therefore, the following is proposed as a research question to be explored further:

Research Question 1: In design teams, how does team orientation influence individual learning outcomes?

Specialization. Finally, diversity of experience can lead to increased specialization and to teams delegating tasks to perceived experts. After only one week of team interaction, participants developed a shared understanding of each member's abilities. Under perceived time pressure, these experts then assumed or were delegated tasks in line with this expertise so as not to "slow the team down". While specialization has been associated with higher team performance (e.g., Lewis, 2004; Liang, Moreland & Argote, 1995), the outcomes for individual learning are

unclear. Indeed, while this line of research is often carried out in student project teams, little to no information is available on the impact of specialization on individual learning outcomes.

"It's never something where we're like waiting on him to do anything cause I think we know we don't really have him do something that would make us get slowed down I guess. Now that I think about that. Like we'll never be like go CAD this or go design this piece…"

It is proposed here that specialization led team members to gain more experience in certain tasks to the deficit of learning outside that specific domain. Therefore, specialization will likely increase the depth of individual skills learned, but will ultimately decrease the breadth of skills learned. While this may have clear benefits for performance, early development of specialization may inhibit individual learning outcomes of team members over time.

Research Question 2: In design teams, how does specialization influence individual learning outcomes?

Context

In a seminal review nearly two decades ago, Williams and O'Reilly (1998) came to the conclusion that the literature offered no consistent main effects of diversity on performance outcomes. Importantly, the authors called for the inclusion of contextual variables to gain a more comprehensive picture of what had proven to be a complex phenomenon. More recently, enough primary studies on and team, task, organizational, and industry-related variables (e.g., task complexity, team size, and team tenure) have been conducted to allow for a meta-analytic review (Bell et al., 2011; Horwitz & Horwitz, 2007; Joshi & Roh, 2009). The results of these meta-analyses suggest that the type of team, performance outcome measured, task complexity, and industry can affect the strength and direction of the diversity-performance relationship.

However, participants pointed to another contextual variable that held great potential for affecting the magnitude and direction of the relationship between process and performance. Namely, conditions of the work environment in the form of specific support factors were

perceived to either facilitate or hinder performance. These factors include: (1) client interaction, and (2) perceived help from an external network (non-client). Each of these categories was discussed at various points throughout the interviews; participants clearly viewed support or lack thereof as instrumental.

In diving deeper, a common theme emerged; support provided the needed access to information. This information often took the form of specialized technical knowledge, details around the scope and goals of the project, or simply an outside perspective. It's likely this emerged as an influential factor due to an overall lack of required knowledge perceived within the teams. This was expressed in more general terms as well as project specific deficits.

"So it's something really new, very new from what I do and from what I know, but I know there are a lot of electronics involved so I would do that, but for some other things the tools here are really new, everything else is so new to me."

"So that would be basically trying to make a code that can translate it, so none of us are experts on it"

Client Interaction. Lack of client interaction caused a high degree of task-related stress and frustration for participants. Halfway through the project point, frustration grew as team members began to feel that lack of information will ultimately hinder their performance. This is seen in hesitation and lack of confidence that the team will perform well. The underlying problem appeared to be an unclear scope and uncertainty about how to approach the problem. In short, teams were essentially not confident in what they were working toward, and therefore lacked goal clarity.

"I still don't know what they expect us to have at the end"

"We do not know how contractions look like and how to define the variables…we don't know which one is best since we don't know which one we want to measure in detail"

"We have not met with our client so we don't even know if we're in the ballpark here. He honestly could get it in two weeks and be like, 'No this is wrong', in which case we would have wasted the summer, which is really unfortunate and has crossed my mind."

Indeed, teams with greater access to clients claimed that this interaction helped to "keep them on the right track" and facilitated a goal setting process. Teams leaned heavily on the advice and direction of their clients when it was given, often forming future plans around client meetings and client feedback. This finding aligns with the goal-setting theory which proposes that having specific, difficult goals to work toward results in higher performance. Locke and Latham (2002) assert that this effect on performance occurs through four underlying mechanisms: goals (1) direct our limited attentional resources to task-relevant activities, (2) serve an energizing function, leading to greater on-task effort, (3) result in more persistence in task-related efforts, (4) and lead to the use of task relevant knowledge and strategies. A participant gives an example of a clear goal below:

"The goal is to test the whole device, have it put together fully and accurately, and eliminate any glues that remain in the device so it can be put together normally."

An important caveat is that information from a source perceived as credible can be detrimental to team performance if it is inaccurate. Novice diverse design teams implicitly trusted information from clients as a credible source; arguably, this was to the detriment of seeking alternative explanations and possibly resulted in confirmation bias. Confirmation bias refers to a preference for supporting versus conflicting information once a decision has been made (Jonas, Schulz-Hardt, Frey, & Thelen, 2001). Once a project decision was made based on client information, conflicting or lack of supporting information in the research process was ignored. Additionally, sources with confirming information were utilized even though the credibility could not be established.

External Support. An external network of support was the second factor participants indicated was critical. This was categorized as perceived help from anyone outside the team excluding the client. The two most common forms of support came from the research assistants and the program director. Participants expressed that one of the main benefits of this support was to help the team rethink or expand their problem approach.

"We were kind of limiting ourselves…we were just looking at one side of things. But then [director] suggested we take a step back from that, and that's when we really [opened up]."

In the most extreme of cases, a lack of information or incorrect information can negate or reverse the effect of positive team process on performance. Alternatively, teams working with ample information can outperform those with poor information even in the face of negative teamwork processes. In fact, external support can help move a project in a positive direction that otherwise may not have occurred. In sum, environmental support affects diverse design team performance such that access to information can weaken or strengthen the relationship between teamwork processes and performance.

Finding 10: All else being equal, performance will be higher for well-informed design teams.

Summary of Findings

The relationship between diversity and team performance was discussed throughout in terms of effective and ineffective behaviors (e.g., information exchange behaviors, team interaction patterns). In an effort to triangulate measurement, effectiveness of behavior was based on several sources, including team ratings from the director of the internship (representative of supervisor ratings), inductive conclusions from the data (made by the researcher), and individual perceptions of performance from participants. In addition, team-level

variables (i.e., social integration) and contextual variables (i.e., environmental support) that can change the strength and of the team process-performance relationship were identified. Below, a summary of the findings (*see* Table 20) is presented.

Table 20. Summary of Findings

	Summary of Findings
Model Variables	**Finding 1:** In design teams, diversity in assertiveness, experience, and demographics, team processes of communication and conflict, and environmental support and social integration all play a role in diverse design team performance.
Communication (Information Exchange)	**Finding 2:** Effective diverse design teams exchange information in a (1) **frequent** (2) **equal**, and (3) **timely** manner.
Communication (Elaboration)	**Finding 3:** Effective diverse design teams elaborate on information to develop a shared understanding.
Task Conflict	**Finding 4:** In design teams, there is a strong positive relationship between diversity and task conflict.
Relationship Conflict	**Findings 5:** Diversity in task *conflict expression* is positively associated with relationship conflict.
Future Team Process	**Finding 6:** Relationship conflict at T1 will lead to an increase in the (1) **frequency** and (2) **intensity** of ineffective communication behavior at T2.
	Finding 7: Relationship conflict at Time 1 will lead to an increase in the (1) **frequency** and (2) **intensity** of relationship conflict at Time 2.
Social Integration	**Finding 8:** Social integration acts as a buffer against the development of relationship conflict.
Individual Learning	**Finding 9:** In diverse teams, peer-to-peer mentoring is a primary mechanism through which individual learning occurs.
	Research Question 1: In design teams, how does team orientation influence individual learning outcomes?
	Research Question 2: In design teams, how does specialization influence individual learning outcomes?
Performance	**Finding 10:** All else being equal, performance will be higher for well-informed design teams.

One additional interesting finding was that nearly 90% of coded performance statements from participants were positive. Furthermore, the vast majority of negatively coded statements came from one team, and the responsibility for poor performance was placed largely on

misinformation. Taken together, this evidence suggests student perceptions of performance were positively skewed compared to (e.g., supervisor) ratings from others. As there is a notoriously low correlation between supervisor and self-ratings (Heidemeier & Moser, 2009), this is not altogether surprising. Potential explanations include and inability to accurately assess performance, a lack of awareness of performance goals, socially desirable responding (e.g., impression management, Paulhus, 1984), or any number of cognitive and social biases (e.g., leniency; Holzbach, 1978) that prohibited recall or report of negative performance perceptions.

CHAPTER 6: Discussion

The findings put forth from this effort advance our understanding of the relationship between diversity and team performance by first uncovering important dimensions of diversity that are currently understudied (e.g., assertiveness, perceived experience). While broader factors of personality have been considered as deep level composition variables (e.g., Bell, 2007), this effort suggests that the finer facet level characteristics also deserve consideration. Furthermore, while differences in ability have been evidenced to lead to process gains and additive effects on performance (Tziner & Eden, 1985), the current findings suggests that skill or experience need only to be perceived to influence team member interaction.

Dimensions of diversity were evidenced to lead to both effective *and* ineffective communication behaviors. This finding is in line with meta-analytic investigations that have failed to find a consistent relationship between diversity and team communication (e.g., Stahl et al., 2010). However, the current effort adds a unique contribution in considering the flow of information in diverse design teams (i.e., exchange, elaboration, and consideration), and the specific underlying behaviors at each stage. The model shows that frequency, equality, timeliness, and comprehension are all critical communication elements. Indeed, unique member input has a long way to travel in order to be useful at the team level.

The findings also suggest that there will be a strong positive relationship between diversity and task conflict in design teams. This is due in part to the nature of the task; specifically, initial stages of the design process are intended to spur divergent thinking and bring out unique and often opposing ideas and perspectives, which should vary widely on diverse teams. When immediately followed by convergent processes, which require the team to evaluate these ideas and move towards a final solution (Farh et al., 2010), it is not surprising that task

conflict emerges. Importantly, diversity in *how* this conflict is expressed is proposed as an underlying mechanism that pushes task conflict into relationship conflict. This finding offers an explanation for why conflict types (i.e., task and relationship) often co-occur (e.g., Jehn, 2010), and suggests that looking at these types separately fails to capture the nuance of how conflict unfolds.

Finally, in isolating teams that experienced relationship conflict at Time 1, the frequency and intensity of both ineffective communication behaviors and relationship conflict increased over time. This suggests that relationship conflict spurs an escalating pattern of negative team interaction behaviors. When considering the task interdependencies of design teams, this would be expected; tighter coupling is required later in the design process (i.e., team tasks changes from more individual-oriented activities like researching the problem to more team-oriented activities like brainstorming) and more interaction is required of members (Smith & Eppinger, 1997). Unfortunately, the compounding of relationship conflict over the design team's lifecycle is unaffected by attempts at open conflict management. These findings support more recent evidence in the literature that conflict management strategies do little to ameliorate relationship conflict once it exists in the team (Behfar et al., 2008).

Fortunately, findings also suggest that team level affective variables can act as a buffer against the negative effects of relationship conflict. Half of the cases studied were able to avoid conflict altogether, or to keep levels from escalating to a point where it would be detrimental to team process or performance. These teams were able to develop what O'Neill and colleagues (2015) call a "team-centered" approach; a conflict profile consisting of high task conflict and low relationship conflict. Teams high on social integration found an alternative route of expression (e.g., joking or teasing in a friendly manner), or were able to overlook or ignore minor

transgressions. Conflict is often an inherent part of the work environment for design teams, and largely unavoidable in the workplace (De Dreu, 2008). Therefore, understanding and promoting the conditions that help reap the benefits of conflict (e.g., social integration), or at least mitigate the negative effect on team process, continues to be an important pursuit.

Finally, access to information was a common theme across both individuals and teams, and continued to grow in importance over the course of the team's lifecycle as project deadlines drew near. Teams relied on client interaction and an external network of support for the specialized knowledge they felt they lacked as a team. A low degree of perceived support was associated with task stress and frustration, whereas a high degree of support was associated with clarity on project scope and goals. Ultimately, teams that felt they did not have the requisite support cited this as one of the main reasons for poor performance.

Theoretical and Methodological Contributions

Integrating theories from the diversity and team conflict literatures, I have presented a context-specific, temporally based framework of diverse design team performance. The framework is accompanied by a set of testable findings to guide refinement of initial theory, and focuses on cycles of communication and conflict that unfold throughout the team's tenure. Both a deductive and inductive approach to analysis identified diversity on three dimensions of team configuration (assertiveness, experience, and nationality), two core team processes (communication and conflict), and two team level constructs (team orientation, social integration) that all have the ability to meaningfully effect performance outcomes either directly or indirectly. Furthermore, environmental factors (i.e., client interaction, external network of support) and the team's approach to task delegation (i.e., specialization) that influence both individual learning and team performance were identified. While integrative theories have begun

to emerge (e.g., van Knippenberg et al., 2004), attempts to empirically investigate these theories remain scarce.

The effort also offers a theoretical explanation for the co-occurrence between different conflict types in the literature. I suggest that task conflict develops or spills into relationship conflict, and offer a theoretical explanation as to *why* this may occur. Toward this end, it is argued that conflict expression style represents an individual difference variable that holds powerful explanatory value, and cuts across many types of diversity generally considered separately. Specifically, differences in directness can be attributed to each individual difference considered in this study (i.e., personality, demographics, and perceived experience), and arguably many other variables considered both surface and deep level (Bell, 2007).

In sum, our understanding of the diversity-performance relationship has evolved significantly since the inconclusive meta-analytic evidence presented by Webber and Donahue (2001). However, the vast majority of efforts continue to focus on the "contingency approach" to studying task conflict, despite ample theoretical evidence for the importance of team process. This mixed method investigation continues to push our understanding forward by looking more closely at how communication and conflict processes unfold, shedding light on equivocal findings that persist in the literature, and encouraging empirical investigations aimed at verifying the proposed model and findings. Additionally, as future research stemming from grounded theory models should evaluate the generalizability of the findings to different samples of interest (Creswell & Plano Clark, 2007), investigations into the importance of the factors and underlying relationships uncovered conducted in similar contexts (e.g., top management teams, teams in high reliability organizations) are encouraged.

From a methodological standpoint, this study addresses the call for more longitudinal, mixed method designs that can capture the complexity of team performance (e.g., Mathieu, et al., 2008). I argue that team conflict cannot be captured by looking at a slice of the data, and that the IMOI model (Ilgen, et al., 2005) that is often invoked should be used as a guiding framework to look at the reciprocal effect of communication and conflict processes over the team's lifespan.

Practical Implications

Generally speaking, the findings from this study can be used to develop interventions at the individual or team level aimed at facilitating the potential benefits, or mitigating the negative effects of diversity on team performance. For example, when team members who were diverse on conflict expression styles interacted, the more direct sender was not aware of the receiver's perceived negative emotional reaction. In fact, when the sender was made aware at a time point where relationship conflict had already begun to occur, it was sometimes seen as surprise. Unfortunately, at that point, the current model would suggest an escalating negative effect on future team process is likely. However, if an intervention occurred prior to the team forming, it is suggested that at least some conflict could be avoided. While cross-cultural training is seen as critical to ensuring effective intercultural interaction (Bennet, Aston, & Colquhoun, 2000), differences in directness of conflict expression are often not addressed. Importantly, an intervention could be as simple as knowing and understanding the conflict expression styles of teammates before conflict occurs.

In a similar vein, the data suggest practical barriers to communication in diverse design teams akin to that of interprofessional teams; oftentimes a different way of referring to things caused confusion or time away from the task to clarify information. The participants expressed a desire to "refer to things the same way". Simple procedures like establishing as shared task

policies (e.g., a required measurement metric) may facilitate more effective communication. Overall, it was clear that most participants desired to communicate more effectively, and any tools that would allow them to do this would be beneficial.

Lastly, the extent that design teams were able to use objective conflict management tools may have stopped relationship conflict from developing by providing a concrete means of evaluating opposing ideas (*see Table 21* for an overview of these tools found in the current study). Those that manage diverse teams should not only provide these tools, but also training on how to use them appropriately.

Table 21. Task Conflict Management Tools

Task Conflict Management Tools		
Tool	**Description**	**Participant Quote**
Pugh Matrix	Weighing the relative merits of ideas/solution based on strengths and weaknesses	*"We have to look at the bad things about both ideas, the positive side and the negative side…generally we have to take the idea that has more positive parts…we just don't have to follow one person…we weigh which one [idea] is okay" B*
Diagramming or Drawing	Sketching out ideas	*"I think it's good to clearly communicate what you're trying to say…diagrams help, especially with engineering."*
Testing	Building all or a piece of the design to physically test it	*"And the other times that the best thing we've done to resolve it is we go and test and then we immediately see- does it work? Does it not? Because that's an empirical way to say, it does not work. Or it does…. So once you have it in your hands and you test it you can be like 'oh, yeah I see what you mean'." C *Maybe use other team swim quote*

Future Directions

Competing theories and more recent work that takes an integrative approach all acknowledge diversity's potential for decrements to team process and performance. Furthermore, the underlying reason cited is the failure to work together as a cohesive team, to share information, and openly and constructively discuss member opinions. Depending on the theoretical approach taken, an unwillingness or inability to share information is often cited, but is rarely measured or reported. Put another way, the underlying cause for decrements to team process is often not assessed. Future research would benefit from explicitly measuring bias or favoritism, motivation and willingness to share information, as well as the attitudes and beliefs behind this.

Additionally, the interviews indicated that conflict is an emotionally charged word. Participants would often deny the existence of conflict in team interactions. However, when not specifically speaking about conflict, or when couched in more neutral language such as "disagreement", participants freely spoke about conflicting ideas and opinions. This allowed the capture of information that may be lost on common measures of task conflict (e.g., Jehn, 1995) that are worded more strongly. For example:

"There were different ideas on how to do things. I would not call it a disagreement more like 'I think we should do it like this' and someone else would say 'No, I think this is better"… and they would talk through it and decide."

If the construct of task conflict is operationalized as disagreement, debate, or playing devil's advocate, then 'conflict' may elicit too strong of a connotation. In line with Loughry and Amason (2014), I suggest that future research should include measures of task conflict that avoid this negative wording. Behaviors uncovered in this effort could be used to inform the development of these measures.

In a review of the team effectiveness literature over the previous decade, Mathieu, Maynard, Rapp, and Gilson (2008) claim that is time for team science researchers to "embrace the complexity" of teams and the organizations within which they are nested. The authors call for a new research paradigm; one in which qualitative analysis is a strategy used to investigate sources of influence that have previously been ignored. The science of teams has seen some progress in this respect (e.g., Klein, Ziegert, Knight, & Xiao, 2006; Shachaf, 2008), but rigorous, structured qualitative methods still in large part have not become a feature of team science. Qualitative methods vary greatly depending on the questions asked and the phenomena under study. While researchers have called for the inclusion of mixed method and qualitative design, there is little guidance available specifically for teams researchers. This research domain is by its very nature complex; while many qualitative studies explore a more narrow set of team behaviors (e.g., leadership; Klein et al., 2006), the science of teams would benefit from methodical guidance on conducting qualitative teams research. Indeed, adapting existing qualitative methods to be appropriate for the study of multi-level team-based phenomena or developing new methods is an area ripe for future research.

Finally, there remains scant research on the temporal concerns inherent to team conflict states and processes (Loughry & Amason, 2014). As conflict appears to be an unavoidable consequence of many heterogeneous teams, how conflict unfolds has wider implications for diverse team performance. Towards this end, there have been four meta-analyses in the previous five years that have attempted to integrate findings and uncover the direct relationship between task conflict and performance. It is suggested here that a direct relationship is unlikely; future research should consider the reciprocal effects of team process. Specifically, research should

explore how conflict at different stages of the team's lifecycle affect the team's ability to engage in other critical team process.

Limitations

In addition to more general limitations of the research method, one perceived limitation of the current study was length of the internship and therefore the time available for collection of the primary data source (i.e., interviews). While 7 weeks allowed ample time for team dynamics to unfold, further opportunity to gather process and performance data from teams would likely have yielded additional insights. Specifically, grounded theory researchers often take time away from the data site to analyze and consider findings, and then return to ask more targeted questions (Creswell, 2007). Given the information found in Phase 1 and Phase 2 of the data collection, questions that gleaned additional information could have been asked. For example, it was discovered that members with high perceived experience often worked on their own to the detriment of team information exchange. Given the opportunity to follow-up, these members could have asked additional questions about the motivation behind this behavior (i.e., why they worked alone, why they did not always update the team, etc.).

Another limitation was that some interviewees were more forthcoming with information, more directly stated information, and in general were better able to articulate important variables of interest to the researcher. For example, the participants had a very difficult time initially explaining the decision making process. Finally, there was an inability to concretely attribute the behaviors to the disposition of members or the situation. Quantitative measured provided support in this respect.

Conclusion

In arguing for the value of diversity in the workplace, Cox and Blake (1991) emphasize that differences in opinion and perspective can promote creative thinking and improve the quality of team processes (e.g., decision making and problem solving). Although equivocal findings are persistent in the literature (Webber & Donahue, 2001), there is evidence that diversity, under the right circumstances, can lead to higher quality outcomes (e.g., Horwtiz & Horwtiz, 2007). Furthermore, the complexity of the problems with which organizations are faced and the demand for innovation drive the need for teams with a breadth and depth of unique knowledge. Science and practice have recognized this need; research on diversity and innovation has grown enormously (e.g., Anderson, Potočnik,& Zhou, (2014). Coupled with the trends of today's workforce demographics (BLS, 2015), it is clear that the use of diverse teams will only continue to rise. Therefore, a deeper understanding how diversity effects team performance, and the underlying processes through which this occurs, represents a pressing research need.

To address this need, and in line with calls for methodologies that can capture the temporal and multi-dimensional nature of teamwork (Mathieu et al., 2008), the current effort utilized a longitudinal mixed-method design to deliver several unique findings. One of main takeaways is that we need to broaden our definition of diversity to include the importance of previously underexplored dimensions (i.e., assertiveness, previous experience). Furthermore, dimensions of diversity may affect the same underlying team processes (i.e., communication, conflict), supporting a more general conceptualization of this construct (e.g., van Knippenberg, 2004). One underlying mechanism through which diversity (across many dimensions) affects these processes is conflict expression; when team members are diverse in *how* the express and

perceive conflict, then task conflict may spillover into relationship conflict. Once this spillover occurs, relationship conflict can have a compounding effect throughout the team's lifecycle.

Additionally, the team's affective climate may act as a buffer against this compounding effect of relationship conflict; teams high on social integration can avoid conflict altogether, find alternative routes to express conflict, or are simply able to overlook minor conflict. Finally, while often overlooked in studies that fail to look at cross-level effects, diversity can also have implication for individual learning outcomes. A primary mechanisms through which individuals learn on diverse teams is peer-to-peer mentoring. Individual learning is also affected by the overall level of team orientation, and the tendency for members to consider the learning goals of others. Taken together, these findings allow us to move forward in our understanding of the team processes (e.g., communication and conflict) that mediate the diversity-performance relationship and how they unfold over time.

REFERENCES

Ackerman, P., & Humphreys, L. G. (1990). Individual differences theory in industrial and organizational psychology. In M. D. Dunnette & L. M. Hough (Eds.), *Handbook of industrial and organizational psychology* (Vol. 1, pp. 223-282). Palo Alto, CA: Consulting Psychologists Press.

Adams, J. S. (1963). Toward an understanding of inequity. *Journal of Abnormal and Social Psychology, 67,* 422-436.

Ancona, D. G., & Caldwell, D. F. (1992). Demography and design: Predictors of new product team performance. *Organization science*, *3*(3), 321-341.

Anderson, N., Potočnik, K., & Zhou, J. (2014). Innovation and creativity in organizations: A state-of-the-science review, prospective commentary, and guiding framework. *Journal of Management*, *40*(5), 1297-1333.

Angrosino, M. V., & Mays de Pérez, K. A. (2000). Rethinking observation: From method to context. *Handbook of qualitative research*, *2*, 673-702.

Barrick, M. R., & Mount, M. K. (1991). The big five personality dimensions and job performance: a meta-analysis. *Personnel Psychology*, *44*(1), 1-26.

Beersma, B., Hollenbeck, J. R., Humphrey, S. E., Moon, H., Conlon, D. E., & Ilgen, D. R. (2003). Cooperation, competition, and team performance: Toward a contingency approach. *Academy of Management Journal*, *46*(5), 572-590.

Behfar, K. J., Peterson, R. S., Mannix, E. A., & Trochim, W. M. (2008). The critical role of conflict resolution in teams: a close look at the links between conflict type, conflict management strategies, and team outcomes. *Journal of Applied Psychology*, *93*(1), 170-188.

Bell, S. T. (2007). Deep-level composition variables as predictors of team performance: a meta-analysis. *Journal of applied psychology*, *92*(3), 595-615.

Bell, S. T., Villado, A. J., Lukasik, M. A., Belau, L., & Briggs, A. L. (2011). Getting specific about demographic diversity variable and team performance relationships: A meta-analysis. *Journal of Management*, *37,* 709-743.

Bendersky, C., Bear, J., Behfar, K., Weingart, L. R., Todorova, G., & Jehn, K. (2014). Identifying gaps between the conceptualization of conflict and its measurement. *Handbook of research in conflict management. Edward Edgar Publishing, United Kingdom*, 79-89.

Bennett, R., Aston, A., & Colquhoun, T. (2000). Cross-cultural training: A critical step in ensuring the success of international assignments. *Human Resource Management*, *39* (2, 3), 239-250.

Berscheid, E., Hatfield Walster, E. (1985). Interpersonal attraction. In L. Gardner & S., Elliot (Eds.), *Handbook of Social Psychology* (pp.413-484). New York, NY: Random House.

Borrego, M., Karlin, J., McNair, L. D., & Beddoes, K. (2013). Team effectiveness theory from industrial and organizational psychology applied to engineering student project teams: A research review. *Journal of Engineering Education*, *102*(4), 472-512.

Bowers, C. A., Pharmer, J. A., & Salas, E. (2000). When member homogeneity is needed in work teams a meta-analysis. *Small Group Research*, *31*(3), 305-327.

Bradley, B. H., Postlethwaite, B. E., Klotz, A. C., Hamdani, M. R., & Brown, K. G. (2012). Reaping the benefits of task conflict in teams: the critical role of team psychological safety climate. *Journal of Applied Psychology*, *97*(1), 151-158.

Bureau of Labor Statistics (BLS). (2015). Labor force statistics from the current population survey. Retrieved from http://www.bls.gov/cps/cpsaat11.htm.

Bunderson, J. S., & Sutcliffe, K. M. (2002). Comparing alternative conceptualizations of functional diversity in management teams: Process and performance effects. *Academy*

of Management Journal, *45*(5), 875-893.

Burke, C. S., Stagl, K. C., Salas, E., Pierce, L., & Kendall, D. (2006). Understanding team adaptation: a conceptual analysis and model. *Journal of Applied Psychology*, *91*(6), 1189-1207.

Byrne D. 1971. The Attraction Paradigm. New York, NY: Academic Press.

Cannon-Bowers, J. A., Salas, E., & Converse, S. (1993). Shared mental models in expert team decision making. In J. Castellan Jr.(Ed.), *Individual and group decision making: Current Issues* (pp. 221-246). Hillsdale, NJ: Erlbaum.

Charmaz, K. (2006). *Constructing grounded theory: A practical guide through qualitative research*. Sage Publications Ltd, London.

Chen, G., Sharma, P. N., Edinger, S. K., Shapiro, D. L., & Farh, J. L. (2011). Motivating and demotivating forces in teams: cross-level influences of empowering leadership and relationship conflict. *Journal of Applied Psychology*, *96*(3), 541-557.

Chi, N. W., Huang, Y. M., & Lin, S. C. (2009). A double-edged sword? Exploring the curvilinear relationship between organizational tenure diversity and team innovation: The moderating role of team-oriented HR practices. *Group & Organization Management*, *34*(6), 698-726.

Cohen, S. G., & Bailey, D. E. (1997). What makes teams work: Group effectiveness research from the shop floor to the executive suite. *Journal of Management*, *23*(3), 239-290.

Colquitt, J. A., LePine, J. A., & Noe, R. A. (2000). Toward an integrative theory of training motivation: a meta-analytic path analysis of 20 years of research. *Journal of Applied Psychology*, *85*(5), 678-707.

Cooke, N. J., Salas, E., Cannon-Bowers, J. A., & Stout, R. J. (2000). Measuring team

knowledge. *Human Factors: The Journal of the Human Factors and Ergonomics Society*, *42*(1), 151-173.

Corbin, J., & Strauss, A. (2008). Basics of qualitative research. Thousand Oaks, CA: Sage Publications.

Costa, P. T., McCrae, R. R., & Dye, D. A. (1991). Facet scales for agreeableness and conscientiousness: A revision of the NEO Personality Inventory. *Personality and individual Differences*, *12*(9), 887-898.

Cox, T. H., & Blake, S. (1991). Managing cultural diversity: Implications for organizational competitiveness. *The Executive*, 45-56.

Cox, T. H., Lobel, S. A., & McLeod, P. L. (1991). Effects of ethnic group cultural differences on cooperative and competitive behavior on a group task. *Academy of Management Journal*, *34*(4), 827-847.

Cramton, C. D. (2001). The mutual knowledge problem and its consequences for dispersed collaboration. *Organization Science*, *12*(3), 346-371.

Creswell, J. W. (2007). *Qualitative inquiry and research design: Choosing among five approaches*. Thousand Oaks, CA: Sage Publications, Inc.

Cronin, M. A., & Weingart, L. R. (2007). Representational gaps, information processing, and conflict in functionally diverse teams. *Academy of Management Review*, *32*(3), 761-773.

Dahlin, K. B., Weingart, L. R., & Hinds, P. J. (2005). Team diversity and information use. *Academy of Management Journal*, *48*(6), 1107-1123.

Day, D. V., Gronn, P., & Salas, E. (2004). Leadership capacity in teams. *The Leadership Quarterly*, *15*(6), 857-880.

DeChurch, L. A., & Marks, M. A. (2001). Maximizing the benefits of task conflict: The role of conflict management. *International Journal of Conflict Management*, *12*(1), 4-22.

DeChurch, L. A., Mesmer-Magnus, J. R., & Doty, D. (2013). Moving beyond relationship and task conflict: Toward a process-state perspective. *Journal of Applied Psychology, 98*(4), 559-578.

De Dreu, C. K. (2006). When too little or too much hurts: Evidence for a curvilinear relationship between task conflict and innovation in teams. *Journal of Management*, *32*(1), 83-107.

De Dreu, C. K. (2007). Cooperative outcome interdependence, task reflexivity, and team effectiveness: a motivated information processing perspective. *Journal of Applied Psychology*, *92*(3), 628-638.

De Dreu, C. K. (2008). The virtue and vice of workplace conflict: Food for (pessimistic) thought. *Journal of Organizational Behavior*, *29*(1), 5-18.

De Dreu, C. K., & Weingart, L. R. (2003). Task versus relationship conflict, team performance, and team member satisfaction: a meta-analysis. *Journal of Applied Psychology*, *88*(4), 741–749.

De Dreu, C. K., & Weingart, L. R. (2003). A contingency theory of task conflict and performance in groups and organizational teams. *International handbook of organizational teamwork and cooperative working*, *88*(4), 151-166.

De Dreu, C. K., & West, M. A. (2001). Minority dissent and team innovation: the importance of participation in decision making. *Journal of Applied Psychology*, *86*(6), 1191-1201.

DeNisi, A. S., & Kluger, A. N. (2000). Feedback effectiveness: can 360-degree appraisals be improved?. *The Academy of Management Executive*, *14*, 129-139.

Desivilya, H., & Eizen, D. (2005). Conflict management in work teams: The role of social self-efficacy and group identification. *International Journal of Conflict Management*, *16*(2), 183-208.

DeWalt, K. M. & DeWalt, B. R. (1998). Participant observation. In H. Russell Bernard (Ed.), *Handbook of methods in cultural anthropology* (pp.259-300). Walnut Creek: AltaMira Press.

de Wit, F. R., Greer, L. L., & Jehn, K. A. (2012). The paradox of intragroup conflict: a meta-analysis. *Journal of Applied Psychology*, *97*(2), 360-390.

Devine, D. J., & Phillips, J. L. (2001). Do smarter teams do better? A meta-analysis of cognitive ability and team performance. *Small Group Research, 32*, 507–532.

Dierdorff, E. C., Bell, S. T, & Belohlav, J.A. (2011). The power of "we": Effects of psychological collectivism on team performance over time. *Journal of Applied Psychology, 96*(2), 247-262.

Driskell, J. E., & Salas, E. (1992). Collective behavior and team performance. *Human Factors: The Journal of the Human Factors and Ergonomics Society*, *34*(3), 277-288.

Dym, C. L., & Little, P. (2004) Engineering Design: A Project-Based Introduction. Hoboken, NJ: John Wiley & Sons, Inc.

Earley, P. C., & Ang, S. (2003). *Cultural intelligence: Individual interactions across cultures*. Stanford, CA: Stanford University Press.

Eby, L. T., & Dobbins, G. H. (1997). CoUectivistic orientation in teams: an individual and group-level analysis. *Journal of Organizational Behavior*, *18*, 275-295.

Eisenhardt, K. M. (1989). Building theories from case study research. *Academy of management review*, *14*(4), 532-550.

Ellison, C. G., & Powers, D. A. 1994. The contact hypothesis and racial attitudes among Black Americans. *Social Science Quarterly, 75,* 385-400.

English, A., Griffith, R. L., & Steelman, L. A. (2004). Team Performance The Effect of Team Conscientiousness and Task Type. *Small Group Research*, *35*(6), 643-665.

Farh, J. L., Lee, C., & Farh, C. I. (2010). Task conflict and team creativity: a question of how much and when. *Journal of Applied Psychology*, *95*(6), 1173-1180.

Fay, D., Borrill, C., Amir, Z., Haward, R., & West, M. A. (2006). Getting the most out of multidisciplinary teams: A multi-sample study of team innovation in health care. *Journal of Occupational and Organizational Psychology*, *79*(4), 553-567.

Ford, G., & Kotzé, P. (2006). Researching culture and usability—A conceptual model of usability. In *People and Computers XIX—The Bigger Picture* (pp. 317-333). Springer London.

George, J. M., & Zhou, J. (2001). When openness to experience and conscientiousness are related to creative behavior: an interactional approach. *Journal of Applied Psychology*, *86*(3), 513-524.

Gillespie, B. M., Chaboyer, W., Longbottom, P., & Wallis, M. (2010). The impact of organisational and individual factors on team communication in surgery: a qualitative study. *International Journal of Nursing Studies*, *47*(6), 732-741.

Glaser, B. & Strauss, A. (1967). The discovery of grounded theory. Chicago, IL: Aldine.

Gong, Y., Kim, T. Y., Lee, D. R., & Zhu, J. (2013). A multilevel model of team goal orientation, information exchange, and creativity. *Academy of Management Journal*, *56*(3), 827-851.

Grimm, S. D., Church, A. T., Katigbak, M. S., & Reyes, J. A. S. (1999). Self-described traits, values, and moods associated with individualism and collectivism: Testing IC theory in

an individualistic (US) and a collectivistic (Philippine) culture. *Journal of Cross-Cultural Psychology*, *30*(4), 466-500.

Groves, K. S., & Feyerherm, A. E. (2011). Leader cultural intelligence in context: Testing the moderating effects of team cultural diversity on leader and team performance. *Group & Organization Management*, *36*(5), 535-566.

Guion, R. M. (2011). Assessment, Measurement, and Prediction for Personnel Decision. New York, NY: Routledge.

Hackman, R. 1983. *A normative model of work team effectiveness*. Technical report No. 2. New Haven, CT: Yale School of Organization and Management.

Hackman, J. R., & Oldham, G. R. (1976). Motivation through design of work: Test of a theory. *Organizational Behavior and Human Performance, 16,* 250–279.

Hall, P. (2005). Interprofessional teamwork: Professional cultures as barriers. *Journal of Interprofessional Care*, *19*(sup1), 188–196.

Hambrick, D. C., Cho, T. S., & Chen, M. J. (1996). The influence of top management team heterogeneity on firms' competitive moves. *Administrative Science Quarterly*, 659-684.

Hambrick, D. Z., & Engle, R. W. (2002). Effects of domain knowledge, working memory capacity, and age on cognitive performance: An investigation of the knowledge-is-power hypothesis. *Cognitive Psychology*, *44*(4), 339-387.

Harrison, D. A., & Klein, K. J. (2007). What's the difference? Diversity constructs as separation, variety, or disparity in organizations. *Academy of Management Review*, *32*(4), 1199-1228.

Harrison, D. A., Price, K. H., & Bell, M. P. (1998). Beyond relational demography: Time and the effects of surface-and deep-level diversity on work group cohesion. *Academy of Management Journal*, *41*(1), 96-107.

Harrison, D. A., Price, K. H., Gavin, J. H., & Florey, A. T. (2002). Time, teams, and task performance: Changing effects of surface-and deep-level diversity on group functioning. *Academy of Management Journal*, *45*(5), 1029-1045.

Hebl, M. R., Foster, J. B., Mannix, L. M., & Dovidio, J. F. (2002). Formal and interpersonal discrimination: A field study of bias toward homosexual applicants. *Personality and Social Psychology Bulletin*, *28*(6), 815-825.

Heidemeier, H., & Moser, K. (2009). Self–other agreement in job performance ratings: A meta-analytic test of a process model. *Journal of Applied Psychology, 94*, 353-370.

Hernandez, S. A. (2002). Team learning in a marketing principles course: Cooperative structures that facilitate active learning and higher level thinking. *Journal of Marketing Education*, *24*(1), 73-85.

Hinsz, V. B., Tindale, R. S., & Vollrath, D. A. (1997). The emerging conceptualization of groups as information processors. *Psychological Bulletin*, *121*(1), 43.

Hoffman, L. (1959). Homogeneity and member personality and its effect on group problem solving. *Journal of Abnormal and Social Psychology, 58,* 27–32.

Hofstede, G., (1980). Culture's Consequences: International Differences in Work-related Values, Sage Publications, London and Beverly Hills, CA.

Hogg, M. A., & Turner, J. C. (1985). Interpersonal attraction, social identification and psychological group formation. *European Journal of Social Psychology*, *15*(1), 51-66.

Hollenbeck, J. R., Beersma, B., & Schouten, M. E. (2012). Beyond team types and taxonomies:

A dimensional scaling conceptualization for team description. *Academy of Management Review*, *37*(1), 82-106.

Holzbach, R. L. (1978). Rater bias in performance ratings: Superior, self-, and peer ratings. *Journal of Applied Psychology,* 63(5), 579-588.

Homan, A. C., Hollenbeck, J. R., Humphrey, S. E., Van Knippenberg, D., Ilgen, D. R., & Van Kleef, G. A. (2008). Facing differences with an open mind: Openness to experience, salience of intragroup differences, and performance of diverse work groups. *Academy of Management Journal*, *51*(6), 1204-1222.

Hofstede, G. (1983). National cultures in four dimensions: A research-based theory of cultural differences among nations. *International Studies of Management & Organization*, *13*(1-2), 46-74.

Hofstede, G., & Bond, M. H. (1984). Hofstede's culture dimensions an independent validation using Rokeach's value survey. *Journal of cross-cultural psychology*, *15*(4), 417-433.

Horwitz, S. K., & Horwitz, I. B. (2007). The effects of team diversity on team outcomes: A meta-analytic review of team demography. *Journal of management*, *33*(6), 987-1015.

House, R. J., Hanges, P. J., Javidan, M., Dorfman, P. W., & Gupta, V. (Eds.). (2004). *Culture, leadership, and organizations: The GLOBE study of 62 societies*. Sage publications.

Iles, P., & Kaur Hayers, P. (1997). Managing diversity in transnational project teams: A tentative model and case study. *Journal of managerial Psychology*, *12*(2), 95-117.

Ilgen, D. R., Hollenbeck, J. R., Johnson, M., & Jundt, D. (2005). Teams in organizations: From input-process-output models to IMOI models. *Annual Review of Psychology*, *56*, 517-543.

International Monetary Fund (2013). World Economic Report. Retrieved October 11, 2015 from

https://www.imf.org/external/pubs/ft/weo/2013/01/.

International Personality Item Pool. (n.d.). Alphabetical Index of 274 Labels for 463 IPIP Scales. Retrieved from http://ipip.ori.org/newindexofscalelabels.htm

Jackson, S. E., May, K. E., & Whitney, K. (1995). Understanding the dynamics of diversity in decision-making teams. *Team Effectiveness and Decision Making in Organizations*, 204-261.

Janssen, O., Van de Vliert, E., & Veenstra, C. (1999). How task and person conflict shape the role of positive interdependence in management teams. *Journal of Management*, *25*(2), 117-141.

Janz, B. D., Colquitt, J. A., & Noe, R. A. (1997). Knowledge worker team effectiveness: The role of autonomy, interdependence, team development, and contextual support variables. *Personnel Psychology*, *50*(4), 877-904.

Jehn, K. A. (1994). Enhancing effectiveness: An investigation of advantages and disadvantages of value-based intragroup conflict. *International Journal of Conflict Management*, *5*(3), 223-238.

Jehn & Bendersky, (2003). Intragroup conflict in organizations: A contingency perspective on the conflict-outcome relationship. *Research in Organizational Behavior, 25,* 187-242.

Jehn, K. A., Northcraft, G. B., & Neale, M. A. (1999). Why differences make a difference: A field study of diversity, conflict and performance in workgroups. *Administrative Science Quarterly*, *44*(4), 741-763.

Jehn, K. A., Rispens, S., & Thatcher, S. M. (2010). The effects of conflict asymmetry on work group and individual outcomes. *Academy of Management Journal*, *53*(3), 596-616.

Jehn, K. A., & Bendersky, C. (2003). Intragroup conflict in organizations: A contingency perspective on the conflict-outcome relationship. *Research in organizational behavior*, *25*, 187-242.

Jonas, E., Schulz-Hardt, S., Frey, D., & Thelen, N. (2001). Confirmation bias in sequential information search after preliminary decisions: an expansion of dissonance theoretical research on selective exposure to information. Journal of personality and social psychology, 80(4), 557-571.

Joshi, A., & Roh, H. (2009). The role of context in work team diversity research: A meta-analytic review. *Academy of Management Journal*, *52*(3), 599-627.

Kalinoski, Z. T., Steele-Johnson, D., Peyton, E. J., Leas, K. A., Steinke, J., & Bowling, N. A. (2013). A meta-analytic evaluation of diversity training outcomes. *Journal of Organizational Behavior*, *34*(8), 1076-1104.

Karn, J. S., & Cowling, A. J. (2008). Measuring the effect of conflict on software engineering teams. *Behavior Research Methods, 40*(2), 582-589.

Kichuk, S. L., & Wiesner, W. H. (1998). Work teams: Selecting members for optimal performance. *Canadian Psychology, 39,* 23–32.

Kirkpatrick, D.L. (1967). Evaluation of training. In R. L. Craig & L. R. Bittel (Eds.), *Training and development Handbook* (pp.87-112). New York: McGraw-Hill.

Klein, K. J., Ziegert, J. C., Knight, A. P., & Xiao, Y. (2006). Dynamic delegation: Shared, hierarchical, and deindividualized leadership in extreme action teams. *Administrative Science Quarterly*, *51*(4), 590-621.

Klimoski, R., & Mohammed, S. (1994). Team mental model: Construct or metaphor?. *Journal of Management*, *20*(2), 403-437.

Kluger, A. N., & DeNisi, A. (1996). The effects of feedback interventions on performance: a historical review, a meta-analysis, and a preliminary feedback intervention theory. *Psychological Bulletin*, *119*, 254-284.

Knight, D., Pearce, C. L., Smith, K. G., Olian, J. D., Sims, H. P., Smith, K. A., & Flood, P. (1999). Top management team diversity, group process, and strategic consensus. *Strategic Management Journal*, *20*(5), 445-465.

Kooij-de Bode, H. J., van Knippenberg, D., & van Ginkel, W. P. (2008). Ethnic diversity and distributed information in group decision making: The importance of information elaboration. *Group Dynamics: Theory, Research, and Practice*, *12*(4), 307.

Kozlowski, S. W., & Klein, K. J. (2000). A multilevel approach to theory and research in organizations: Contextual, temporal, and emergent processes. In K. Klein & S. Kozlowski (Eds.), *Multilevel theory, research, and methods in organizations: Foundation, extensions, and new directions* (pp.3-90). San Francisco, CA: Jossey-Boss.

Kroll, J. F., & Stewart, E. (1994). Category interference in translation and picture naming: Evidence for asymmetric connections between bilingual memory representations. *Journal of Memory and Language*, *33*(2), 149-174.

Lau, D. C., & Murnighan, J. K. (2005). Interactions within groups and subgroups: The effects of demographic faultlines. *Academy of Management Journal*, *48*(4), 645-659.

LePine, J. A. (2003). Team adaptation and postchange performance: effects of team composition in terms of members' cognitive ability and personality. *Journal of Applied Psychology*, *88*(1), 27-39.

Levine, J. M., & Moreland, R. L. (1990). Progress in small group research. *Annual Review of Psychology*, *41*(1), 585-634.

Li, J., & Hambrick, D. C. (2005). Factional groups: A new vantage on demographic faultlines, conflict, and disintegration in work teams. *Academy of Management Journal*, *48*(5), 794-813.

Locke, E. A., & Latham, G. P. (1990). *A theory of goal setting & task performance*. Englewood Cliffs, NJ: Prentice-Hall, Inc.

Locke, E. A., & Latham, G. P. (2002). Building a practically useful theory of goal setting and task motivation: A 35-year odyssey. *American Psychologist*, *57*(9), 705.

Locke, E. A., Sirota, D., & Wolfson, A. D. (1976). An experimental case study of the successes and failures of job enrichment in a government agency. *Journal of Applied Psychology*, *61*(6), 701-711.

Loughry, L. M., & Amason, C. A. (2014). Why won't task conflict cooperate? Deciphering stubborn results. *International Journal of Conflict Management*, *25*(4), 333-358.

Mannix, E. & Neale, M. A. (2005). What differences make a difference?. *Psychological Science in the Public Interest*, *6*(2), 31-55.

Marks, M. A., Mathieu, J. E., & Zaccaro, S. J. (2001). A temporally based framework and taxonomy of team processes. *Academy of Management Review*, *26*(3), 356-376.

Marshall, C., & Rossman, G. B. (1989). Design qualitative research. *Calfornia: Sage*.

Martins, L. L., Schilpzand, M. C., Kirkman, B. L., Ivanaj, S., & Ivanaj, V. (2013). A contingency view of the effects of cognitive diversity on team performance: The moderating roles of team psychological safety and relationship conflict. *Small Group Research*, *44*(2), 96-126.

Mathieu, J. E., Heffner, T. S., Goodwin, G. F., Salas, E., & Cannon-Bowers, J. A. (2000). The influence of shared mental models on team process and performance. *Journal of Applied Psychology*, *85*, 273–283.

May, G. L. (2008). The effect of rater training on reducing social style bias in peer evaluation. *Business Communication Quarterly*, *71*(3), 297-313.

McCrae, R. R., & Costa, P. T. (1987). Validation of the five-factor model of personality across instruments and observers. *Journal of Personality and Social Psychology*, *52*(1), 81-90.

McGrath J. E., (1984). Groups: Interaction and Performance. Englewood Cliffs, NJ: Prentice-Hall, Inc.

McGrath, J. E., Arrow, H., & Berdahl, J. L. (2000). The study of groups: past, present, and future. *Personality and Social Psychology Review*, *4*(1), 95-105.

McLeod, P., & Lobel, S. 1992. Tbe effects of etbnic diversity on idea generation in small groups. Paper presented at the annual meeting of the Academy of Management, Las Vegas

McLeod, P. L., Lobel, S. A., & Cox, T. H. (1996). Ethnic diversity and creativity in small groups. *Small Group Research*, *27*(2), 248-264.

Mesmer-Magnus, J. R., & DeChurch, L. A. (2009). Information sharing and team performance: a meta-analysis. *Journal of Applied Psychology*, *94*(2), 535-546.

Miles, M. B., Huberman, A. M., & Saldaña, J. (2014). *Qualitative data analysis: A methods sourcebook*. Los Angeles, CA: SAGE Publishing.

Milliken, F. J., & Martins, L. L. (1996). Searching for common threads: Understanding the multiple effects of diversity in organizational groups. *Academy of Management Review*, *21*(2), 402-433.

Mohammed, S., & Angell, L. C. (2004). Surface-and deep-level diversity in workgroups: Examining the moderating effects of team orientation and team process on relationship conflict. *Journal of Organizational Behavior*, *25*(8), 1015-1039.

Mohammed, S., Ferzandi, L., & Hamilton, K. (2010). Metaphor no more: A 15-year review of the team mental model construct. *Journal of Management*, 1-35.

Mooney, A. C., Holahan, P. J., & Amason, A. C. (2007). Don't take it personally: Exploring cognitive conflict as a mediator of affective conflict. *Journal of Management Studies*, *44*(5), 733-758.

Murray, A. I. (1989). Top management group heterogeneity and firm performance. *Strategic Management Journal*, *10*(S1), 125-141.

Neuman, G. A., Wagner, S. H., & Christiansen, N. D. (1999). The relationship between work-team personality composition and the job performance of teams. *Group & Organization Management*, *24*(1), 28-45.

Norman, W. T. (1963). Toward an adequate taxonomy of personality attributes: Replicated factor structure in peer nomination personality ratings. *The Journal of Abnormal and Social Psychology*, *66*(6), 574-583.

Nunnally, J. C. (1975). Psychometric Theory—25 Years Ago and Now 1. *Educational Researcher*, *4*(10), 7-21.

Ohbuchi, K. I., Fukushima, O., & Tedeschi, J. T. (1999). Cultural values in conflict management: Goal orientation, goal attainment, and tactical decision. *Journal of Cross-Cultural Psychology*, *30*(1), 51-71.

Olson, B. J., Parayitam, S., & Bao, Y. (2007). Strategic decision making: The effects of cognitive diversity, conflict, and trust on decision outcomes. *Journal of Management*, *33*(2), 196-222.

O'Neill, T. A., Allen, N. J., & Hastings, S. E. (2013). Examining the “Pros” and “Cons” of Team

Con flict: A Team-Level Meta-Analysis of Task, Relationship, and Process Conflict. *Human Performance*, *26*(3), 236-260.

O'Neill, T. A., McLarnon, M. J. W., Hoffart, G. C., Woodley, H. J., & Allen, N. J. (2015). The structure and function of team conflict state profiles. Journal of Management.

Orwin and Spjut (2009). Engineering Design: A project based introduction. Hoboken, NJ: John Wiley & Sons.

O'Reilly III, C. A., Caldwell, D. F., & Barnett, W. P. (1989). Work group demography, social integration, and turnover. *Administrative Science Quarterly*, 21-37.

Ott-Holland, Catherine J., Jason L. Huang, Ann Marie Ryan, Fabian Elizondo, and Patrick L. Wadlington. "The effects of culture and gender on perceived self-other similarity in personality." *Journal of Research in Personality* 53 (2014): 13-21.

Oyserman, D., Coon, H. M., & Kemmelmeier, M. (2002). Rethinking individualism and collectivism: evaluation of theoretical assumptions and meta-analyses. *Psychological Bulletin, 128*(1), 3-72.

Panteli, N., & Sockalingam, S. (2005). Trust and conflict within virtual inter-organizational alliances: a framework for facilitating knowledge sharing. *Decision Support Systems*, *39*(4), 599-617.

Park, H. S., Levine, T. R., Weber, R., Lee, H. E., Terra, L. I., Botero, I. C., ... & Wilson, M. S. (2012). Individual and cultural variations in direct communication style. *International Journal of Intercultural Relations*, *36*(2), 179-187.

Paulhus, D. L. (1984). Two-component models of socially desirable responding. *Journal of personality and Social Psychology*, *46*(3), 598.

Pearsall, M. J., & Ellis, A. P. (2006). The effects of critical team member assertiveness on team performance and satisfaction. *Journal of Management*, *32*(4), 575-594.

Pelled, L. H. (1996). Demographic diversity, conflict, and work group outcomes: An intervening process theory. *Organization Science*, *7*(6), 615-631.

Pelled, L. H., Eisenhardt, K. M., & Xin, K. R. (1999). Exploring the black box: An analysis of work group diversity, conflict and performance. *Administrative Science Quarterly*, *44*(1), 1-28.

Porter, L. W., & Steers, R. M. (1973). Organizational, work, and personal factors in employee turnover and absenteeism. *Psychological Bulletin*, *80*(2), 151-176.

Rico, R., Molleman, E., Sánchez-Manzanares, M., & Van der Vegt, G. S. (2007). The effects of diversity faultlines and team task autonomy on decision quality and social integration. *Journal of Management*, *33*(1), 111-132.

Rock, D. & Grant, H. (2016). Why diverse smarter. Harvard Business Review. Retrieved from https://hbr.org/2016/11/why-diverse-teams-are-smarter.

Roberts, B. W., Chernyshenko, O. S., Stark, S., & Goldberg, L. R. (2005). The structure of conscientiousness: An empirical investigation based on seven major personality questionnaires. *Personnel Psychology*, *58*(1), 103-139.

Saavedra, R., Earley, P. C., & Van Dyne, L. (1993). Complex interdependence in task-performing groups. *Journal of Applied Psychology*, *78*(1), 61-72.

Salas, E., Cooke, N. J., & Rosen, M. A. (2008). On teams, teamwork, and team performance: Discoveries and developments. *Human Factors: The Journal of the Human Factors and Ergonomics Society*, *50*(3), 540-547.

Salas, E., Dickinson, T. L., Converse, S. A, Tannenbaum, S. I. (1992). *Toward an understanding of team performance and training*,. In Swezey, R. W & Salas, E. (Eds), *Team: Their Training and Performance* (pp.3-29). Norwood, NJ: Ablex.

Salas, E., Sims, D. E., & Burke, C. S. (2005). Is there a "Big Five" in teamwork?. *Small Group Research*, *36*(5), 555-599.

Shachaf, P. (2008). Cultural diversity and information and communication technology impacts on global virtual teams: An exploratory study. *Information & Management*, *45*(2), 131-142.

Schendel, J. D., & Hagman, J. D. (1982). On sustaining procedural skills over a prolonged retention interval. *Journal of Applied Psychology*, *67*(5), 605-610.

Schwoerer, C. E., May, D. R., Hollensbe, E. C., & Mencl, J. (2005). General and specific self-efficacy in the context of a training intervention to enhance performance expectancy. *Human Resource Development Quarterly*, *16*(1), 111-129.

Simons, T., Pelled, L. H., & Smith, K. A. (1999). Making use of difference: Diversity, debate, and decision comprehensiveness in top management teams. *Academy of Management Journal*, *42*(6), 662-673.

Simons, T. L., & Peterson, R. S. (2000). Task conflict and relationship conflict in top management teams: the pivotal role of intragroup trust. *Journal of Applied Psychology*, *85*(1), 102-111.

Smith, R. P., & Eppinger, S. D. (1997). A predictive model of sequential iteration in engineering design. *Management Science*, *43*(8), 1104-1120.

Smith-Jentsch, K.A., Salas, E. & Baker, D.P. (1996). Training team performance-related assertiveness. *Personnel Psychology*, *49*(4), 909-936.

Smith-Jentsch, K. A., Nimax, L. L. C., & Center, J. S. (2015). *On shifting from autonomous to interdependent work*. Technical Report February, NASA, Houston, Texas.

Somech, A., Desivilya, H. S., & Lidogoster, H. (2009). Team conflict management and team effectiveness: The effects of task interdependence and team identification. Journal of

Organizational Behavior, 30(3), 359-378.

Stahl, G. K., Maznevski, M. L., Voigt, A., & Jonsen, K. (2010). Unraveling the effects of cultural diversity in teams: A meta-analysis of research on multicultural work groups. *Journal of International Business Studies*, *41*(4), 690-709.

Stasser, G., & Titus, W. (1985). Pooling of unshared information in group decision making: Biased information sampling during discussion. *Journal of Personality and Social Psychology, 48,* 1467–1478.

Stasser, G., & Titus, W. (1987). Effects of information load and percentage of shared information on the dissemination of unshared information during group discussion. *Journal of Personality and Social Psychology, 53*(1), 81-93.

Stasser, G., & Stewart, D. (1992). Discovery of hidden profiles by decision-making groups: Solving a problem versus making a judgment. *Journal of Personality and Social Psychology*, *63*(3), 426-434.

Stewart, G. L. (2006). A meta-analytic review of relationships between team design features and team performance. *Journal of Management*, *32*(1), 29-55.

Stewart, G. L., & Barrick, M. R. (2000). Team structure and performance: Assessing the mediating role of intrateam process and the moderating role of task type. *Academy of Management Journal*, *43*(2), 135-148.

Steyer, R., Schmitt, M., & Eid, M. (1999). Latent state–trait theory and research in personality and individual differences. *European Journal of Personality*, *13*(5), 389-408.

Strauss, A. (1987). Qualitative analysis for social scientists. Cambridge, MA: Cambridge University Press.

Strauss, A. & Corbin, J. (1990; 2008). Basics of qualitative research: grounded theory procedures

and techniques. Newbury Park, CA: Sage.

Sundstrom, E., De Meuse, K. P., & Futrell, D. (1990). Work teams: Applications and effectiveness. *American Psychologist*, *45*(2), 120-133.

Taras, V., & Rowney, J. (2007). Effects of cultural diversity on in-class communication and student project team dynamics: Creating synergy in the diverse classroom. *International Studies in Educational Administration*, *35*(2), 66-81.

Ten Velden, F. S. T., Beersma, B., & De Dreu, C. K. (2007). Majority and minority influence in group negotiation: the moderating effects of social motivation and decision rules. *Journal of Applied Psychology*, *92*(1), 259-268.

Ting-Toomey, S. (1988). Intercultural conflict styles: A face-negotiation theory. In Y. Kim & W. Gudykunst (Eds.), *Theories in intercultural communication* (pp. 213-235). Newbury Park, CA: Sage.

Tjosvold, D. (1998). Cooperative and competitive goal approach to conflict: Accomplishment and challenges. *Applied Psychology, 47,* 285–31.

Tress, B., Tress, G., & Fry, G. (2005). Researchers' experiences, positive and negative, in integrative landscape projects. *Environmental Management*,*36*(6), 792-807.

Trubisky, P., Ting-Toomey, S., & Lin, S. L. (1991). The influence of individualism-collectivism and self-monitoring on conflict styles. *International Journal of Intercultural relations*, *15*(1), 65-84.

Tsui, A. S., Egan, T. D., & O'Reilly III, C. A. (1992). Being different: Relational demography and organizational attachment. *Administrative Science Quarterly*, 549-579.

Turner, J. C., Brown, R. J., & Tajfel, H. (1979). Social comparison and group interest in ingroup favouritism. *European Journal of Social Psychology*, *9*(2), 187-204.

Turner, J. C., Hogg, M. A., Oakes, P. J., Reicher, S. D., & Wetherell, M. S. (1987).

Rediscovering the social group: A self-categorization theory. Cambridge, MA: Basil Blackwell.

Tziner, A., & Eden, D. (1985). Effects of crew composition on crew performance: Does the whole equal the sum of its parts?. *Journal of Applied Psychology*, *70*(1), 85.

Van de Ven, A. H., Delbecq, A. L., & Koenig Jr, R. (1976). Determinants of coordination modes within organizations. *American Sociological Review*, 322-338.

Van Dick, R., Van Knippenberg, D., Hägele, S., Guillaume, Y. R., & Brodbeck, F. C. (2008). Group diversity and group identification: The moderating role of diversity beliefs. *Human Relations*, *61*(10), 1463-1492.

Van Knippenberg, D., De Dreu, C. K., & Homan, A. C. (2004). Work group diversity and group performance: an integrative model and research agenda. *Journal of Applied Psychology*, *89*(6), 1008-1022.

Van Knippenberg, D., & Schippers, M. C. (2007). Work group diversity. *Annual Review of Psychology*, *58*, 515-541.

Van Knippenberg, D., van Ginkel, W. P., & Homan, A. C. (2013). Diversity mindsets and the performance of diverse teams. *Organizational Behavior and Human Decision Processes*, *121*(2), 183-193.

Wanous, J. P., Poland, T. D., Premack, S. L., & Davis, K. S. (1992). The effects of met expectations on newcomer attitudes and behaviors: a review and meta-analysis. *Journal of Applied Psychology*, *77*(3), 288-297.

Watson, W. E., Johnson, L., & Merritt, D. (1998). Team orientation, self-orientation, and diversity in task groups their connection to team performance over time. *Group Organization Management*, *23*(2), 161-188.

Watson, W. E., Kumar, K., & Michaelsen, L. K. (1993). Cultural diversity's impact on interaction process and performance: Comparing homogeneous and diverse task groups. *Academy of Management Journal*, *36*(3), 590-602.

Webb, N. M. (1989). Peer interaction and learning in small groups. *International journal of Educational research*, *13*(1), 21-39.

Webb, N., & Kenderski, C. Student interaction and learning in small group and whole class settings. In P. Peterson, L, Cherry Wilkinson, & M. Hallinan (Eds.). The social context of instruction: Group organization and group processes (pp. 162-179). San Francisco: Academic Press, in press.

Webber, S. S., & Donahue, L. M. (2001). Impact of highly and less job-related diversity on work group cohesion and performance: A meta-analysis. *Journal of Management*, *27*(2), 141-162.

Weingart, L. R., Behfar, K. J., Bendersky, C., Todorova, G., & Jehn, K. A. (2015). The directness and oppositional intensity of conflict expression. *Academy of Management Review*, *40*(2), 235-262.

Wildman, J. L., Shuffler, M. L., Lazzara, E. H., Fiore, S. M., Burke, C. S., Salas, E., & Garven, S. (2012). Trust development in swift starting action teams: A multilevel framework. *Group & Organization Management*, *37*(2), 137-170.

Williams, K. Y., & O'Reilly III, C. A. (1998). A review of 40 years of research. *Res Organ Behav*, *20*, 77-140.

Witt, L. A., Burke, L. A., Barrick, M. R., & Mount, M. K. (2002). The interactive effects of conscientiousness and agreeableness on job performance. *Journal of Applied Psychology*, *87*(1), 164-169.

Wittenbaum, G. M., Hollingshead, A. B., Paulus, P. B., Hirokawa, R. Y., Ancona, D. G.,

Peterson, R. S., ... & Yoon, K. (2004). The functional perspective as a lens for understanding groups. *Small Group Research*, *35*(1), 17-43.

Zellmer-Bruhn, M. E., Maloney, M. M., Bhappu, A. D., & Salvador, R. B. (2008). When and how do differences matter? An exploration of perceived similarity in teams. *Organizational Behavior and Human Decision Processes*, *107*(1), 41-59.

APPENDIX A: Interview Question Bank

Initial Interview

1. What, if any, were your expectations about relocating to the Houston, Texas area? What were your thoughts about and experience with this situation?
    a. Follow up: Was anyone involved in helping you relocate? How were they involved?
2. What, if any, were your expectations about the summer internship program at Rice University? What were your thoughts about and experience with this situation?
    a. Was anyone involved in helping you decide to attend? How were they involved?
    b. What are the expected challenges and benefits of attending this program?
3. What goals do you hope to achieve by attending this program? What do you hope to gain?
4. Tell me how you went/are going about preparing for this internship?
    a. Do you feel adequately prepared? Please explain.
5. Why did you choose to attend this program?
6. Do you know what is expected of you in this program?
7. Have you ever participated in any educational programs or activities abroad before this program? Please describe the experience.
8. Do you have any questions or concerns about this study?

Recurring Interviews (sample items)

1. Do you have any questions or concerns about what you've experienced with the study so far?
2. Could you describe a typical day when you are working on projects individually?
3. Could you describe a typical day for me when you are working on projects in a team?
    a. Could you describe the project you are working on now?
        i. Could you describe the last time your team met?
            1. Can you describe how the team communicated?
                a. Did you feel comfortable expressing your ideas and opinions?
            2. Describe what was achieved during the meeting.
            3. Was anyone in charge of the meeting?
            4. How do the members of your team get along with each other?
                a. How do people treat each other on your team?
            5. How does your team make decisions?
        ii. Tell me about a time your team had to make a decision.
            1. Who contributed to the decision?
            2. What was discussed during the decision?
            3. Do you feel your contribution was taken into account?
            4. How was the final decision made?

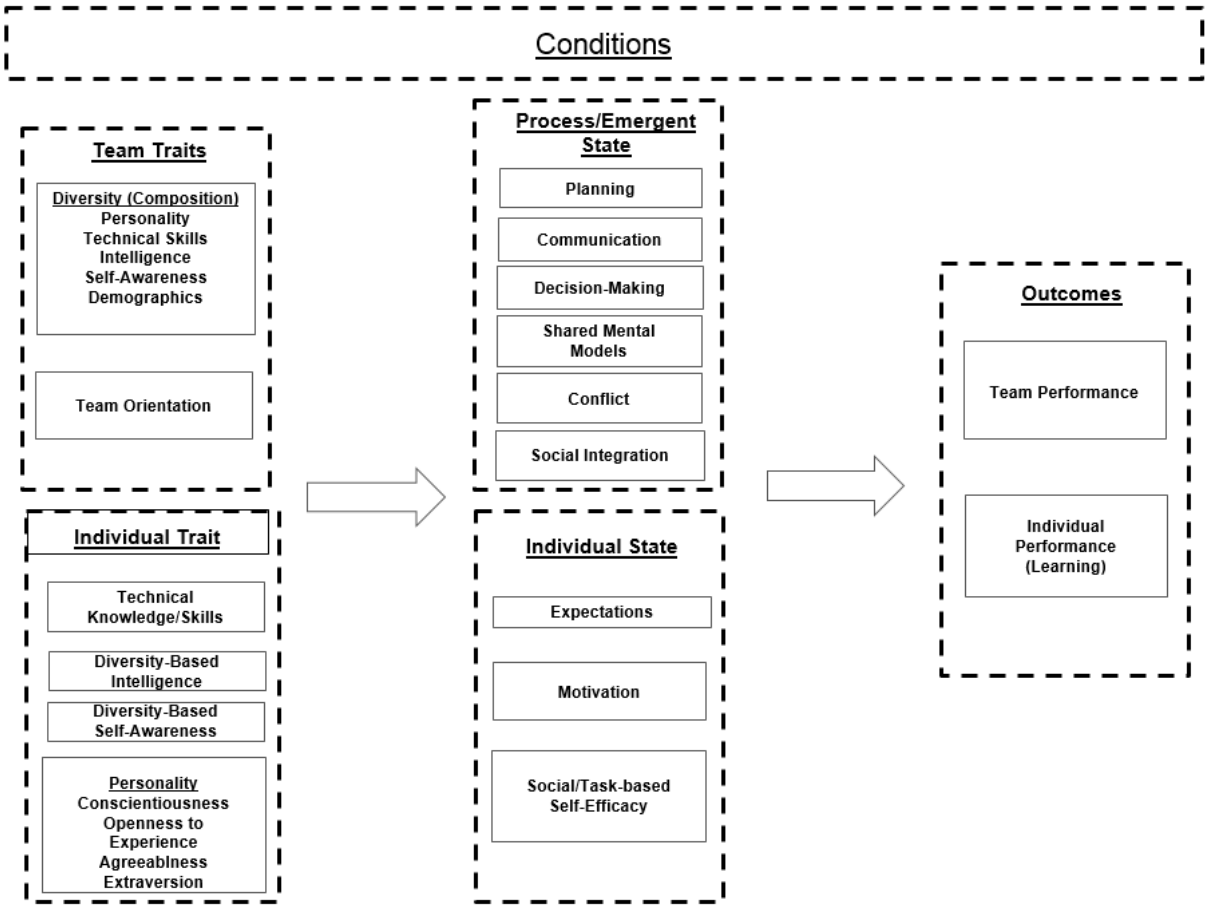
4. When you working on your team, do you feel you have clear roles and responsibilities?
    a. Can you describe your roles and responsibilities?
5. How does your team decide what to work on for the day? Do you typically plan things out, or follow where the day takes you? Do you follow a schedule?
    a. How does your team delegate tasks?
    b. How do you decide who does what tasks?
6. Has your team had any major conflict/disagreement? If so, how was it handled?
7. Has your team experienced any communication issues? If so, how were the addressed?
8. Do you feel you have the knowledge and skills necessary to perform well in this program?
9. What do you like about working in teams? What do you dislike?
10. What have you found most interesting about your experience so far?
11. Do you know what is expected of you in this program?
12. How are you feeling about your ability to perform well in the program?
13. Please describe you're the amount of work you have to do to successfully complete this program.
14. How comfortable do you feel approaching others and your professor for help?
    a. If you had an issue with the project or another student, what is the likelihood you would speak up?
15. What are your goals for the project next week?
16. Was the scope of your project clear when you began? (deliverables, deadlines, etc.)?
17. How is the morale on your team (confidence, energy, enthusiasm for the project)?

Final Interview

1. How did the final prototype go?
    a. Do you think it's what the client wanted?
    b. Do you feel your team did the best they could?
    c. Are you happy with the final product?
2. As you look back on your experience with relocating, do you think your expectations were met? Were they too low, too high? Was anything unexpected?
    a. Was this your first time abroad/do you have any experience visiting/living abroad?
    b. Do you feel like you adapted well?
3. As you look back on your experience with this program, do you think your expectations were met?
    a. Were they too low, too high? Was anything unexpected?
    b. Was the information you received prior to the intership pretty accurate, or was it different?
4. What did you like about this program? What did you dislike about this program?
5. What are the most important lessons you learned in going through this experience?
6. What have you learned about the different cultures of your teammates? Any interesting facts, information, etc.?

7. Were you comfortable interacting with teammates from different cultures? Were you confident in your interactions?
    a. Were you comfortable living here in Houston? Was there anything you did or didn't like about it?
    b. Do you feel you'd be comfortable visiting Malawi or Brazil? (for American students)
8. How much do you think you know about the norms/beliefs/practices of the different cultures you interacted with? Do you know this information before or did you learn from the students here?
9. How much attention and effort toward learning about culture and intercultural experiences did you put in?
10. Do you feel like you had the appropriate verbal and non-verbal behaviors when interacting with others from different cultures?
11. Were you consciously aware of the culture factor when interacting with others? Do you think this affected your behavior?
12. Did you ever feel stress about 1) your move to Houston, 2) interacting with new/different people, 3) the project/internship? If not, any other emotion?
    a. If yes, what do you think was most stressful?
13. Do you think you were successful in reaching your goals for this internship? Did you get everything out of it that you wanted?

APPENDIX B. Preliminary Model of Diverse Design Team Performance



APPENDIX C: Personality

Instructions: Listed below are phrases describing people's behaviors. Please use the rating scale provided to describe how accurately each statement describes ***you***. Describe yourself as you generally are now, not as you wish to be in the future. Please read each statement carefully, and then bubble in the number that corresponds to the number on the scale below.

1.	The life of the party	① ② ③ ④ ⑤
2.	Feel little concern for others	① ② ③ ④ ⑤
3.	Always prepared	① ② ③ ④ ⑤
4.	Get stressed out easily	① ② ③ ④ ⑤
5.	Have a rich vocabulary	① ② ③ ④ ⑤
6.	Don't talk a lot	① ② ③ ④ ⑤
7.	Interested in people	① ② ③ ④ ⑤
8.	Leave my belongings around	① ② ③ ④ ⑤
9.	Relaxed most of the time.	① ② ③ ④ ⑤
10.	Have difficulty understanding abstract ideas	① ② ③ ④ ⑤
11.	Feel comfortable around people	① ② ③ ④ ⑤
12.	Insult people	① ② ③ ④ ⑤
13.	Pay attention to details	① ② ③ ④ ⑤
14.	Worry about things	① ② ③ ④ ⑤
15.	Have a vivid imagination	① ② ③ ④ ⑤
16.	Keep in the background	① ② ③ ④ ⑤
17.	Sympathize with others' feelings	① ② ③ ④ ⑤
18.	Make a mess of things	① ② ③ ④ ⑤
19.	Seldom feel blue	① ② ③ ④ ⑤
20.	Not interested in abstract ideas	① ② ③ ④ ⑤
21.	Start conversations	① ② ③ ④ ⑤
22.	Not interested in other people's problems	① ② ③ ④ ⑤
23.	Get chores done right away	① ② ③ ④ ⑤

26.	Have little to say	① ② ③ ④ ⑤
27.	Have a soft heart	① ② ③ ④ ⑤
28.	Often forget to put things back in their proper place	① ② ③ ④ ⑤
29.	Get upset easily	① ② ③ ④ ⑤
30.	Do not have a good imagination	① ② ③ ④ ⑤
31.	Talk to a lot of different people at parties	① ② ③ ④ ⑤
32.	Not really interested in others	① ② ③ ④ ⑤
33.	Like order	① ② ③ ④ ⑤
34.	Change my mood a lot	① ② ③ ④ ⑤
35.	Quick to understand things	① ② ③ ④ ⑤
36.	Don't like to draw attention to myself	① ② ③ ④ ⑤
37.	Take time out for others	① ② ③ ④ ⑤
38.	Shirk my duties	① ② ③ ④ ⑤
39.	Have frequent mood swings	① ② ③ ④ ⑤
40.	Use difficult words	① ② ③ ④ ⑤
41.	Don't mind being the center of attention	① ② ③ ④ ⑤
42.	Feel others' emotions	① ② ③ ④ ⑤
43.	Follow a schedule	① ② ③ ④ ⑤
44.	Get irritated easily	① ② ③ ④ ⑤
45.	Spend time reflecting on things	① ② ③ ④ ⑤
46.	Quiet around strangers	① ② ③ ④ ⑤
47.	Make people feel at ease	① ② ③ ④ ⑤
48.	Exacting in my work	① ② ③ ④ ⑤

24.	Easily disturbed	① ② ③ ④ ⑤
25.	Have excellent ideas	① ② ③ ④ ⑤

49.	Often feel blue	① ② ③ ④ ⑤
50.	Full of ideas	① ② ③ ④ ⑤

APPENDIX D: Cultural Dimensions

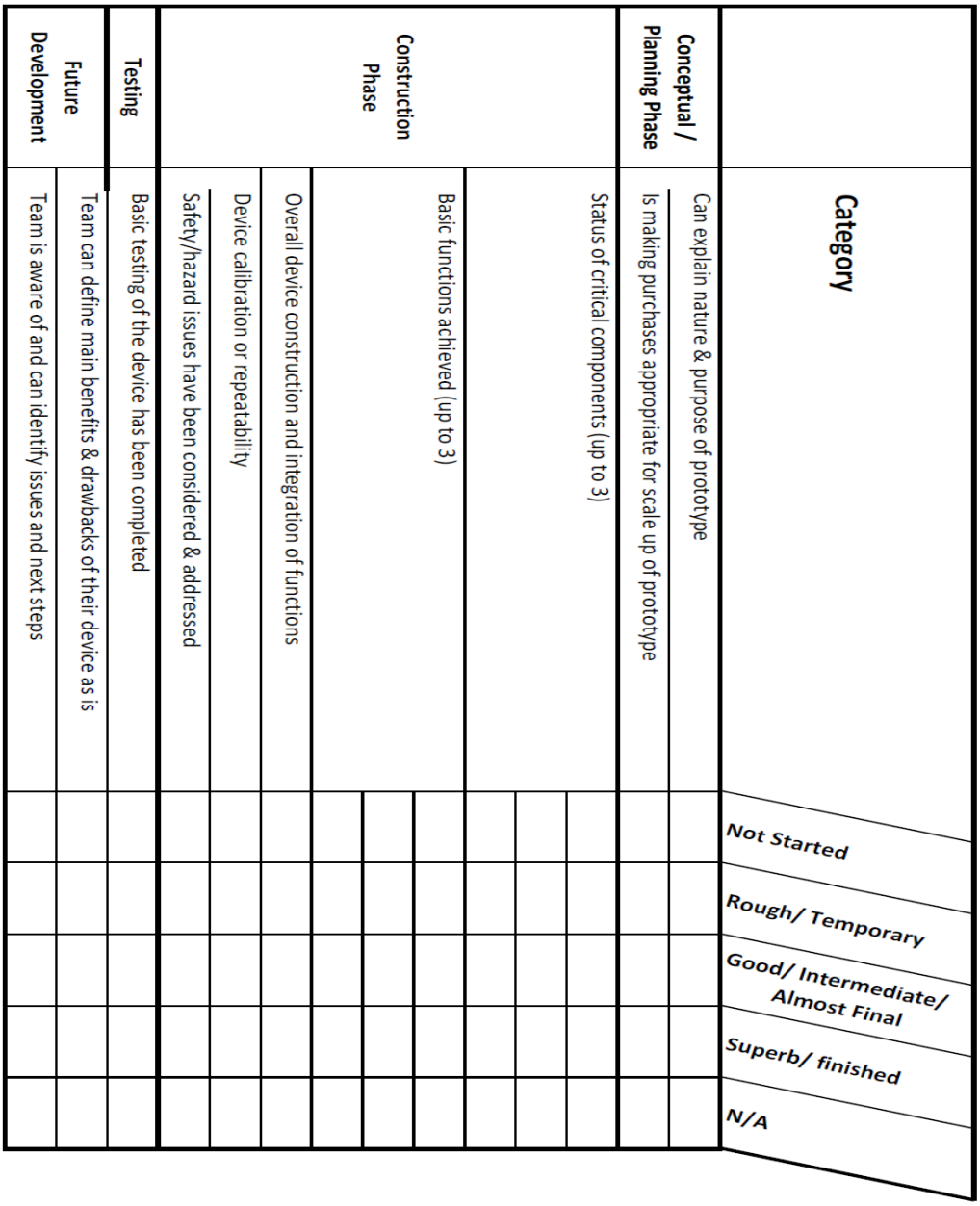
Instructions: Listed below are phrases describing people's attitudes and beliefs. Please use the rating scale provided to describe how accurately each statement describes ***you***. Describe yourself as you generally are now.Describe yourself as you honestly see yourself, in relation to other people you know of the same sex as you are, and roughly your same age. Please read each statement carefully, and then answer on the 7 point scale (1 = strongly disagree; 7 = strongly agree). (Adapted from Bontempo, 1993, Brockner, 2001; Hofestede, 1986

1. I believe inequality in society should be minimized.
2. The way to change a social system is by redistributing power.
3. People in power are entitled to privileges.
4. There should be established ranks in society with everyone occupying their rightful place.
5. Communications with superiors should always be done using formally established procedures.
6. I am willing to take risks in life.
7. Uncertainty in life causes me anxiety and stress.
8. If rules do not fit the situation, they should be changed.
9. I prefer to follow written rules and regulations.
10. Conflict and competition can be constructive if others are fair.
11. I believe it is important to engage in service-related activities.
12. Sex roles in society should be clearly differentiated.
13. Performance and growth are important to me.
14. Quality of life and environment are important to me.
15. Men should be assertively, and women should be nurturing.
16. One should live one's like independently of others as much as possible.
17. It is important to me that I perform better on tasks that others.
18. When working with a group, harmony should always be maintained.
19. If the group is slowing me down, it is better to leave and work alone.
20. I can count on my relatives for help if I find myself in any kind of trouble.

APPENDIX E: Skills Inventory

	Experience (Please Circle)			List Programs/Skills
Prototyping	None	Some	Extensive	
Drawing/Sketching	None	Some	Extensive	
Laser Cutter	None	Some	Extensive	
Plasma Cutter	None	Some	Extensive	
Sanding/Painting/Finishing	None	Some	Extensive	
Computer Aided Design	None	Some	Extensive	
CNC Machining	None	Some	Extensive	
3D Printing	None	Some	Extensive	
Molding	None	Some	Extensive	
Mill/Lathe	None	Some	Extensive	
Power Tools	None	Some	Extensive	
Electronics	None	Some	Extensive	

APPENDIX F: Prototype Form



APPENDIX G: Final Code List

Final Code List

Expectations (Master Code: EXPT)
Subcodes
EXPT-Int [+,-]: Expectations related to interacting with others
EXPT-FO [+, -]: Expectations related to the program received from others
EXPT-Proj [+, -]: Expectations related to the project
EXPT-Relo [+, -]: Expectations related to relocating
EXPT-Met [+,-]: Expectations that have been met
EXPT-Not Met [+, -]: Expectations that have not been met/are different than expected

Technical Skills (Master Code: TS)
Subcodes
TS-PE: Previous experience with ENG120 or ENG200 coursework
TS-Hands: Hands on engineering/technical skills
TS-Theor: Theoretical training related to engineering

Cultural Interaction Experience (Master Code: CIE)
Subcodes (None)
CIE: Previous experience with cultural interactions

Diversity-Based Self-Awareness (Master Code: DBSA)
Subcodes
DBSA [+, -]: General
DBSA-B&V [+, -]: Beliefs and values
DBSA-Beh [+, -]: Behaviors

Diversity-Based Intelligence (Master Code: DBI)
Subcodes
DBI-Behavioral [+,-]
DBI-Cognitive [+,-]
DBI-Metacognitive [+,-]
DBI-Motivational [+,-]

Personality (Master Code: PERS)
Subcodes
PERS-A[+,-]: Agreeableness
PERS-Asser [+,-]: Assertiveness - task based extraversion
PERS-C [+,-]: Conscientiousness
PERS- Comp [+,-]: Compliance
Pers-C- Del [+,-]: Deliberation
PERS- E [+,-]: Extraversion
PERS-O: [+,-] Openness to experience
PERS-Pro [+]: Proactivity; includes initiative to prepare for the program
PERS-Work [+, -]: Work-centrality

PERS-Patience [+, -]
PERS-Stub [+, -]: Stubbornness

Motivation (Master Code: MOT)
Subcodes
MOT-Inst: Instrumentality (belief internship program will lead to secondary desired outcomes)
MOT-I [+,-]: Internal/intrinsic Motivation

Self-efficacy (Master Code: SEFF)
Subcodes
SEFF-Inter: Self-efficacy related to social interactions
SEFF-Gen: General self-efficacy
SEFF-Lea: Self-efficacy related to learning material

Perceived Stress (Master Code: STRS)
Subcodes
STRS-Int [+,-]: Stress related to interacting with others
STRS-Lea [+,-]: Stress related to learning
STRS-Pers: Stress related to personal issues (e.g., relocating)
STRS-Task [+,-]: Stress directly related to the project or task

Team Orientation (Master Code: TOR)
No Subcodes
TOR [+,-]

Cultural Dimensions (Master Code: CULT)
Subcodes
CULT-Coll: collectivistic culture
CULT-Indv: individualistic culture
CULT- PD [-, +]: high power distance
CULT-Diff/Int: Interactions that highlight cultural differences and issues

Context (Master Code: CNXT)
Subcodes
CNXT-Bar-Lack: Lack of identification of barriers (no identification of challenges to task or teamwork)
CNXT-Bar-Res: Perceived barriers to task performance (resource-oriented; supplies, time, etc.)
CNXT-Bar-Tech: Perceived barriers to task performance (technically-oriented; lack of information, from others, lack of knowledge, lack of previous experience)
CNXT-Bar-Soc: Perceived barriers to social interaction (social-oriented; organizational and cultural policies/norms)
CNXT-Help [+, -]: Help received from others/from the program (versus lack thereof or unhelpful feedback). To be labeled positive, help needs to be perceived as beneficial to team goals.
CNTXT-CI [+,-]: indicates the presence/absence of client interaction
CNTXT-Fam: Familiarity with teammates (having worked/socialized with them in some capacity before)

CNTXT-PSim [+,-]: perceived similarity to team members
CNTXT-Res: Perceived resources/resources that facilitated task performance

Emergent States (Master Code:ES)
ES-Equal: Perception that all members contribute equally [+,-]
ES-PS [+,-]: Psychological Safety
ES-SMM [+,-]: Shared mental models
ES-TMS- Spec [+,-]: Transactive Memory Systems, Specialization
ES-Trust: Trust
TEFF[+,-]: Team Efficacy

Team Process (Master Code: PROC)
Subcodes
PROC-Com [+,-]: Communication
PROC-Com-IE [+,-]: Communication-information elaboration
Proc-Com-Style
Proc-Com-Doc (Use of documentation for communication or planning)
Proc-Com-FeedRec
PROC-Dec [+,-]: Decision-making
PROC-Dec-Test (Use of testing as a decision making strategy)
PROC-Plan [+,-]
PROC-Conf-Task [+,-]: Task conflict
PROC-Conf-Rel [+,-]: Relationship conflict
Proc-Conf-Proc [+, -]: Process conflict
Proc-Conf-StyleAvoid: Avoidant conflict style
Proc-Conf-StyleApproach Approach conflict style
PROC-SI [+,-]: Social integration/cohesion (attraction to the group, satisfaction with the group, and interaction among different members)
PROC-GS: Goal setting (Denotes goal setting process, not specific goals)

Leadership Constructs (LEAD)
Subcodes
LEAD-Em [+,-]: Leadership emergence
LEAD-Ment: Mentoring others
LEAD-Del: Leadership delegation
LEAD-Input: Soliciting input
LEAD-Shared: Shared Leadership
LEAD-Mot: Motivating others

Performance/Team Outcomes (Master Code: OUT)
Subcodes
OUT-PP [+,-]: Perceived Perf: team performance as perceived by the team member
OUT-PP-Learn [+,-]: Perceived Learning: Learning as perceived by the team member
OUT-PP-Prod [+,-]: Perceived productivity/efficient use of time

OUT- Sat [+,-]:

Interdependence (Master Code: INTER)
Subcodes
INTER: (used to discuss the process/level of interdependence in general)
INTER-High: high team interdependence
INTER-Low: low team interdependence

Organizational level (Master Code: ORG)
Subcodes
ORG-SI [+,-]: Social integration

Task Level (Master Code: (TASK)
Subcodes
TASK-Pdiff [+,-]: Perceived difficulty

Team Level (Master Code: TEAM)
Subcodes
TEAM-PS: Perceived similarity with team members
TEAM-RR: roles and responsibilities
TEAM-WD: workload distribution

Team Roles (TROLE)
Subcodes
TROLE-Med: mediator

Goals (Master Code: GOAL)
Subcodes (this category indicates goal that is set as opposed to an orientation)
GOAL-Communal: Communal goal
GOAL-Clarity [+,-]: Having clear and specific goals
GOAL- Learn: Learning goal
GOAL- Perf: Performance goal

Goal Orientation (Master Code: GO)
Subcodes
GO- Learn: Goal orientation learning
GO-Perf: Goal orientation perf

Teamwork Awareness (Master Code: TW Awareness)
No Subcodes (used to indicate a focus on teamwork as an essential performance element)

PerChallenge (Master Code: PerChallenge)
No Subcodes (Similar to task difficult, but used to denote a specific task challenge)

APPENDIX: IRB Approval

IRB #: IRB-FY2016-682

Title: 905078-2 Fostering successful collaboration: How diversity influences the process and performance of design teams

Creation Date: 6-6-2016

End Date: 5-10-2017

Status: Approved

Principal Investigator: Margaret Beier

Review Board: Expedited Administrative Reviews Sponsor: