Designing Online Social Support Systems to Build the Self-Efficacy of Newcomers

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ABSTRACT
Newcomers, or new members to organizations or professions, bring insights that are critical to the advancement of society. Yet newcomers often have low self-efficacy, or low beliefs in their abilities to achieve a task, which can impact performance and retention. Research suggests that self-efficacy can be developed through in-person social support. However, less is known regarding how self-efficacy can be developed in newcomers through online social support, which is potentially more accessible for all. As such, this dissertation asks: How might we design socio-technical systems that facilitate online social support to build the self-efficacy of newcomers? To answer this question, I first conduct an interdisciplinary literature review of relevant theories and systems focused on facilitating offline and online social support for newcomers. Based on this literature review, I design and present three original research studies that examine how socio-technical systems can be designed to support newcomers using online crowds, groups, and individuals. My findings suggest that online social support is difficult to facilitate due to lack of time, uncertainty by the mentor of how to best support, and resistance of the newcomer to online sharing. However, prompting newcomers to externalize progress online can help supporters understand newcomer needs, increasing the possibility of newcomers receiving social support. Theoretically, this work provides an emergent understanding of the applications of Social Cognitive Theory online by providing evidence that online communities can help to prompt online and offline social support for newcomers. Practically, this work identifies design implications for building online social support systems and introduces two novel socio-technical systems. The findings broaden our understanding of how online social support might facilitate aid to newcomers by externalizing progress and providing role models online in a variety of contexts — from entrepreneurship, education, corporations, and beyond.
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This research is only the beginning of a lifetime of work I plan to conduct dedicated to helping design tools and systems that better support people at work. As I move forward in my career, I am eager to continue to engage with building online systems of social support for newcomers, and people at all different stages of their professions. For example, I plan to apply my work on Pairachute to be utilized by our students at Brave Initiatives, to help them get social support from tech mentors to help launch their careers forward. In addition, I hope to work or consult with technical teams (such as Facebook, AirBnB, Agora, Education First, or Slack) to help them think through how to design socio-technical systems that build the self-efficacy of their users.

Technology has the capacity to greatly connect and support, yet it can also make us feel more isolated and alone. I hope to build a career focused around building more empathetic, caring, and socially supportive technology that brings us closer together. Finally, I am eager to continue to write and teach on my work related to building online social support systems that build the self-efficacy of workers. I am eager to use this knowledge gained in my doctoral research to utilize technology to connect us more closely together and create a more supportive world.

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CHAPTER 1: INTRODUCTION

1.1 Problem Description

Newcomers are critical to the advancement of organizations and society because they provide fresh perspectives on existing processes and innovative ideas [Kraut et al., 2009; Ng & Burke 2005; Bessant 2003]. However, newcomers can struggle with low self-efficacy when they enter, particularly given their lack of experience, expertise, and identity [Scott & Bruce 1994; Gerber 2011, Gerber et al. 2012; Fisher 1985; Meister et al 2014]. The degree of one’s self-efficacy, defined as the extent to which one holds belief in his or her own capabilities to organize action, impacts performance, risk-taking, persistence, and retention in entrepreneurial settings, in classrooms, in corporate workplaces, and beyond [Chen 1998; Gerber 2011, Gerber et al. 2012; Shalley & Zhou 2004; Ford 1996; Bauer et al. 2007].

Research suggests that self-efficacy can be developed when seeing role models, feeling a sense of mastery, receiving social support, or improving psychological states through building a resilient mindset [Bandura 1982; Amabile 2011]. In this dissertation, I focus primarily on the mechanism of facilitating social support, defined as: (1) emotional support, that provides empathy, trust, and care; (2) appraisal support, that validates progress and actions; (3) instrumental support, that provides tangible aid and services to assist; or (4) informational support, that provides advice, suggestions, and problem solving. I focus on the construct of social support as it has been shown to particularly help create positive emotional experiences that reduce stress, which is particularly valuable for newcomers engaged in stressful work [Pearlin et al. 1981; Scott & Bruce 1994]. Furthermore, social support can enhance motivation to learn and build self-efficacy to promote question-asking, risk-taking, and thoughtfulness [Krajcik & Shin
Despite the benefits of social support, research suggests that providing offline social support to newcomers is difficult to manage and orchestrate, particularly given the busy schedules and physical distance between newcomers and supporters [Jossi 1997]. Furthermore, supporters often struggle to know how to offer helpful input, what kind of advice to give, and when is best to offer help -- particularly when work is complex and uncertain [Caruso et al. 2006; Marx et al. 1997; Dillenbourg and Jermann 2011]. In addition, though newcomers can feel uncertainty, they often refrain from seeking help offline due to time and energy of help-seeking, as well as the social and emotional costs of asking for help and decreasing externally perceived self-efficacy [Tyre & Orlikowski 1994; Nadler, 1991; Lee, 2002]. These factors can impact their likelihood of getting sufficient social support when they need help [Bohns & Flynn 2010].

Research suggests that online systems can potentially help orchestrate communication and provide online social support to newcomers as they gain confidence in their work processes [Bierema & Merriam 2002; Hui et al 2014; Kittur et al. 2013]. Given that it can be hard to know when and how to give social support, online systems can be used to help guide supporters in offering more effective online and offline social support to newcomers throughout the work process [Greenberg et al. 2014; Hui et al. 2014]. In addition, online chat systems and messaging also allow asynchronous communication between mentors and newcomers, helping bridge geographical distances and time constraints [Jossi 1997, Bierema & Merriam 2002]. Research also suggests that when newcomers feel a sense of social support from an online community, they are more likely to seek help due to feelings of psychological safety -- or the shared belief that the team is safe for risk-taking [Rees Lewis et al. 2015, Edmondson et al. 2004].
However, less is known about how online social support can be facilitated to increase the self-efficacy of newcomers. More specifically, we lack an understanding of what design guidelines are needed to effectively facilitate online social support to impact the self-efficacy of newcomers. We also lack an understanding of how online socio-technical systems can better utilize tools like reflection, externalizing progress, and help-seeking to prompt online social support for newcomers. We focus on socio-technical systems given the role that technology now plays in the future of work, as well as the accessibility that it affords to people around the world.

1.2 Research Objective

This research seeks to examine how to develop online systems that help strengthen the self-efficacy of newcomers. To do so, I present the results of three original research studies that examine how technical systems can be designed to help influence newcomer self-efficacy through providing social support from online crowds, groups, and individuals. I focus on presenting three research studies that build on one another as this allows me to bridge evidence from three different research contexts to develop an evidence-based argument for how to develop self-efficacy from socio-technical systems. I also use a design-based research approach for developing two novel systems in my second two studies, given its benefits of applying iterative design and scientific methods to produce useful systems and effective theory [Easterday et al. 2014]. The three research studies presented in this dissertation expand our understanding of the impact that online crowds, groups, and individuals can have on the self-efficacy of newcomers. From the findings of these three research studies, I propose design implications for building online social support systems to build the self-efficacy of newcomers. I also highlight remaining gaps in the research and areas for future research related to designing online social support
systems that build the self-efficacy of newcomers.

### 1.3 Research Questions & Contexts

This research seeks to answer question: *How might we design sociotechnical systems that facilitate online social support to build the self-efficacy of newcomers?* I chose to examine how to design socio-technical systems that support newcomers in three unique contexts: (1) crowdfunding, (2) project-based learning, and (3) corporate on-boarding. While different contexts, they represent three environments where newcomers enter with ambiguity, vulnerability, and the need for support as they navigate a new work environment [Jones et al 1986; Reichers 1987]. These are also three settings in which there is high turnover in newcomers deciding that they do not belong in a particular community based on the response of those around them [Chao 2007]. These three contexts are also all hybrid environments where users engage online to support offline work [Zitter & Hoeve 2012]. Finally, these three contexts allow us to explore the differences in newcomers receiving online social support from crowds (via crowdfunding), from groups (via project-based learning), and from individuals (via mentorship programs in corporate onboarding). Comparing findings across the three groups of newcomers is difficult given the unique contexts and that many variables are changing across these settings so it will be hard to isolate the impact of any variable. However, while we cannot make causal claims, it does help us to better understand implications for this research in a variety of settings to assess if key findings emerge across all three groups of newcomers. Furthermore, comparing across crowds, groups, and individuals helps me to assess how these different online supporters compare and is best to utilize a certain type of audience for the support of newcomers. To examine these three contexts, my three research studies ask the following respective research
questions:

1. **Study One — Crowdfunding:** How does receiving online social support from an online crowd influence the self-efficacy of newcomers participating in entrepreneurial work?

2. **Study Two — CheerOn:** How does facilitating online social support from a group of online supporters influence the self-efficacy of newcomers in project-based learning?

3. **Study Three — Pairachute:** How does externalizing progress and learning through shared online reflection with a partner influence the online social support newcomers receive and the self-efficacy they feel when entering new corporations?

Throughout this dissertation I use the term “newcomer” to define participants examined who are all new to an organization or work setting who are often lacking in experience and identity formation [Saks et al. 1994; Jones 1986; Reichers et al. 1987]. The term newcomer epitomizes first-time entrepreneurs in crowdfunding highlighted in Study One, project-based learning students highlighted in Study Two, and new employees entering a corporation highlighted in Study Three. In each context, the newcomer is new to his/her environment and experiences some level of uncertainty when coping with new demands and ambiguity [Fisher 1985]. In each study, I refer to newcomers according to their common titles (ex: entrepreneurs, students, and new employees) for clarity and relevance, though they all represent newcomers.

### 1.4 Overview of Dissertation

The goal of this dissertation is to better understand how to design online social support systems for newcomers in order to increase their self-efficacy upon entering new work environments. To begin, **Chapter Two** grounds this research in a literature review to investigate how researchers in Psychology, Human Computer Interaction (HCI), Organizational Behavior, and Learning Sciences have explored theories and developed offline and online systems to support newcomers. The findings of this literature review highlighted existing gaps in our understanding of how social support from online communities could impact the self-efficacy of newcomers and what
specific features were most impactful. These gaps motivated further inquiry into the impact that online crowds, groups, and individuals could have on newcomers. Thus, Chapter Three presents Study One examining the impact of online social support from crowds in crowdfunding communities on the self-efficacy development of newcomers participating in entrepreneurial crowdfunding work. Our findings from Study One increased our understanding of how online crowds could support newcomers, but revealed the lack of personalization that online crowds can have without prompting online social support. Thus, Chapter Four sought to understand if prompting online social support from an online group could impact newcomers through presenting Study Two on the design and evaluation of CheerOn, an online cheering system for teams, and its impact on supporting newcomers in project-based learning teams. Our findings from Study Two revealed that online social support could be prompted from online groups to help facilitate some impersonal online social support and some offline help-giving. However we found that groups still often felt removed from newcomers and unable to know how to sufficiently offer social support. This motivated further examination into the impact that online individuals could have on supporting newcomers at work and how to prompt real social support through reflection. Thus, Chapter Five presents Study Three on the design and evaluation of Pairachute, a mobile application to increase social support for newcomers within organizations through paired reflection. I examine the three research studies side-by-side in Chapter Six and present the theoretical and design contributions of this work, as well as key limitations with plans for future work.
2. CHAPTER 2: RELATED WORK

To increase our understanding of how to design sociotechnical systems that facilitate online social support for newcomers, I first examine and synthesize research conducted across the fields of psychology, human computer interaction (HCI), organizational behavior, and learning sciences related to building self-efficacy of newcomers through offline and online social support systems. By comparing and contrasting the research around supporting newcomers in each of these fields, we can better understand how to design effective online social support systems to increase self-efficacy. To do so, I examine literature related to: (1) increasing the self-efficacy of newcomers, (2) effective social support and mentorship systems for newcomers, and (3) reflection interventions to support newcomers at work. As such, my literature review aims to answer the following research questions: Section 1: Building the Self-efficacy of Newcomers: How does self-efficacy impact the motivation of newcomers and how it can be developed? Section 2: Facilitating Online and Offline Social Support for Newcomers: What online and offline social support systems have been created to support the self-efficacy of newcomers and what can we learn from their design? Section 3: Utilizing Online and Offline Reflection to Support Newcomers: What online and offline reflection systems have been created to support the self-efficacy of newcomers and what can we learn from their design?

2.1 Methods

Inspired by Froehlich and colleagues [2010], I conducted an extensive literature review across a variety of domains and fields to deduce key learnings in the design of an emerging area of technical systems that support newcomers at work. I blended prior research in Psychology and
Computer Human Interaction (HCI) related to self-efficacy and social support to draw larger insights across fields into a single important dialogue [Froelich et al. 2010]. Such an investigation would not be possible in a lab study or design-based research experiment alone as it would not allow the breath of investigation and comparison that such a literature review offers. To conduct this literature review, I first conducted online related work searches, reviewed literature reviews from related work, and compiled a list of related work based on colleague recommendations. I primarily focused on articles printed since 2000, although I did review some older journal articles to better understand the early theories of social support, reflection, and self-efficacy when recommended by colleagues or referenced as seminal pieces in current research.

To find the articles for this literature review, I first searched for peer-reviewed articles in Human Computer Interaction and Computer Supported Cooperative Work in the HCIBib database as well as the Association for Computing Machinery Journal database. I looked specifically for ACM Transactions on Computer-Human Interaction and Journal of Human Computer Interaction related to socio-technical systems to support and build the self-efficacy of newcomers. To understand research related to supporting newcomers to entrepreneurship in Study One, I examined journals related to entrepreneurship. To examine research related to supporting newcomers in the classroom in Study Two, I reviewed articles in Learning Sciences, Computer Supported Cooperative Learning, and Education journals related to supporting project-based learners. To examine research related to supporting newcomers in the workplace in Study Three, I looked for research from Social Psychology in Psychology, Business, Organizational Behavior, and Management Review journals. Altogether, I read and analyzed over 215 articles.
I found that each of these disciplines uses a variety of terms related to newcomers including: novice entrepreneurs, project-based learners, new hires, new employees, and more. Though the terms differed, all of the newcomers face similar challenges. For example, while learning scientists spoke about newcomer as “project-based learners”, they shared many of the similar struggles of seeking help and having to learn new things that psychologists examined in “novices” and “newcomers”.

For this literature review, I sought to examine how each discipline addressed the concept of “newcomer work”, when a worker is new is new to his/her environment and experiences some level of uncertainty when coping with new demands and ambiguity [Fisher 1985]. As such, when looking for relevant literature, I searched for keywords including: self-efficacy, newcomers, newcomers, social support, onboarding, reflection, and help-seeking. From these articles, I focused on research that examined offline and online systems, as well as theory, supporting the development of self-efficacy through reflection. I sought to understand the impact that social support and reflection can have on newcomers, and I focused on peer reviewed research papers that highlighted their impacts on self-efficacy. I compiled the most relevant literature on these topics in a spreadsheet, highlighting key themes that emerged from each text and overlapping or conflicting concepts (ex: challenges in help-seeking, self-efficacy building techniques, or challenges in the mentorship process for new hires). I grouped literature to assess key themes and removed papers that repeated claims. I drew on examples from other similar literature reviews in HCI when planning the methodology and analysis plan for the literature review— particularly the literature review models of Fitzpatrick & Ellingsen 2013, Froehlich et al. 2010, Levine & Moreland 1990, and Eikey et al. 2015.
2.2 Developing the Self-Efficacy of Newcomers

In this section, I review prior research to understand what factors influence newcomer self-efficacy and how to design systems to increase the self-efficacy of newcomers. To do so, I consider: (1) the need for self-efficacious newcomers, (2) why newcomers often have low self-efficacy, (3) ways to develop self-efficacy, (4) existing offline and online systems that have addressed building self-efficacy, and (5) existing gaps or complexities in the literature.

Newcomers are critical to organizations, yet difficult to support: While supporting newcomers is critical to organizational advancement, incorporating newcomers into a new environment and retaining them can be difficult [Kraut et al., 2009]. As many as 22% of new hires leave their jobs within their first year primarily due to low organizational socialization, particularly when new hires feel that they don’t fit in with others in the organization [Chao 2007]. In addition, newcomers can experience feelings of surprise when entering as they find that their assumptions about the organization do not conform with their previous understandings and experiences [Hughes 1958; Louis 1980, Jones 1986]. Incorporating and supporting newcomers can be difficult for existing staff given busyness and daily demands of ongoing work, as well as feeling far from what it felt like to be a newcomer [Jossi 1997, Jokisaari & Nurmi 2009].

Importance of self-efficacy: Self-efficacy, or as defined in the Introduction, “the belief in one’s capabilities to organize and execute the course of action required to manage prospective situations” [Bandura 1995, pg. 2], is critical for the success of innovative work, or work that involves introducing and applying ideas to benefit others, because innovators need to be willing to take risks and navigate through significant uncertainty [Bandura 2009]. Research suggests that workers with high self-efficacy focus on pursuing new opportunities, while those with lower
self-efficacy focus on avoiding risks [Kreuger and Dickson 1993, 1994]. Level of self-efficacy also predicts innovative actions such as willingness to file for patents or launch new businesses [Chen, Greene, and Crick 1998; Markman and Baron 1999; Zhao, Serbert, and Hills 2005]. Self-efficacy has also been shown to influence innovative intentions, learning motivation, risk-taking, and willingness to ask for help [Zhao, Serbert, & Hills 2005; Bandura 1997; Krajcik & Shin 2014, Blumenfeld et al. 1991]. Furthermore, worker’s self-efficacy levels have been shown to impact job performance and retention [Bandura 2009; Stajkovic et al 1998; Chen 1998; Shalley & Zhou 2004; Baum, Locke, and Smith 2001; Baum and Locke 2004].

**Self-efficacy impacts motivation:** Self-efficacy can strongly influence one's motivation and progress [Bandura 2009; Shalley et al. 2004]. Research suggests that self-efficacious workers are more likely to generate ideas and take initiative in their occupational self-development [Speier and Frese 1997]. Workers with high self-efficacy view obstacles as attainable and push through setbacks [Krueger and Dickson 1994]. As such, they devote more time to challenging tasks and exert greater levels of effort [Bandura and Schunk 1981; Schunk and Hanson 1985; Schunk, Hanson, and Cox 1987]. A worker’s self-efficacy levels have been shown to impact goal setting, resilience, and persistence [Bandura 2009; Stajkovic et al 1998; Chen 1998; Shalley & Zhou 2004; Baum, Locke, and Smith 2001; Baum and Locke 2004]. This is in part because self-efficacy impacts the stress, anxiety, and coping capabilities experienced by workers [Bandura 2008]. Workers who have low self-efficacy can experience stress both emotionally and physiologically, whereas workers with high self-efficacy feel less stress around task ambiguity or towards heavier workloads given their belief in their abilities [Jex and Bliese 1999; Bandura 2009].
Low self-efficacy of newcomers: Newcomers within an organization show lower levels of self-efficacy due to their lack of experience and identity in the new organization [Fisher 1985; Bauer et al. 2007]. Furthermore, newcomers can feel anxiety about their lack of knowledge and often are unsure of whom to ask for help to complete their tasks [Van Maanen et al. 1979]. As such, newcomers may experience low self-efficacy than experts when discovering, evaluating, or exploiting new opportunities [Lande and Leifer 2010, p. 8], which decreases their persistence and progress [Lande and Leifer 2010]. Furthermore, uncertainty regarding role demands, performance anxiety, and the number of new tasks a newcomer must learn at the start can all contribute to lower levels of self-efficacy [Moreland & Levine 1989; Jones 1986; Saks 1994].

As a result of not asking for help, newcomers can use tools inefficiently or make misguided decisions, slowing down their progress [Berlin and Jeffries 1992]. In addition, not asking for help can be a negative cycle, given that self-efficacy can also impact socialization and role orientation of newcomers in organizations [Jones 1986]. Furthermore, newcomers can feel that they are not skilled enough to be in a certain role, impacting how welcome they feel when they enter a team environment and their self-efficacy of belonging in that environment [Meister et al. 2014]. Research suggests that workers with lower self-efficacy are much more likely to leave a profession compared to those with higher self-efficacy levels [Glickman & Tamashiro, 1982].

Self-efficacy development research: Fortunately, research suggests that self-efficacy is malleable and can be developed. Bandura’s Social Cognitive Theory [1982] suggests that self-efficacy can be developed in four primary ways: (1) mastery; (2) modeling; (3) social support; and (4) physiological states.
To begin, experience of mastery, or seeing oneself succeed at tasks, can help to boost self-efficacy [Bandura 1982]. Research suggests that encouraging reflection on performance mastery and goal accomplishment can help employees better gauge their progress and, in turn, can help to boost their self-efficacy if they can see the progress they are making [Bandura 1991].

Modeling, or seeing examples of others succeeding at similar tasks, has also been shown to help boost self-efficacy [Bandura 1982]. Saks [1994, 1995] suggests that organizations can integrate this mechanism to build self-efficacy in newcomers through guided mastery experiences.

Social support or getting feedback from others can also help to build self-efficacy [Bandura 1982]. Supportive communication contributes to taking on more productive roles within an organization [Parker 1998]. Supportive communication can also lead to setting accurate expectations and clear roles, which impacts self-efficacy [Fisher 1985].

Improving physiological states, or improving physical and emotional responses to challenge can also help build self-efficacy [Bandura 1982]. Organizations can encourage resilience and stepping up to roles as a pathway to increasing persistence and improving performance [Jones 1986; Ashford & Saks 1996].

While we understand ways to develop self-efficacy, applying these tactics can be challenging for managers due to constraints on proximity, scheduling, and differing expectations regarding what approach is best to take and where workers are in their work life [Rees Lewis et al., 2015; Jokisaari & Nurmi 2009].

**Self-efficacy development via online tools:** HCI researchers have begun to examine ways that online engagement can be used to develop self-efficacy to motivate behavior. Using
Bandura’s Social Cognitive Theory [1982], HCI research finds that online tools can support self-efficacy development through the mechanisms of online mastery, online modeling, online social support, and online physiological states.

HCI research suggests that online communities can offer a unique, public space to showcase progress on task performance [Shea & Bidjerano 2010]. In addition, research in crowdfunding also demonstrated that newcomers showcasing their project work on crowdfunding platforms were able to use the online community as a space to show all of their progress, helping to build their self-efficacy [Hui et al. 2013; Harburg et al. 2015]. Thus, online communities can offer spaces for showcasing of mastery experiences for newcomers through highlighting progress.

Online communities also offer a unique space for newcomers to have access to role models and online professional coaches which are more difficult to access offline [Rees Lewis et al. 2016; Easterday et al. 2014]. Furthermore, research in crowdfunding demonstrated that newcomers showcasing their project work on crowdfunding platforms were able to use the online community as a space to shadow models and help to learn from the experiences of others, impacting self-efficacy [Hui et al. 2013; Harburg et al. 2015].

HCI research suggests that online communities can be utilized as spaces for social support. For example, research suggests social networking platforms, such as MySpace and Facebook, have been shown to provide emotional support through likes, shares, and supportive comments on their posts [Boyd & Vozikis 1994, Gangadharbatla 2008]. Research in online crowdfunding demonstrated that newcomers were able to use the online community as a space to build their self-efficacy through receiving emotional, appraisal, and informational support [Hui
et al. 2013; Harburg et al. 2015]. Research has also shown how certain features within online platforms can help to facilitate social support for users, helping to foster the development of self-efficacy [Bandura 1982]. For example, signals of social support or approval via personal tokens of appreciation online increased user participation and creation on Wikipedia by 60% [Restivo, M. & van de Rijt, 2012]. In addition, 78% of Wikipedians agreed that receiving compliments from others on your edits or articles, was the primary reason they decided to make more Wikipedia edits [Wikipedia Editor Survey 2013].

HCI research has also demonstrated that newcomers showcasing their project work on crowdfunding platforms were able to use the online community as a space to build their self-efficacy and see that challenge was normal through seeing examples of others struggling [Hui et al. 2013; Harburg et al. 2015].

Online communities offer a unique space to provide a community of role models, to track and celebrate progress and small wins, to encourage through setback, and to initiate social support newcomers at work and create an environment of support around workers. Research suggests that the act of participating on a platform can improve user’s sense of self-efficacy around their ability to perform and contribute to that community [Kollock 1999]. These findings point us to a number of opportunities for design features that could be implemented when building systems that increase the self-efficacy of newcomers.

**Challenges & Opportunities of Online Systems to Build Self-Efficacy:** While online platforms can provide a unique opportunity to develop the self-efficacy of newcomers, a number of challenges exist:

(a) **Lack of sufficient and sustained support:** While there are ways in which self-efficacy can be
initially developed, there is little understanding how to sustain online social support [Harburg et al 2015]. More curated or assigned social support could help to improve the consistency and timing of online social support for newcomers.

(b) Challenge of help-seeking for newcomers and being vulnerable: Fearing evaluation, newcomers can have difficulty sharing online their setbacks or their need for help [Rees Lewis et al. 2015, Harburg et al 2015]. Newcomers express feeling low self-efficacy when their work is unsuccessful and publicly (and permanently) displayed than when they are successful [Greenberg et al 2014; Harburg et al 2015].

(c) Lack of personalization: Online tools can feel less personal to the unique needs of individuals, impacting newcomers’ use and desirability to use the tool [Jarvenpaa & Lang 2005; Van Den Hoof et al. 2012]. As such, the need exists to build systems that suit the personal needs of individual workers (ex: feedback style, communication frequency, medium of communication preference) to help increase likelihood of engagement with the tool.

Summary: The review of this literature suggests that self-efficacy is critical to the motivation, retention, and performance of newcomers. However, self-efficacy is low for newcomers who lack experience and a strong sense of identity within an organization, particularly newcomers from minority groups, in comparison to the self-efficacy of those who come from majority groups. While research suggests that self-efficacy can be developed through feeling a sense of social support [Bandura 1982], we lack an understanding of how online communities can be utilized to provide more personalized social support to newcomers as well as how to prompt social support from online communities. We focus on online communities and socio-technical systems given the role that technology now plays in the future of work, as well as the
accessibility that it affords to people around the world.

2.3 Social Support Systems to Build the Self-Efficacy of Newcomers

In this section, I focus specifically on existing social support systems and how they can be utilized as a tool to build the self-efficacy of newcomer [Bandura 1982; Amabile 2011]. I focus on the construct of social support as it has been shown to particularly help create positive emotional experiences that reduce stress, which is particularly valuable for newcomers engaged in stressful work [Pearlin et al. 1981; Scott & Bruce 1994]. Furthermore, social support can enhance motivation to learn and build self-efficacy to promote question-asking, risk-taking, and thoughtfulness [Krajcik & Shin 2014, Blumenfeld et al. 1991]. I examine more closely how mentorship and other social support systems have been created to support the self-efficacy of newcomers and what we can learn from them to design more effective online social support systems.

**Social support can build self-efficacy:** Research highlights the importance of social support from peers and supervisors in organizations to help newcomers build self-efficacy when entering new organizations [Ostroff & Kozlowski 1992; Nelson et al. 1991; Jones 1986]. While there are many definitions of social support, I follow the House [1981] definition of social support, which defines it as messages of support that demonstrate: (1) emotional support, (2) appraisal support, (3) instrumental support, or (4) informational support. We chose House’s [1981] definition as it allowed us to categorize and differentiate various social support types relevant to supporting newcomers (ex: differentiating appraisal support praising certain actions or statements made, from emotional support that expresses care, from instrumental support that provides tangible assistance, to informational support that offers informational advice). These
distinctions allowed us to more closely examine the different mechanisms for providing social support online. Table 1 demonstrates the ways in which these types of social support can be facilitated. Research suggests that social support can create positive emotional experiences that reduce stress and build self-efficacy [Pearlin, Lieberman, Menaghan, & Mullan 1981], allowing newcomers to persist despite their inexperience. Furthermore, social support can enhance motivation to learn and can encourage help-seeking, risk-taking, and thoughtfulness [Krajcik & Shin 2014, Blumenfeld et al. 1991]. Social support has also been shown to help individuals pursue goals [Brunstein, Dangelmayer, & Schultheiss 1996; Feeney 2004; Rusbult, Finkel, & Kumashiro 2009], which help to build self-efficacy [Bandura 1982].

<table>
<thead>
<tr>
<th>Social Support Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emotional support</td>
<td>Provides empathy, trust, and care</td>
</tr>
<tr>
<td>Instrumental support</td>
<td>Provides tangible aid and services to assist</td>
</tr>
<tr>
<td>Informational support</td>
<td>Provides advice, suggestions, and problem solving</td>
</tr>
<tr>
<td>Appraisal support of…</td>
<td>Provides affirmation on the appropriateness of acts or statements</td>
</tr>
<tr>
<td>…value of project</td>
<td>States qualities about the project</td>
</tr>
<tr>
<td>…work</td>
<td>Says something about the correct (right/wrong) or information about the quality of work</td>
</tr>
<tr>
<td>…person</td>
<td>Makes statements about qualities of team</td>
</tr>
</tbody>
</table>

Table 1. Descriptions of Social Support: Social support is given through the offering of emotional, instrumental, informational support, and appraisal support (of value of project, work, or person) to impact the self-efficacy of newcomers (House 1981).

Existing solutions to help increase social support for newcomers: Program designers have implemented a number of techniques to facilitate social support for newcomers. Some of these solutions include newcomer welcome orientation events, team feedback practices, and mentorship programs to help guide newcomers [Parker 1998; Compass et al. 2010]. These types of programs can help increase job satisfaction and emotional well-being [Saks 1994]. While
there are many techniques to support newcomers, I focus on mentorship in this section given the benefit that social support and access to role models can have on building self-efficacy [Bandura 1982]. Furthermore, mentorship offers the potential for a personalized and ongoing approach of providing social support for newcomers, in comparison to orientation events and team feedback practices.

**Mentorship to facilitate social support for newcomers**: Mentorship is one way to support the development of self-efficacy [VanVianen 1999]. Mentorship, or “a reciprocal and collaborative learning relationship between two (or more) individuals who share mutual responsibility and accountability for helping a mentee work toward achievement of clear and mutually defined learning goals” [Zachary 2005, pg. 3], has been shown help to build the self-efficacy of newcomers through increasing their sense of competence and confidence [Kram 1983]. Research by Koberg et al [1998] found that newcomers who reported receiving more mentorship showed higher levels of self-efficacy than those who reported receiving less mentoring. Mentoring theory also suggests that mentors can be particularly helpful in providing informational support, emotional support, and role modeling for newcomers, which have all been shown to impact self-efficacy [Kram & Isabella 1985, VanVianen 1999].

**Building self-efficacy in newcomers from minority groups through social support from mentors**: Mentorship can be particularly powerful for supporting newcomers from minority groups who often feel low self-efficacy within organizations due to not feeling that they belong compared to those from majority groups [Gunn 1995]. For example, mentorship has been shown to have a particularly beneficial impact on self-efficacy of women in tech, including encouraging women to stay in the field [Ambrose et al. 2005, Margolis et al. 2003]. In part, mentoring helps
increase the sense of identity in newcomers, which is often a challenge for female newcomers or racial-ethnic minorities. [Payton & White 2003]. This increased sense of belonging for minority newcomers (based on gender or racial-ethnic identity) can help move those on the periphery of a social network to more of the center [Payton & White 2003]. In Bierema's [1996] study, women reported that having teammates share information on company culture helped them feel a greater sense of belonging and better process experiences [p. 157]. Research suggests that increased sense of belonging and identity in an organization can be impacted by socialization with existing people within an organization [Arnett 2004].

**Peer mentorship to facilitate social support:** While traditional mentorship relationships typically involve an older, more experienced mentor giving social support to a younger, less experienced newcomer [Ragins & Kram, 1997], peer mentorship has opened up the doors to a more reciprocal relationship of mentorship between two individuals of similar status within a setting and often age [Kram & Higgins 2001]. In peer mentorship, co-workers provide social support to one another through (a) psychosocial support (i.e. personal feedback, confirmation, and emotional support), and (b) career support (i.e. knowledge and information sharing, career and job-related feedback) [Bryant & Terborg 2008; Kram & Isabella 1985]. Peer mentorship is more of a two-way process of social support exchanged in both directions in comparison to traditional mentoring [Bryant & Terborg 2008], removing some of the tension that occurs when pairs are of different levels of tenure in mentorship relationships [Bryant & Terborg 2008; McDaugall & Beattie 1997]. As such, peer mentorship can allow individuals to feel less intimidated and work more effectively with their peers through creating increased communication and sharing between newcomers and another in the organization [Ward 2008].
**Challenges of offline mentorship programs:** A number of challenges exist in traditional mentorship programs for both mentors and newcomers, particularly: (a) training and monitoring mentors, (b) building trust, (c) effective pairing/matching, and (d) facilitating help-seeking and help-giving. I articulate these challenges below.

(a) **Training & Monitoring Mentorship:** Training and monitoring mentors takes time [Burke & McKeen 1989; Allen et al. 2006b]. Providing sufficient training and hands-on training for peer mentors is time-intensive and challenging given the complexity of newcomer needs (including informational support and emotional support), as well as the busyness of work schedules [Billett 2003; Terrion, Philion, and Leonard 2007]. The challenge of training and monitoring mentorship programs can lead to less effective mentorship conversations, less frequent mentorship meetings, and less impact the self-efficacy of newcomers than could be possible if mentorship is fostered properly [Terrion, Philion, and Leonard 2007]. This lack of sufficient training or monitoring can result in peer mentors can having difficulty knowing what questions to ask and how best to support newcomers [Terrion, Philion, and Leonard 2007].

(b) **Trust-building:** Another challenge and opportunity for effective mentorship centers around building trust between mentor and newcomer pairs [Higgins et al. 2008; Hughes 2004]. Research suggests that the work environment can impact the trust felt between pairs and the benefits of mentorship [Billett 2003]. Having a trusted mentor is a strong indicator of mentorship success, particularly when mentorship occurs at a distance [Holland, 2009]. At the extreme, some of the most negative mentoring relationships involve manipulation, bullying, betrayal, or sabotage of a career, which can come as a result of mismatched values or personalities [Eby et al. 2007]. Trust has been shown to be a significant factor in the effectiveness and depth of mentor’s
pairings, influencing the honesty with which newcomers are willing to share and process growth and learning [Hughes 2004, pg. 282]. Research suggests that trust can be developed through: (a) familiarity, (b) shared experiences and goals; (c) open and reciprocal disclosure between pairs over time, (d) demonstration of non-exploitation over an extended period of time [Dani et al. 2006].

(c) Pairing Mentors & Newcomers: Matching the right mentor and newcomer pairs can play a critical role in the success and trust developed in mentorship pairings [Blake-Beard et al. 2007]. Research suggests that newcomers typically like to receive mentorship from role models who share characteristics to themselves, particularly gender or ethnicity given that they feel that they share similar challenges [Packard 1999]. Matching mentors and newcomers of similar backgrounds can be particularly difficult for those in fields with one dominant gender or ethnicity, such as science and engineering fields [Seymour 1997]. However, while some argue for the importance of matching mentors and newcomers with similar characteristics for instrumental and emotional support [Ensher & Murphy 1997], others argue that race and gender should not play a role in mentor selection and that benefits can come from diversified mentoring [Jossi 1997]. Regardless of how mentors and newcomers are paired, both parties should benefit in some way from the relationship [Clemsen 1986].

(d) Help-seeking: Feelings of mutual respect and trust within mentorship pairings can also influence a newcomers’ willingness to seek help from a mentor. Research suggests that help-seeking can be particularly difficult for newcomers due to their: (1) lack of awareness of needing help, (2) the challenge of knowing whom to ask for help and identifying potential helpers, (3) knowing how to best ask for help and having a framework to do so, (4) deciding to
ask for help, and (5) responding to help given [Nelson-Le Gall 1981; Foong et al. 2017]. In addition, all newcomers struggle to maintain their identity and risk exposing their own vulnerabilities, which can negatively impact their willingness to seek help [Collins & Feeney 2000; Downey & Feldman 1996; Fisher, Nadler & Whitcher-Alagna 1982; Goffman 1955; Nadler & Fisher 1986; Ryan & Solky 1996].

(e) Help-giving: It is difficult for newcomers to initiate help-seeking. It is also rare for mentors to encourage help-seeking, as they often wait for newcomers to come to them [Bohns & Flynn 2010; Rees Lewis et al. 2015]. In addition, mentors are inherently biased and often have difficulty seeing beyond their own circumstances and needs [Caruso, Epley, & Bazerman 2006; Ross, Green, & House 1977; Ross & Sicoly 1979]. These gaps in empathy can be particularly challenging when dealing with emotional circumstances, such as embarrassment. Understanding embarrassment requires taking the other person’s perspective [Van Boven, Lowenstein, and Dunning 2005]. Research suggests that a mentor is better able to give help when they understand what challenges newcomers are experiencing and empathize with their challenge of asking for help [Bohns & Flynn 2010]. This finding has implications on designing tools that help mentors understand what challenges newcomers are experiencing and notifying mentors when newcomers are in need of greater support. In addition, research suggests that newcomers desire help in reducing uncertainty and in managing expectations when they enter a new environment [Miller & Jablin 1991; Jerris 1993]. Stohl [1986] argued that helpful messages for newcomers: (a) provide details on norms, values, expectations, rules, and sense-making, (b) offer input on the team culture and how to get by in the new culture, (c) share information on community members and network links within the organization, and (d) explain the importance of informal
communication within the organization [Stohl 1986, pg. 283]. These suggestions help us better understand the types of messaging that should be sent to newcomers upon entry into a new work environment.

**Online mentorship systems to facilitate social support:** Given the challenges of mentorship programs (i.e. training & monitoring, trust-building, pairing, help-seeking and -giving), researchers have begun to explore ways in which online platforms might help improve the mentorship process and provide an aid to offline interaction. Videoconferencing, email, and telementoring are a few examples of technologies that have been implemented to help increase the possibility for help-giving and help-seeking between mentors and newcomers in professional settings. A few examples of such systems include: Mentor Center (http://mentorcenter.bbn.com/), The Electronic Emissary (http://www.tapr.org/emissary/), and LearnWell eMentors (http://www.learnwell.org/). Research has shown that use of telementors, email, and video-based mentorship can also help to reduce feelings of isolation experienced by newcomers and, in turn, help to increase retention [Alliance 1995]. Tools like Slack (www.slack.com) and Facebook Workplace (www.facebook.com/workplace) are also online tools that can help to increase help-giving and help-seeking, and also can improve the monitoring process for newcomers as the platform allows for quick check-ins. Research in the Learning Sciences has shown that online communities can offer a powerful space to facilitate mentorship, help-seeking –and giving, as well as facilitate social support between newcomers and a network of professional coaches who are typically difficult to access [Rees Lewis et al. 2015]. For example, the Digital Loft provides a platform for newcomers working to externalize help needs and receive mentorship, feedback, and support from professional coaches on their project work.
[Easterday et al. 2015]. In sum, online socio-technical systems have the potential to be used to help ameliorate some of the challenges in mentorship programs through helping and facilitate increased monitoring, social support, trust building, help-giving and help-seeking for mentorship pairs across the globe, increasing the possibility of building newcomer self-efficacy [Jossi 1997].

**Challenges and opportunities for online mentoring systems:** While online communities offer a unique space for facilitating social support for newcomers, these systems can still present many of the same challenges that offline social support systems face. For example, newcomers still have difficulty externalizing help needs in an online public setting and offline meetings can be more helpful [Rees Lewis et al. 2015]. In addition, short messages of social support from mentors can feel less personal and be hard to trust as genuine [Harburg et al. 2015]. Finally, mentors can struggle to know what help newcomers need and wrestle with the most effective ways to give help [Rees Lewis et al. 2015]. Thus, a system that facilitates the process of reflecting on tough questions and help requests could improve this process. In addition, an online system could allow for pairs to communicate in a synchronous way that is difficult for remote pairs working in different locations [Jossi 1997]. Increased communication and contact between mentor pairs via an online tool could ultimately impact the self-efficacy of newcomers.

**Summary:** Our findings suggest that social support can be an effective way to build self-efficacy in newcomers. Mentorship is one way that social support can be effectively fostered within organizations to build newcomer self-efficacy as it allows for a more personalized social support system. However mentorship is still difficult to facilitate due to the challenges of training and monitoring mentors, building trust, pairing mentors and newcomers appropriately, as well as facilitating effective help-seeking and help-giving. While HCI researchers have begun to
examine how socio-technical systems could be developed to increase communication and facilitate social support for newcomers, there remain large gaps in our understanding of how to facilitate effective and personalized help-seeking and trust-building within mentorship relationships.

2.4 Reflection Systems to Build the Self-Efficacy of Newcomers

There are a number of ways that social support can be facilitated to aid newcomers: peer support groups [Richman et al. 1987]; help lines or email bots to answer questions [Lochrie 2016], Q&A chat rooms for staff [Quish 2010]; or traditional mentorship programs [Galbraith & Cohen 1995]. I focus on paired reflection because it allows newcomers to reflect with a partner and answer questions that are difficult to ask to a broader support group or can be difficult to facilitate within an in-person meeting. Reflection also supports reciprocal exchange and familiarity, which are critical to building trust, as explained above [Hughes 2004].

This section examines the role that reflection systems could have on facilitating social support to build self-efficacy in newcomers. I examine research on different factors that can influence the effectiveness of reflection including timing, the wording of the reflection prompt, as well as the impact of reflecting with others over doing so alone. I highlight existing challenges and opportunities for building online reflection systems to facilitate social support and ultimately impact the self-efficacy of newcomers.

Reflection can help improve self-efficacy: The process of reflection, or intentional thinking towards a goal, can impact worker self-efficacy, ultimately impacting performance [Dewey 1933; Stefano et al. 2014]. The process of reflection typically involves identifying underlying values, beliefs, assumptions and allowing people to see that they can impact a
situation by the way they frame and act on it [Marsick & Matbia 2009]. For example, Stefano et al. [2016] found that employees who spent 15 minutes reflecting each day on two key lessons they learned that day over the course of 10 days reported higher levels of self-efficacy at work and performed 23% better in an assessment of knowledge at the end of the training than those who did not reflect. Researchers also found that reflecting on learning from past events was more effective at increasing learning performance and building self-efficacy than building additional experience alone [Stefano et al. 2016]. The research suggests that this is in part because reflection can allow for increased understanding of a task, which can then lead to higher levels of self-efficacy and performance [Zollo and Winter 2002; Kale and Singh 2007]. In addition, reflection that helps workers explain and codify past actions has been shown to help workers develop cognitive abilities. This, in turn, impacts performance, [Immordino-Yang, Christodoulou, and Singh 2012] and furthers learning, growth, mood, relationship building [Bono et al. 2013], mental and physical health, as well as coping abilities [Mezirow 1991; Pennebaker 1997]. In sum, reflection has the ability to help increase the self-efficacy and performance of workers as it provides an opportunity to help newcomer feel a sense of mastery and receive social support. Therefore, creating online systems that facilitate reflection could help to aid in the development of self-efficacy of newcomers.

**Offline reflection systems:** Journaling can help promote reflective thinking skill [e.g. Hiemstra, 2001; Jasper, 1999; Keys, 1999] as well as can help provide evidence of the types of reflective thinking skills that are being used by individuals [Bourner 2003; Wood & Lynch 1998]. Reciprocal journaling allows a newcomer to reflect with a more experienced worker to facilitate dialogue around thoughts, feelings, and expectations [Tillman 2003]. The process of
reciprocal journaling can impact the self-efficacy of newcomers through allowing them the chance to examine their past behaviors and prepare for the future [Valli 1997]. The process of journaling can also allow for dialogue to continually exist in an ongoing style and can allow for social support [Alterio 2004; Boud 2001; Dunlap 2006; Farrell 1998; Gillis 2001; Jarvis 2001; Philion 2005; Tillman 2003]. Daily diary logs are another way that reflection can take place workers [Roberts et al. 2009; Smith 1999]. These are often used to track moods, goals, or emotional states for workers. Offline reflection can also take place in the form of verbal face-to-face reflection and discussion in pairs or groups [Raelin 2008].

**Reflecting with others:** Reflection with others adds the potential to impact social support, as well as accountability, and help-seeking and receiving. As reviewed previously, there are important for newcomers with lower levels of self-efficacy as they engage in complex work. Teams that reflected together on their functioning as a team increased their performance [Schippers, Homan, and van Krippenberg, 2013]. In addition, when workers were given feedback on past performance they showed increases in self-efficacy [Anseel, Lievens, and Schollaert 2009]. Research also found that when workers reflected with others on past actions, they were able to better understand the relationship between their actions and associated outcomes [Kale and Singh 2007]. Research suggests that reflecting with peers instead of a superior can help facilitate more honest reflection [Boud 1999]. Peer reflection typically involves collaboratively providing two-way reflection, feedback, and support to a colleague [Zemke & Moon 1999]. For example, when new teachers wrote shared journals together and gave feedback to one another on each other’s reflections, this resulted in increased meaning-construction and reflection [Good and Whang, 2002]. Research suggests that there are benefits of social
interaction on workers and developing friendships through shared experience [Kreijns, Kirschner, & Jochems, 2003; Liaw & Huang, 2000; Northrup, 2001]. Furthermore, relationships at work help newcomers learn about their company’s culture and better process [Bierema 1996]. Reflection in teams can remove the more personalized element of reflection, but can lead to group learning before, during, and after work experiences [Katz 2001; Garvin 2000].

Reflection on progress and learning has been shown to help increase self-efficacy and boost motivation in workers. Research found that newcomers reflecting on progress in PBL classrooms boosted students’ self-efficacy by helping change their perception of their abilities to be software development professionals [Dunlap 2005]. Reflection on growth can also help to improve the articulation and codification of past experiences on a task, influencing how workers interpret work difficulty [Kogurt & Zander 1992]. Workers who see difficulty as normal and part of the process can help to increase their sense of resilience and persistence which impacts self-efficacy [Oyserman, Destin, & Novin 2015; Fisher & Oyserman 2017]. Stefano et al. [2014] found that having users reflect on two key learnings each day throughout a training increased self-efficacy and performance on learning assessment tests at the end of the training. The results of reflection on key learnings were found to be more powerful on building self-efficacy and increasing learning than having additional skills training [Stefano et al. 2014]. In addition, research showed that when newcomers were given feedback on past performance through reflection with a peer or instructor they showed increased levels of self-efficacy [Anseel, Lievens, and Schollaert 2009]. Furthermore, research found that reflecting on progress combined with feedback from peers and tutors helped to build self-efficacy through helping build perception of being self-regulated [van den Boom et al. 2007].
While we understand that feedback from peers or tutors can helpful in building self-efficacy, it is less clear if reflecting with others online might be more beneficial in facilitating social support. Stefano et al. [2014] found that reflecting alone can have similar effects to reflecting with others, noting that further examination is needed to explore how paired reflection could impact coaching and social support. However, Stefano et al. [2014] suggest that it is more difficult to boost self-efficacy when all prior experiences have been negative. Thus, greater exploration is needed to understand the effects of reflecting with others versus alone on self-efficacy and motivation.

**Timing of reflection practices:** A number of reflection practices exist to help individuals and groups learn from past experiences. These practices take place before, during, and, after [Boud 2001, Kolb 1984; Schon, 1983, 1987; Mezirow, 1991; King and Kitchener, 1994], and can also prompt self-distancing or reflecting on experiences so as to make greater meaning out of them [Kross et al 2011]. Reflection in anticipation of events involves thinking about how to prepare for what is to come. Reflection in the midst of action involves thinking about what is occurring, what is working, what is not working and how others are responding to our actions. And reflection after events involves thinking about past behavior and recounting what happened, what feelings or emotions were present, and learning from the experience to impact future ways of operating. Boud [2001] offers a framework for the ways in which reflection can take place during these three stages of time. I chose this framework over others as it builds on existing reflection frameworks to clearly outline a process for reflection before, during, and after events. Boud [2001] also examines reflection of newcomers when building the framework, which is more relevant to our target population for this research on newcomers. This helps us to better
understand the timing and types of questions that could be used to prompt reflection when building systems to support newcomers.

**Challenges of offline reflection systems:** Offline reflection presents a number of key challenges including often being time-intensive, easy to lose, hard to read, difficult to track, and difficult to share vulnerably. Below we outline each of these challenges with supporting evidence.

a) *Time intensive:* Despite its benefits, reflection is an effortful action that takes time and facilitation [Harri-Augstein & Thomas 1991]. To begin, journaling requires time management and often participants can forget to write until the last minute [Phipps 2005].

b) *Easy to lose:* In addition, paper journals can be easily lost or cumbersome to remember to carry back and forth [King 2006].

c) *Hard to read:* Handwriting in offline journaling can be difficult to read and have others interpret [Phipps 2005].

d) *Difficult to track:* Paper diary logs can have similar challenges in helping to track process and remembering to complete the logs without reminders [Roberts et al. 2009; Hayman et al. 2012].

e) *Hard to share vulnerabilities:* While face-to-face reflection can be helpful in getting better feedback, it can also be difficult to facilitate and expose vulnerability around more challenging topics [Hayman et al. 2012; Rees Lewis et al. 2015].

**Online reflection systems:** Given these issues with offline reflection, a number of technical tools have been developed to aid with reflection processes. Computer-Mediated
Communication (CMC) can increase reflection practices and allow the possibility for easier reflection with others given that it can happen asynchronously and from any location [Hawkes and Romiszowski 2001]. However, the lack of guidance in some CMC communication can impact its effectiveness in helping to facilitate reflection. Four popular technologies for reflection include (1) online journaling, (2) online tracking systems, (3) peer assessment systems, and (4) instant messaging systems:

(1) **Online journaling (or e-journaling)** is one form of CMC that can allow participants to reflect on experiences in an ongoing manner both before, during, and after events. McIntryre and Tlusty [1995] found that online journaling helped connect people working in distant locations and it enhanced the communication processes. Online journaling allows for continual communication in an asynchronous and non-simultaneous way allowing for more flexibility of use [McIntryre and Tlusty 1995]. This reflection process can also allow for mentors or supervisors to more easily provide support to newcomers through receiving updates in real time [King et al 2006]. Weblogs or microblogs, such as Tumblr [www.tumblr.com], are one form of online journaling that can facilitate reflective thinking and perspectives before, during, and after events. For example, reflective weblogs were used in classrooms to help classmates understand where other students are in the process and were shown to help students more effectively learn [Sharma & Xie 2008]. In addition, the Digital Loft facilitates reflective blog-style posts from newcomers who are asked to reflect on progress, goals, and help needs to a community of mentors, teammates, and external supporters [Easterday et al. 2013]. This tool was found to facilitate in-person help-seeking and social support [Rees Lewis et al. 2015].

(2) **Online tracking systems** have been used to promote reflection before, during, and
after events in working spaces through facilitating easy reporting and tracking of emotions, performance, and moods. One example of this is a tool called *emotionalcities* [www.emotionalcities.com; Wernqvist 2007] and *D-Tower* [http:www.d-toren.nl] which help to collect and show the moods and emotions of individuals through the colors of a visual display in an office to assess the sentiment of the office and worker happiness. *MoodMap* [Morris et al., 2010] allows users in high-stress work environments to rate their moods through an interactive app and activate mobile therapies as needed. Pervasive technologies, such as the *FitBit* [www.fitbit.com] or games like the *Nintendo Wii Sports* [http://wiisports.nintendo.com] allow users to monitor, track, and reflect on their performance with a partner and receive social support in return. These solutions demonstrate how technology can track and impact moods, emotions, and communication practices to boost self-efficacy either alone or in a team.

(3) Peers reflection systems, such as Mobile and Peer Assessment Participation (MAPS) systems, help to facilitate self and peer reflection processes of newcomers. Research found that students who participated and gave feedback to others using a web-based peer assessment were more effective at evaluating their own work [Tsai et al. 2002]. For example, Interactive Response System (IRS) allowed students to anonymously share thoughts and answers with peers and helped instructors to monitor understanding and growth [Davis, 2003; Draper & Brown, 2004; Penuel et al., 2007; Smodal & Gregory, 2003; Vahey & Crawford, 2002; Wang et al., 2004]. *Radar* is another peer reflection system that was found to facilitate reflection that helped to decrease conflict and increase positive attitudes towards collaboration in groups [Phielix et al. 2010]. These findings showcase how peer reflection can be utilized to facilitate feedback and build understanding between pairs, yet less is known about how such systems could specifically
help to facilitate social support.

(4) Instant Messaging (IM) and interactive chat room systems have also been designed to help facilitate quick check-in and communication within the workplace. For example, Rear View Mirror (RVM) is a system that was designed to promote presence awareness, instant messaging, and group chat between workers [Herbsleb et al. 2002]. Other internal messaging systems, such as Slack or Facebook, have been used to promote reflection and increased communication between users, contributing to increased levels of self-efficacy [Gangadharbatla 2008]. These instant messaging and chat systems demonstrate that they can allow for spaces of conversation and check-ins between pairs. However, reflecting on harder topics and sharing vulnerably is difficult and often requires greater prompting. Thus future research should explore how to prompt deeper sharing and reflection between pairs within chat systems to ensure that real problems are addressed.

Challenges of online reflection systems: Despite the benefits of these online reflection systems, a number of key challenges exist. For one, using technology to reflect can present possible issues of privacy and willingness to be vulnerable in an online setting [Ensher et al. 2003]. Thus, finding ways to promote comfort, privacy, and safety in such environments is critical. In addition, adoption can be difficult to those wary of technology or who don’t have technical competencies [Ensher et al. 2003]. In addition, online journaling can make communication challenging, making it difficult for participants to pick up nonverbal cues, information about members’ presence, self-image, attitudes, moods, actions, and reactions [Short, Williams, & Christie 1976]. Questions remain about whether even pervasive computing could facilitate more meaningful connection and reflection between individuals and stir
communication and emotional reflection. Finally, it is not entirely clear if reflecting with others online might be more beneficial in promoting coaching and ultimately increasing self-efficacy [Stefano et al. 2014]. Research has shown that when learnings are shared or savored, their effects are even more significant [Gable et al. 2004; Ilies et al. 2011; Langston 1994]. However, Stefano et al [2014] found that reflecting alone can have similar effects to reflecting with others, noting that further examination is needed to explore how paired reflection could impact coaching and social support. Thus, further exploration of the effects of reflecting with others versus alone and the effects on self-efficacy and motivation need further investigation.

2.5 Summary

This research helps us to better understand the ways in which social support and reflection can be facilitated to build the self-efficacy of newcomers through showing what has been done in past related work. This research suggests design implications across disciplines to examine how, together, they can inform building technical systems. To do so, we highlight key findings from literature in Psychology, Human-Computer Interaction, Learning Sciences, and Organizational Behavior with relation to the impact of online social support and reflection to build self-efficacy. We examine how these disciplines speak to each other and align or disagree with one another. We find that the different disciplines speak about similar concepts using different terms, but that they also can be enriched by each other’s findings. Comparing the findings together also helped to highlight existing gaps in the literature and understanding remain. As such, our findings have implications on the ways in which we can use an interdisciplinary perspectives to design more effective social support systems for newcomers, specifically through externalizing their progress and learning. This, in turn, can help support
newcomers of all kinds working across domains. However, questions remain as to how technology can effectively facilitate social support and reflection for newcomers, who have difficulty sharing vulnerabilities and the need for support. Thus, Studies One, Two, and Three will help to provide increased understanding and insight into this subject and how such systems can be effectively developed. Study One contributes to an increased understanding of how online communities can be utilized to provide online social support to newcomers through showcasing crowdfunding project work, impacting the self-efficacy of newcomers. Study Two contributes to our understanding of how online social support can be elicited from small online groups through showcasing task progress or newcomer design students in order to build their self-efficacy of newcomers. Study Three contributes to an increased understanding of how online social support for newcomers in a corporation can be elicited from individual mentors through shared online reflection. Comparing the findings of three studies helps to build onto this literature review to understand the impact that facilitated online social support from crowds, groups, and individuals can have on newcomers.
3. CHAPTER THREE: UNDERSTANDING THE IMPACT OF ONLINE CROWDFUNDING COMMUNITIES ON NEWCOMER SELF-EFFICACY (STUDY ONE)

Chapter Two revealed that online communities can offer the possibility of developing the self-efficacy of newcomers, but questions remain regarding what socio-technical features of the crowdfunding platform specifically impact newcomers and how newcomers respond to social support from online communities. Thus, this study examined how online crowdfunding platforms can develop self-efficacy in newcomers. Crowdfunding provides a unique avenue to study self-efficacy given its role as a space for newcomers to seek financial and emotional backing for their work. We explore ways to augment self-efficacy with socio-technical mechanisms, and conclude with a better understanding of what features are helpful and unhelpful for increasing self-efficacy for newcomers in a crowdfunding context.

3.1 Problem & Background

Crowdfunding—raising funds from online crowds typically in exchange for an award [Gangadharbatla et al 2008]—has been particularly attractive to newcomers who lack equity and access to traditional sources of funding [Gerber & Hui 2013]. Rather than asking for funds from venture capitalists, banks, or foundations, newcomers to entrepreneurship can seek contributions from thousands of people through crowdfunding platforms, like Kickstarter [“Kickstarter Stats” 2016]. Crowdfunding platforms have raised more than one billion dollars for thousands of newcomers in the past five years [“Kickstarter Stats” 2016]. As CSCW researchers investigate the crowdfunding ecosystem as a new form of computer supported cooperative work, we are learning how the design features in these online communities support not just the exchange of
funds, but also the exchange of social support for newcomers working on novel ideas ranging from programming and manufacturing to marketing and project management [Muller et al. 2013; Gerber & Hui 2013]. For example, newcomers share instructional YouTube videos and use Facebook and Twitter to spread their ideas.

As discussed in chapter two, higher levels of self-efficacy are associated with greater levels of success and motivation in newcomers [Shane 2003]. Recent CSCW research suggests that online communities, such as Dribble, may be particularly well suited to support increased levels of self-efficacy through providing a community of support, role models, and feedback to participants [Hui et al 2019].

Through this research, we seek to answer the broader question of: **How does receiving online social support from an online crowd influence the self-efficacy of newcomers?** We specifically look at this by asking: *(1) How does the community and public aspect of crowdfunding impact newcomer self-efficacy? (2) How do the socio-technical features of crowdfunding systems impact newcomer self-efficacy?* By understanding these questions, we can identify opportunities to refine and redesign features of online communities to improve the user’s self-efficacy [Kraut & Resnik 2012]. We know little about how participating in online communities influences the self-efficacy of newcomers and the impact that this process has on self-efficacy. The crowdfunding platform provides an ideal context for us to better understand what does and doesn’t work in an online environment. In addition, crowdfunding is a unique environment in that it combines fundraising with the possibility of networking, access to role models, and access to social support-- in comparison to other sites that focus solely on one of those features (ex: Facebook as social network site, Wikipedia as a peer production community,
and Behance as an online community for creatives). As such, crowdfunding provides an ideal environment for examining how to design interactive socio-technical systems that foster social support to build self-efficacy.

3.2 Methods

To understand how participation in the crowdfunding community affects self-efficacy, we conducted a qualitative study of 53 newcomers working on crowdfunding over three years, interviewing them about their experiences during the crowdfunding process. Interviews followed a semi-structured protocol, focusing on the project creators’ experience with their campaign. Like previous CSCW researchers interested in developing an initial understanding of an emerging phenomenon [Panovich et al. 2012], we chose this method of semi-structured interviews because it allowed us the opportunity to ask questions directly of entrepreneurs and to evaluate what key themes arose. In addition, previous CSCW researchers [Hui et al. 2014] used this methodology to study self-efficacy and found this to be an accurate measure of assessment. This data has been used to inform previous studies on the role of community in crowdfunding [Hui et al. 2014], motivations and deterrents to crowdfund [Gerber & Hui 2013], the effect of public failure [Greenberg 2014], and the role of social networks in campaign publicity [Hui et al. 2014]. In this study, we focus on a previously uncovered emergent theme of how project creators build self-efficacy.

Participants used three different platforms—Kickstarter, IndieGoGo, and Rockethub—the most popular and successful platforms in the US at the time [“alexa.com” 2011]. Project types varied including Art (7), Comics (3), Dance (1), Design (16), Education (1), Fashion (2), Film & Video (8), Food (4), Games (10), Music (3), Photography (3), Publishing (7), Science
Approximately 50% of project creators met their fundraising goal on at least one of their projects, which is similar to the success rate of Kickstarter, the largest crowdfunding platform at the time [“Kickstarter Stats” 2016]. Most creators maintained full time day jobs – spending between 30 minutes and seven hours a day on weeknights or weekends working on their crowdfunding project. Three informants relied on crowdfunding as their primary source of income. Participant ages ranged from 20 to 65 years old and raised between $41 and $433,365. Fourteen creators launched more than one campaign, ranging between one to nine campaigns per creator interviewed. Interviewees were not compensated for their participation.

We recruited interview participants through random and snowball sampling, which allowed us to identify typical and atypical participants from the crowdfunding population. We divided our semi-structured interview protocol into two sections. In the first section, we asked participants about their professional background and how they learned about and became engaged in crowdfunding. During the second phase, we asked participants to describe the work involved—both collaborative and independent. Average interview length was 30 minutes. Interviews were conducted over video conferencing, phone, and in person. Interviews were conducted during and after the creators’ campaigns. Advantages of this research approach include collecting both reflective and in situ data. Disadvantages include biases from self-report [Spradley 1980]. In this study, we used structured quantitative analysis [Panovich et al. 2012] to examine the role of self-efficacy in crowdfunding. We based our initial coding protocol on Social Cognitive Theory [Bandura 1982] to identify instances of social support, as well as modeling, mastery, and physiological states in the socio-technical system. We code for all four
mechanisms, rather than social support alone, to examine the variety of ways in which self-efficacy could be developed in online communities as well as to which mechanisms are most prominent. We then collected each instance in an excel spreadsheet and studied how these instances did or did not build self-efficacy and performed inter-rater reliability.

3.3 Findings

Crowdfunding provides a new avenue for newcomers engaged in entrepreneurial work to increase their self-efficacy through: (1) social support, via public financial and emotional support from an audience, (2) modeling, via entrepreneurs access to examples and lessons of other entrepreneurs, (3) mastery, via the development of concrete new skills as a result of publishing on the site, and (4) physiological states, via the way entrepreneurs can feel energized during crowdfunding campaigns. Yet not everyone receives these benefits. Our results demonstrate that crowdfunding can also decrease self-efficacy from these very same features. These results point to ways socio-technical systems can be improved to develop the self-efficacy of newcomers.
Table 2: Mechanisms & Sociotechnical System Features Impacting Self-efficacy: This table highlights the socio-technical features observed on crowdfunding platforms and the positive and negative effects each had on self-efficacy.

These findings suggest that crowdfunding communities can both increase shown decrease self-efficacy levels in entrepreneurs through socio-technical features on the site. Online communities were shown to influence self-efficacy through facilitating (1) social support, (2) modeling, (3) mastery experiences, and (4) physiological states. Entrepreneurs’ expressed gains in self-efficacy through the following platform features: the ability to receive feedback and the number of backers supporting their work, seeing examples of others succeeding on crowdfunding to serve as role models, or having their percent funded and financial progress publicly showcased. However, our results also suggest that self-efficacy can be decreased when entrepreneurs lack social support for their work, when they feel daunted by their work, and when their failed project is publicly visible to others. We summarize the key mechanisms and socio-
technical features that influence self-efficacy in Table 2. The following sections will go through these findings in greater detail, with quotes from our interviews with entrepreneurs to support each claim.

3.3.1 Online Social Support

The crowdfunding process allows entrepreneurs to be able to receive support from a wide audience of strangers and offers others a tangible way to support them in their work.

(a) Online Social Support Legitimizes Work: By receiving positive feedback, encouragement, and financial support, entrepreneurs report feeling their ideas are valued and legitimate. One entrepreneur crowdfunding his scientific research explained that having others express interest in his work and offer financial support boosted his self-efficacy in his own abilities to pursue his work: “For any project you sort of wonder if people are going to like you and like your [work]...so I definitely got more confident once people were clearly interested in it, and clearly engaging in the dialogue and supporting me financially.” Entrepreneurs report that social support through online communities on crowdfunding sites, via platform features such as comments and dollars pledged, makes them feel more confident that their work is something that others desire. One entrepreneur of a board game project explained that after his successful crowdfunding campaign, he felt that he could demonstrate to a publisher that he has a strong audience of support for his work. In turn, this allowed him to confidently show that he could be successful professionally and it legitimized his product to others: “Now there's actually real hard numbers showing, ‘Hey, there's an interested audience in this enough to get this number of orders um, now are you interested?’ ... So I can go in there [to speak with a publisher] with
much more confidence ... I can license that game to a publisher, which I've done twice...actually three times now."

(b) Online Social Support Motivates Effort: Entrepreneurs also reported feeling more motivated and excited about their work through engaging with the public online. Crowdfunding comment boards allow entrepreneurs to receive feedback on their ideas. As an entrepreneur working on a photography project explained: “People talking about and people helping you get your ideas together and.... commenting kind of inspires you to add more and more to the idea and make it more successful.” Receiving feedback and support from the public motivated this entrepreneur to pursue and improve upon his photography work. In addition, positive feedback can motivate users to feel like their work is desired. Another entrepreneur building a consumer product venture reported that the process of going through crowdfunding helped him confirm that he could be successful if he tried and that he should follow his intuition, as he stated: “It was awesome. It was 100% confirming. It gave me tons of confidence. That’s part of why I asked for so little. There wasn’t a sense that I was a surefire winner. It was hugely helpful to my confidence and it encouraged me to follow my instincts.” Though he had at first doubted his abilities to raise money and asked for little at the start to protect himself and have a higher chance of winning, he felt a renewed sense of confidence about his decisions after seeing the support of others through the crowdfunding process.

(c) Online Social Support Helps Entrepreneurs Overcome Obstacles: The supportive relationship developed between entrepreneurs and funders can also lead them to seek new opportunities after crowdfunding. For example, one entrepreneur expressed how, after failing his crowdfunding campaign, his team went on to sell their product on eBay because of the
encouragement of their Kickstarter backers. This suggests that supportive relationships developed with their funders through crowdfunding can lead them to effectively sell their work on other online platforms. One entrepreneur went on to sell over 7,000 copies of his game on Amazon, thus making the leap into the mainstream product market.

Entrepreneurs express that the support of others helps them believe that they can do their work. This can influence what entrepreneurs tell themselves about their performance abilities. For example, a photographer who raised $2,000 to finance a community venture to raise awareness of homelessness discussed how the feeling of having many people supporting his work made him feel that he had to have more optimistic self-talk. He explained: “You have to tell yourself the entire time, ‘Hey, this is going to happen, this is going to get funded, and this is going to be an awesome project because you have all these people backing you up the entire way.’” This entrepreneur shows how having the support of a crowd backing up his work throughout the 30 day campaign made him feel that he needed to push himself and change his beliefs about the project. Thus, crowdfunding platforms offer a unique setting where entrepreneurs can put their work out to the public for recognition, comments, and financial support. If the support is there, this validation can help entrepreneurs change their perception of self-efficacy.

When crowdfunding entrepreneurs fail to reach their funding goals, continued validation of their work by the public encourages them to persevere. For example, one independent comic book artist expressed how after failing his first campaign, he and his team cut all communication with their supporters for two weeks. Yet their supporters still checked in to ask how things were going and to offer their support. In turn he expressed that the process of failing helped to
strengthen him as an entrepreneur as learned many lessons from his first failure: “I don’t want to be cheesy but [failing] made me stronger... I mean, by going dark for two weeks, people literally wrote me ‘Hey are you guys still around? ... Then if you saw the latest Kickstarter [campaign], ... first thing we said is we failed, we didn’t do it, we wanted to raise seven grand, now we're back, we're smarter, and we're redoing it.” By showing their interest in the entrepreneurs’ work even after a failed campaign, social support helped the entrepreneur to recover quickly and return to work.

(d) Online Social Support from Strangers Creates Feeling of Impact: Participants also gained confidence in their abilities to succeed at their projects through receiving the support of people outside of their personal network. One entrepreneur of a photography franchise explained: “Some of my biggest pledges are from people that I've never known, so it's really cool to see that other people are inspired by it... There is one woman who's pledged on my project and we constantly talk... she kind of helps me with coming up with new things and she's been sharing the page and she's been contacting news outlets around here to kind of tell them about the project.” This entrepreneur found it motivating and surprising that his supporters came from all over the globe and were willing to offer their suggestions and financial support. The crowdfunding process allows for the chance to seek support from a wider audience and motivation from outside of the typical network they can access offline. He was unsure that his project would have been possible without a crowdfunding platform, like Kickstarter: “It would have been a lot tougher [without Kickstarter] and it would have been more selective of people, a more select group of funders. It’s just cool that people from California have pledged for my project and I'm in Detroit. And it's just like a whole different experience that Kickstarter offers.”
Being able to receive validation from a geographically diverse audience online allows them to see the positive impact of their work on a larger scale. As one entrepreneur seeking funding for a DNA project explained: “I’ve gotten dozens of emails from people around the world who are really interested in the project, and who want to help on the scientific end or telling their friends and family, or a documentary TV producer contacted me, so I mean these are things that don’t normally happen if you just have a grant proposal... so putting it out to the public has been really great for me.” Many entrepreneurs reported being encouraged by the inflow of support and positive attention that was drawn to their projects through the crowdfunding process.

(e) A New Avenue for Online Public Validation: Crowdfunding also provides a unique community where the public can offer support through an easier-to-access medium. For example, on Kickstarter, supporters can quickly donate through Amazon payments. Given that the crowdfunding process takes place online, funders from around the world can easily offer their support and funding. An owner of a dance studio described how the dance community was more likely to donate money to support her dance shows through Kickstarter than through traditional donation methods, such as in person: “I have people that have been fans of mine for a long time who had never donated and when we did it on Kickstarter they did.” This entrepreneur suggests that the set-up of crowdfunding platforms made it more feasible or appealing for the public (and “long-time” fans) to actually be able to support her financially.

Entrepreneurs also expressed that crowdfunding allowed them to give others a technological platform to support their work: “And it turns out that there were a lot of friends and family that wanted to support what I was doing and didn’t have an avenue to do so. And [crowdfunding] provided an avenue.” Crowdfunding allows a communal space for entrepreneurs
to have new opportunities for gaining public awareness and receive funding for their work. In addition, entrepreneurs reported that crowdfunding provides a unique (and unparalleled) space for them to actually see “followers turn into real dollars” and provides a way to “monetize social media.”

(f) Visualization of Feedback Boosts Self-Efficacy: Crowdfunding platforms also offer the unique ability of viewing the validation of others in a public setting. Entrepreneurs can receive quantitative data through number of comments, email notifications, numbers of funders, and financial support. These features can help to increase the self-efficacy of entrepreneurs. Many entrepreneurs expressed how much they enjoyed seeing “likes” for their crowdfunding projects and doing so helped them understand the number of people they are reaching and the quantity of people who recognize their work. This visual demonstration of public support can increase their self-efficacy and belief in their ability to succeed at their work. “It's absolutely amazing that you can come up with an idea and have the whole world sit there and pledge for your idea to actually happen, you know? And all that excitement that I get every day that I see so and so pledged $20 so and so pledged $200, all that excitement I owe to everybody else, and…it kind of gives you a lot of faith in the world and faith in you know the project itself because it's not just you that is so excited about it...You have people on a daily basis pledging for your project and commenting and messaging, and it's an ego boost.” The visualization of success for an entrepreneur through emails, likes, commenting, messaging, and financial pledges can help boost their sense of efficacy and make them feel that others are excited about the work that they are doing.
(g) Negative Self-Efficacy through Online Social Support: While some entrepreneurs felt highly supported through their campaign, others expressed that the lack of online social support in crowdfunding led them to feel unvalued in their work. Some entrepreneurs expressed that they received little to no social support throughout the entirety of their campaigns. For example, one entrepreneur working on a video project spent over $200 advertising for his project and still received no support or financial backers. As he stated: “Support? Not at all. I didn’t receive any contact from anyone in those 10 days. Went in without any expectations as it was my first attempt. People have such low attention spans that they probably don’t read the text... I have done enough sales, I am tired of selling myself.” This entrepreneur decided after the campaign that moving forward he would not turn to the crowd for help, but keep things more private.

Another entrepreneur hoping to publish her first book described her shift in self-efficacy after people didn’t support her work: “Oh my god, I lost confidence in myself...I was hurt by some of the people who didn’t kick in, it was ... harmful to my ego.” Entrepreneurs expressed the challenge of having people they thought would support them not do so. One entrepreneur reported that she expected her friends to contribute, but their lack of financial support made her feel less confident in her ability to succeed and made her discount the support of others who have already backed her project. She continued: “So that was hard, you know, ‘cause I do have a lot of friends, and I do a lot of stuff for my friends, and when I was in the black, believe me they were all getting stuff from me. And it’s kinda hard when the shoes on the other foot and you hope people will support you, and they don’t.” The lack of online social support made the entrepreneur feel abandoned and she realized that she had less support for her work than anticipated. Another entrepreneur expressed a similar sentiment after not receiving the expected
support from friends: “I networked on Facebook and on social media but there has been no interest or support for it yet- closest friends are the least supportive when you try to do something different.” In addition, some entrepreneurs struggled with getting feedback that they disagreed with or was negative from the public. This was particularly offensive as it was from people they did not know and thus seemed more critical. As one entrepreneur working on selling hooks explained after receiving critical design feedback on crowdfunding: “It’s a little bit of an insult for people to say you know you can do this better. There were also some moderately negative [points of feedback]. When someone criticizes, it’s hard.” The lack of support from others or negative feedback led some entrepreneurs to feel depressed and more critical of their work. Entrepreneurs’ perspective can change as they realize that there might be less support for their idea than they expected, given the expansive nature of the Internet and the large number of projects that are available for funders to support. This is consistent with research suggesting that users can become disillusioned when they see the competitive space they are entering [Kraut & Resnick 2012].

### 3.3.2 Online Modeling

Our interviews suggest that crowdfunding platforms provide a unique opportunity for role modeling, or seeing examples of similar others as motivation for self, which can boost self-efficacy [Boyd & Vozikis 1994]. This is done through entrepreneurs being able to view others’ project profiles via the crowdfunding platform. For example, a film director described that after seeing one of his peers raise money for a film through crowdfunding, he started using social media to build an audience to finance his own short film. He eventually raised over $15,000 from 314 people: “I was baffled by the idea that the guy just, in like a 24-hour period, used Twitter to
raise like thousands of...And it really flipped a switch for me, and I realized social networking and stuff is really going to change the way creative people can get things done... I can get on Twitter today and raise money for a movie tomorrow. Like I’ve been cultivating my Twitter circle, my Twitter network for like 5 years now.” This entrepreneur saw the benefits of using a social media tool, like Twitter, to raise support for his idea. Seeing this example motivated him to begin building his network for his own campaign.

(a) Learning From the Lessons of Others Online: In addition, entrepreneurs report learning from others, which can shape their own behavior. As one entrepreneur said, “I tried to read what some of the other people had done and pay attention to the people who were successful and tried to learn from them because I think some of the things about it were potentially counter intuitive. For example, ... my initial inclination was to make the time frame as long as possible, thinking that that would help me to raise more money. But, the advice I seem to get from reading about other people’s experience was that having a shorter campaign was actually more beneficial.” This entrepreneur succeeded his funding goal and raised $4,741 for his photography program. Seeing examples of others gives entrepreneurs the confidence to try it themselves. For example, a 40-year-old man described how he was motivated to pursue his long-time dream of starting a food truck business after seeing other newcomer entrepreneurs succeed through crowdfunding: “The guy that did one on Kickstarter two weeks ago ... it was essentially a little frame that you would sit a cell phone on top of... This is essentially a cardboard box with a hole in it! [laugh] It is! ... It was just unbelievable how much money he raised.” By seeing the example of others with similar skill levels succeeding, he said he realized that he was capable of doing the same. Entrepreneurs find role models by browsing crowdfunding project pages and
learning from how others presented and approached their work. In addition they report using the way others manage their projects to help guide how theirs are managed. Entrepreneurs express learning from others on crowdfunding platforms regarding organization about deliverables and using social media to market their products.

(b) Learning From Others’ Mistakes & Failures Online: Entrepreneurs also report learning from the mistakes of others and hope to avoid the same pitfalls themselves. One game designer explained how he noticed that many projects would show a similar pattern where they would generate a lot of enthusiasm on Kickstarter and then show no activity for months after the campaign, causing much of the enthusiasm to evaporate. He described how he did not want to make the same mistake: “I wanted to do ... an instant gratification thing... with the first novel as quickly as possible, which is why we didn't start a Kickstarter until we actually [were] well underway, editing and layout was happening.” Surprisingly entrepreneurs did not report being frustrated by seeing the failures of others, but encouraged and inspired to not make the same mistakes.

(c) Learning Through Mentorship Model: Entrepreneurs expressed how working beside others helped them learn and gain confidence in running their own crowdfunding project. One entrepreneur working in the tabletop gaming community explained his process of shadowing a fellow entrepreneur on their crowdfunding campaign before trying it out for himself: “I rode shotgun on a couple of Kickstarter’s ... so I kind of got to see someone else running a Kickstarter, but with the ultimate thing being a product that got added in my catalogue... [laugh] that was a nice dip the toe in way of approaching it.” This entrepreneur highlights the benefits of learning through mentorship, which is a crucial element within communities of practice [Lave
& Wenger 1991]. He went on to lead four successful crowdfunding campaigns selling his board games after this experience. Another entrepreneur shadowed a friend who was also raising funds for a game design: “I kind of rode on [a fellow entrepreneur’s] coattails a bit when he was developing a little matrix game ... and that was what initially exposed me to kind of the versatility of crowdfunding, that you can actually get small print runs done for a committed and really strong fan base.” The crowdfunding platform provides a unique place for entrepreneurs to draw inspiration from others through seeing sample projects or having others to look up to as role models. In turn, many entrepreneurs reported feeling greater belief in their own abilities.

(d) Negative Self-Efficacy through Online Modeling: While some entrepreneurs found inspiration looking at entrepreneur examples online, others found this process to be demotivating and stifling. Some entrepreneurs expressed that seeing examples made them feel that all of the good ideas had already been taken or that only people with an established reputation succeed. One entrepreneur working on selling CD’s explained: “I spent about a week reading the Kickstarter website -- I looked at projects and what kinds of things had gotten sold and action. It seem that the best things have already gotten a following...” Seeing that others were ahead of where they were or had a seemingly unfair advantage was demotivating to some entrepreneurs. This is consistent with Bandura’s theory that even the mere sight of a formidable looking opponent can lower self-efficacy more than when someone is faced with an opponent that looks less impressive [Bandura 1982]. Several entrepreneurs also commented that with so much content on the Internet they felt that people could not see their projects and that their ideas were more hidden online.
Entrepreneurs also expressed frustration by the misconception that crowdfunding was easy. Many saw examples of crowdfunding projects online and anticipated that they would be able to mirror their success, only to find that it was more difficult that they thought, consistent with CSCW research on the role of community in crowdfunding [Hui et al 2014]. One entrepreneur who worked on a CD campaign explained this realization: “I've noticed that it's a lot more competitive to get your idea out there than it sounds... it sounds really easy to be like, "Ok, I'm going to come up with this project and post it all over the internet, and people are going to love it!" and it's not that easy because... the internet is full of endless possibilities and... They're so overwhelmed by everything else that you see and hear and watch on a daily basis.” Other entrepreneurs expressed that it was a lot more difficult than it had seemed, as one voiced: “I’ve realized that it’s not as easy as Kickstarter would say that it is.” Another entrepreneur expressed how he looked at examples of other projects and tried to model his after theirs, but was unsuccessful. “I wrote mine in the same format of someone who raised a couple thousands. People said to lower the amount you are asking for, now asking for more specific things, but haven’t been successful yet. Even though I advertised everywhere- every group or social media.” Although the entrepreneur modeled the behavior of others, they didn’t find the same level of success. Our research demonstrated that some entrepreneurs draw great inspiration from others within the community, yet some can develop unrealistic expectations or fail to pursue their own strategies as they attempt to follow the example of others.

3.3.3 Online Mastery

The crowdfunding experience can also influence entrepreneur’s sense of mastery, or seeing oneself succeed or fail at a task [Bandura 1982]. The platform allows entrepreneurs to gain
concrete skills and observe their success as well as their failures displayed in a public setting. This can both increase and decrease self-efficacy. The entrepreneurs we interviewed reported gaining skills in things like management, communication and marketing, as well as social networking to advance their work.

(a) Project Management Skills: Entrepreneurs reported that working on crowdfunding projects helped them improve their management of large-scale projects. As one entrepreneur working on an art crowdfunding project reported: “It was a very sort of complicated thing to pull off and doing it really gave me a lot of confidence in myself and my team on how we can pull off large-scale projects.” This entrepreneur showed that her confidence in herself and her team was strengthened through feeling a sense of mastery after succeeding at the task. Many entrepreneurs expressed feeling a sense of accomplishment and mastery as they succeeded what they had set out to do.

(b) Communication Skills: Crowdfunding platforms provide a space where entrepreneurs can jump into their work and take risks. It also provides the chance for entrepreneurs to practice communicating their work to others. One entrepreneur described how she had to learn how to explain her work in a way that would inspire others who knew little about the subject: “To be able to communicate with people who aren’t scientifically minded takes a skill and a realm of comfort, so making the video was key. And being able to come up with something inspiring and understandable to the general public... definitely requires a set of skills that writing a grant to NSF would never call upon.” By learning how to communicate their work to a broader audience on crowdfunding platforms, participants found that they were able to reach many more people than they would typically reach offline. In turn, this process pushed them to become skilled at
different communication styles. Entrepreneurs also report learning how to communicate different messages to different audiences depending on what they need to hear: “It’s very different to pitch your project to the public than it is to pitch it to a grant organization and you know it may seem like there’s two divergent streams, like two very different ways of presenting your project... and trying to convince the public that I’m not just this person in my ivory tower, and thinking thoughts that don’t mean anything to anyone but myself and so it’s really sort of pairing those two together is what I’m learning how to do.” Entrepreneurs build skills in communicating to new audiences and presenting their work in a way that makes sense to newcomers in order to garner their support. Entrepreneurs also reported learning how to make a convincing video for their project that others would want to watch: “I've been surprised by some of the stuff I've learned about the utility of the video in the project, but also about its length, like you lose most of your viewers of the video by the 90 second mark, unless you've really hooked them. And many don't watch past the first 30 seconds, so like you have to really up front deliver the reason to buy.”

(c) Social Networking Skills: Entrepreneurs reported improving their social networking skills through publicizing their work on crowdfunding platforms. As one entrepreneur pursuing a photography crowdfunding campaign remarked: “I've gotten better at probably you know, being more confident in the way that I social network, and knowing that I'm not looking as terrible as I think I look.” Crowdfunding provides a space where entrepreneurs can get noticed by a large crowd of people from around the world and develop a reputation for their work that is not feasible offline. This allows entrepreneurs who may not have been known before, to develop a sense of professionalism for their work. One game designer described how he built a stronger
following with each successive crowdfunding project he launched: “I had built up enough of an audience that people were interested in my first commercial game, and then my second commercial game, and then my third commercial game. And so gradually I found myself becoming a professional game designer, totally by this totally weird roundabout way that’s sort of a new model compared to what used to be the norm.” Entrepreneurs reported that opportunities arose through the crowdfunding process that helped build up their professional reputation. This is consistent with Weick’s theory of “small wins,” suggesting that in order to accomplish a larger task, they need to first have a smaller accomplishment [Weick 1993]. One entrepreneur explained some of the new opportunities that arose from her crowdfunding campaign: “Well, I got a book deal, that was the biggest thing. My book... is coming out at the end of March. I also got to be on CNN, which was great. I spoke about the project at the Museum of Contemporary Art in Chicago...Having $25,000, a chunk of capital, that gave me a lot more financial security than I’ve ever really had.” Through developing their reputation as experts on crowdfunding platforms, entrepreneurs reported that they felt like they could mentor and support others in developing their work. Entrepreneurs explained that after going through the crowdfunding process they felt confident sharing their lessons learned with others. As one entrepreneur described: “I still am learning it...it’s a fun experience, um, and now I feel much more confident in offering advice to people [compared to] where I was five years ago.” Entrepreneurs reported that as they went through the crowdfunding process, they found themselves being able to speak in conferences and public platforms about their expertise. One entrepreneur who was new to business explained how after participating in crowdfunding, someone asked him to speak on a panel about his experience: “Suddenly I found myself like talking for 5 minutes straight about like the business elements going into it and why you want to
try to launch your project on a Tuesday because you know marketing research has shown people tend to interact more with social media and read blog posts and maybe hop over to Kickstarter page on Tuesdays.” The entrepreneur surprised himself by how articulate he was on this issue and how he was able to teach others after going through the process himself. He also reported feeling able to more confidently speak on the topic, via blogs and other platforms, like Pinterest: “I think have culled you know that... advice down to a few links of interest that I've put on a Pinterest board that I try to share out to people when people come to me now and ask, "How do, how do I do a Kickstarter?" I'm like well go read all these first, and then come back... I've ended up being a guy who knows a lot about Kickstarter.” Entrepreneurs explained that they were able to offer insights and their developed expertise with others after working on crowdfunding platforms. An entrepreneur explained how he mentored a couple dozen people on crowdfunding platforms after going through the experience himself. The crowdfunding process allows entrepreneurs to develop their expertise in the field and develop themselves as professionals.

(e) Negative Self-Efficacy through Mastery: While many entrepreneurs expressed feeling a positive sense of mastery through crowdfunding, others expressed that not achieving their goal led them to doubt their work and belief in themselves. As one entrepreneur working on selling his music said, “It was very hard [when I didn’t make the goal], it brings up all kinds of doubts, you think -- is this project any good, is there a market out there for it?” Others entrepreneurs expressed that in the process of the campaign they realized their weaknesses as entrepreneurs or lack of skills. One entrepreneur said that he wished he had the skills to put up a video and felt that it negatively influenced his project not having one on his project page. Another entrepreneur working on raising funds for a building expressed: “[I gained] no skills, but
it highlighted a shortcoming that I lack which is clarity and communication.” Other entrepreneurs expressed that the process of not accomplishing the goal they set for themselves was defeating. The nature of their failure being so public and obvious from the website caused additional grief. As one filmmaker entrepreneur remarked: “It was a little depressing. It was obvious that it was going to fail. I was defeated but trying to find other ways to get it funded.” Having campaign failure publicly displayed permanently on the crowdfunding website also negatively impacted some entrepreneurs. One entrepreneur working on a crowdfunding project raising money to remodel a home ended up deactivating his Facebook account and not wanting to go on the Internet after his project failed. Failing at a personal goal can be defeating, yet having this failure publicly displayed for the world to see can lead some entrepreneurs to retreat and decrease self-efficacy.

3.3.4 Online Physiological States

Our results also demonstrated that some entrepreneurs found the process of running a crowdfunding campaign physically and emotionally exhilarating. Many expressed the thrill of having a specific time pressure on themselves to raise the funds and that this energy pushed them forward. One entrepreneur working on developing a game for female scientists described how the process was similar to the exhilaration of running in a marathon. As she described: “The emotional involvement was like running in a race and having people cheer for you. Relying on so many people made it seem realistic for me... It was so cool because we set a goal, and to see us actually hit it,... It gives you confidence to see that it actually happened and if you did it then you’d do it again. It gives you a feeling of “Damn!” Entrepreneurs expressed the excitement of getting to watch their product be released to the world and the emotional thrill of seeing how
people responded to their work. One entrepreneur described: “To me, it wasn’t so much the amount of money, it was more of just the fun of seeing my product in the world.” Many expressed that it was less about the funding and more so the emotional support that they received. One entrepreneur working on publicizing his music told about the calls and e-mails he received during the campaign, which gave greater meaning and value to his work. As he said, “Anyone that I met or saw knew about it [my crowdfunding project] and it was all they talked about…. To see how many people responded and engaged in the process was really exciting and made me appreciate what I do. I realized that there is a place for what I do.” Many entrepreneurs found great energy and exhilaration from the crowdfunding campaign and from the short process of asking for funds from others. One entrepreneur described the enthusiasm he feels when receiving emails from those who support his projects: “My favorite thing is waking up in the morning and looking at my email saying, "So-and-so pledged!" You know and it's like you get those Kickstarter emails and I'm just like, "Ooh!" like all excited and I'm constantly refreshing it.” E-mail notifications as well as social media “likes” and “comments” about one’s crowdfunding project uplifted the spirits of entrepreneurs and boosted their self-efficacy.

(a) Negative Self-Efficacy through Physiological States: While some found the crowdfunding project exciting and exhilarating, others found it incredibly demanding and emotionally stressful. As one entrepreneur working on selling a rap CD stated about the campaign, “It was 15 days of hell -- I couldn’t sleep it was awful. I’d get little dings thinking it was a donation, but it was torture. Really stressful because you’re trying with everything you have to raise money and spending everything you did. If money’s not coming in, you’re trying to think about what you are doing wrong.” Another said how the campaign changed while they
were working on it, but tried to brush things off after failing to get the funding they had requested: “I started out really confident, I just wanted to get a sense of how much people connected with the music and if the quality was better and if they felt more confident in donating. I was really excited putting it up, but I was really down...” Some entrepreneurs mentioned how the process affected them physically and emotionally and the stress that was involved with pushing an idea forward and not receiving the support they expected. This negative physiological response led to decreased levels of self-efficacy in entrepreneurs.

Entrepreneurs expressed how the process of asking for money was physically and emotionally daunting for them. One entrepreneur working on a music campaign said: “It’s a scary thing asking everyone for all of that and to be honest it still weighs on me because I still have to give back the rewards, even $20 is a lot to ask. Now I make a concerted effort to help and I understand how hard it is to raise money, and it was scary. And it walks this fine line of remembering that you’re raising money for a good thing and being conscious.” The entrepreneur demonstrates the physical and emotional weight that the process can have on entrepreneurs. Others report of the endurance needed for this type of emotionally exhausting task. One entrepreneur reported the process of sticking with their goal and the physical trials of the process and making oneself vulnerable: “When I launched the campaign, I remember pressing “Launch!” – and feeling so good... But really it was just beginning... it was like an endurance task – how many people we can get... It was the worst feeling, like check your pride at the door. Even going back looking at Facebook I want to go back to people and say “oh god, I’m so sorry that I asked money of you”... This is a bit ridiculous.” Entrepreneurs mention the “endurance”
and the effort needed to do this type of work and the physical and emotional exhaustion that the trying process of a campaign can have on entrepreneurs that can decrease self-efficacy.

### 3.4 Design Implications

The findings of this research points to several design principles for developing online social support systems including the benefits of: (1) facilitating ongoing social support to newcomers, (2) externalizing progress and mastery, rather than permanent failure, and (3) providing ways for newcomers to learn from the failures and successes of others through online mentorship. These findings motivate future design in externalizing progress and facilitating social support from groups via *CheerOn*, as well as motivate future design on helping newcomer externalize progress and receive social support through online mentorship in the Pairachute study.

To begin, we recommend that socio-technical systems to support self-efficacy for entrepreneurs provide an online space where newcomers can receive positive online social support and encouragement from others in the community. This is consistent with empirical research of online communities that rely on reputation systems and badges [Liang et al. 2008] to promote participation and better work. For example, Wikipedia started WikiLove, which allows users to get notes and images of encouragement from fellow users in the community. Providing tools for entrepreneurs to receive positive affirmation, such as “barnstars” on Wikipedia or “likes” on Facebook, could be helpful in building self-efficacy [Benkler et al. 2014]. We also recommend providing more ways to see the level of public support received, or to showcase people who have viewed their page. Currently crowdfunding platforms provide badges for supporters every time they fund a new type of project, but there is no equivalent badge system
for entrepreneurs. Allowing newcomers to see their funding progress in ways other than the dollar amount could help to boost self-efficacy.

In addition, it can be helpful to facilitate the realization of skill mastery by newcomer, as well as encourage them to gain more skills. This might be done through a badge system that depicts different skills learned, such as a communication badge if you send a certain number of updates or a funding badge when you hit a certain target financial goal by an early period of time. For example, online communities like CodeCademy depict user success on user pages with stars and checks of success (CodeCademy, n.d.). This allows users to feel a sense of pride for what they have accomplished thus far. Displaying these badges will also allow others to identify experts with certain skills, thus promoting the culture of mentorship in online communities.

However, we also found that for those who don’t reach their financial goals, the visual display of their failure can be quite demotivating. We recommend providing a way for those to manage the failure experience [Greenberg 2014]. For example, entrepreneurs could pick what data is shown depending on how their campaign is progressing or have the option to remove failed crowdfunding projects to reduce feelings of failure. In addition, we recommend a way to notify others in the community if you are struggling and need support. Building on Bandura’s theory of social support and our findings, we suggest providing ways for people to feel supported despite failure. For example, crowdfunding platforms could encourage supporters of failed projects to send encouraging notes to entrepreneurs post-failure to boost self-efficacy and help people bounce back.

Entrepreneurs can discover new ways to conduct their work, as well as how to avoid common mistakes through seeing the examples of others. Thus, we recommend providing a tool
to allow people to shadow others doing crowdfunding projects in similar spaces. For example, entrepreneurs could list the skills that they need help with and be matched with other entrepreneurs who have experience with these skills. We learned that it is helpful to “ride shotgun” with others through an mentorship model, building on research in communities of practices describing the importance of mentorship in learning new skills and building self-efficacy [Bandura 1982]. For example, IndieGoGo labels each crowdfunding team member with a “user role,” [IndieGoGo, n.d.] which could help newcomer entrepreneurs to identify who to ask for help. We recommend allowing a user resource exchange [Greenberg 2014] that helps find role models depending on what specific skills are needed (ex: combatting failure or advertising). Building on social cognitive theory of role modeling and mentorships, we also recommend showing some role models of people failing and coming back to succeed at a crowdfunding campaign [Bandura 1982]. This suggests the benefit of showcasing failure, growth and learning online to help normalize these processes for newcomers.

3.5 Discussion

Through a qualitative study of 53 entrepreneurs, we found that online communities can provide a highly unique opportunity to influence the self-efficacy of entrepreneurs as they pursue their work. Our results suggest that crowdfunding platforms have the potential to support interpersonal interactions that motivate entrepreneurial work more efficiently and at a large scale. For example, users report gaining confidence in their work through features such as: positive affirmation and visual support from the crowd; seeing successful role models or being mentored by others in the community; mastering skills such as learning to communicate their projects; and gaining motivation to succeed through having a timeline for their project during the
campaign. Yet we found that the same principles that can build self-efficacy in entrepreneurs can also sometimes make it weaker. Several socio-technical features of the crowdfunding interface that were shown to negatively influence self-efficacy included: negative feedback from backers, permanent public display of failed projects, the misconception around the ease of crowdfunding, and the time intensive nature of campaigns which left some entrepreneurs exhausted and stressed. These features played a role in developing negative self-efficacy in some entrepreneurs.

(a) Contributions to Social Cognitive Theory: This work builds on social cognitive theory in several key ways. At a high level, it suggests that self-efficacy can be developed in crowdfunding spaces through social support, modeling, mastery, and physiological states, four features that support self-efficacy based on social cognitive theory [Bandura 1982].

**Online Social Support:** Our results suggest that audience size and social anonymity can impact self-efficacy on crowdfunding platforms. Entrepreneurs reported feeling increased confidence after receiving feedback from those they did not know as it felt as though their work was more valid. In addition, the large audience size made entrepreneurs feel like a large crowd was watching them, which is not always as accessible in offline environments. While research argues that online communities can offer a safe space for users [Warschauer 1997], our data demonstrates that crowdfunding platforms can be risky, challenging spaces where users receive harsh criticism, praise, or both, from the public. Thus our research demonstrated that entrepreneurs can both increase or decrease self-efficacy quite severely given the validation (or lack thereof) of their online audience.

**Online Modeling:** This research adds complexity to social cognitive theory around modeling by suggesting that even when entrepreneurs see examples of others failing, they can
still develop self-efficacy for their work. Though past research argued that self-efficacy can be decreased through social comparison [Bandura 1997], our results suggest that social comparison and watching the failures or successes of others on crowdfunding can increase ones learning and self-efficacy towards their work. This points to the value of newcomers being mentored by more experienced members of the community and learning from their experiences to gain heightened self-efficacy for their work.

**Online Mastery:** This work also builds on social cognitive theory through demonstrating how mastery in an online setting can impact self-efficacy, particularly given the audience size. Crowdfunding platforms create a space where it is very obvious if entrepreneur achieve or fail to reach their goal. Our results suggest that this public display of mastery or failure can influence an entrepreneur’s perceptions of their own abilities. Given the large audience size online, entrepreneurs can feel higher or lower levels of mastery depending on their results, which can influence their self-efficacy.

**Online Physiological States:** Furthermore, this research builds on social cognitive theory around physiological factors through demonstrating that with an emotionally taxing process like crowdfunding—where stakes are high, deadlines are short, and members feel accountable, vulnerable to their supporters – higher stress can be deduced. Entrepreneurs who were most successful were those who had a plan ahead of time and knew what to expect. Thus, greater counseling of entrepreneurs before entering the process could be helpful.

**(b) Contributions to Computer-Supported Cooperative Work:** This research builds on previous computer-supported entrepreneurship research by showing how crowdfunding experiences online support or hinder self-efficacy in entrepreneurs. While entrepreneurs reported
gaining skills and boosts in their confidence through using crowdfunding sites, our results also showed that even experience failure in crowdfunding could sometimes build self-efficacy. This boost came from online social support, people continuing to encourage them in their work, which put the entrepreneurs on track to try again. Previous research pointed at how some sites have used badging to motivate and reward users [Liang et al. 2008]. Our research suggests that that social support for entrepreneurs on crowdfunding platforms may be stronger than financial benefits alone. Many respondents reported that this social support was more important than the money and why they did it. However, while the public experience of crowdfunding engaged more people in social support, it also exposed entrepreneurs to public experiences of criticism. While receiving feedback can support improved work quality [Vygotsky 1987], excess criticism and failure can be detrimental for one’s self-efficacy [Bandura 1982].

Our findings suggest that crowdfunding has the potential to change how newcomers view their work and build their careers moving forward after the campaign. Currently opportunities for newcomer entrepreneurs to build self-efficacy are often competitive and limited to a few selected entrepreneurs, such as through tech incubators for start-up businesses like Y Combinator or Techstars [Bluestein et al. 2010]. In addition, newcomers typically don’t have an established following to provide support [Marlow & Dabbish 2014]. Yet crowdfunding allows them to not only get financial support, but also the psychological support needed to perform their work. This suggests that while designed for as a tool for fundraising, socio-technical systems can help to achieve other desired outcomes such as developing self-efficacy. In addition, online communities can provide an opportunity for any entrepreneur to submit their idea and call on a large audience of people from around the world to support them.
More entrepreneurs are now beginning their careers through crowdfunding because working on these platforms provides them with possible support, mentoring, and training that are less available offline. Some design instructors have already begun to teach students to crowdfund as part of their course projects [Dow et al. 2013]. Since anyone with Internet access can crowdfund, entrepreneurs from underserved communities or with few connections to angel investors or venture capitalists have the same opportunities as those surrounded by traditional funding opportunities. This empowering experience can allow people of all ages, ethnicities, and genders to initiate and make progress on their projects at a speed and scale that is not available to all offline [Kittur et al. 2013].

3.6 Limitations & Future Work

Being a newcomer to entrepreneurial work can be daunting [Shane 2003]. Understanding how to best support entrepreneurs as they work via online tools could shape the way people pursue their work. Future work will involve developing our understanding of what specific parts of the campaign affect self-efficacy most and how to enhance these features to build self-confidence. We plan to conduct greater experimental work to measure the impact of crowdfunding on self-efficacy [Chen 1998] in order to better disaggregate specific platform features from entrepreneurial experiences. For instance, we could use self-efficacy survey to measure changes before and after running a crowdfunding campaign. While our qualitative methodology was effective for identifying early patterns and creating a baseline understanding what is occurring within the development of self-efficacy in crowdfunding, this methodology had its limits in allowing us to pull apart specific effects on newcomer self-efficacy. In the future we will run a regression analysis of what factors are most impactful in entrepreneurs with higher
levels of self-efficacy, comparing features such as age, business experience, and product type. This study will illuminate individual characteristics and the experience of social technical systems. Additionally, we plan to run a controlled experiment where a set of entrepreneurs are given self-efficacy enhancing socio-technical features while working on their crowdfunding project (ex: being sent positive feedback and being shown examples of positive role models throughout their work on the project) and compare the self-efficacy levels and results of those not using the tool. The control would allow us to understand the impact of self-efficacy tools on performance and retention.

**Summary:** Crowdfunding provides a new avenue for newcomers to receive online social support and increase their self-efficacy through (1) *social support*, via public financial and emotional support from an audience, (2) *modeling*, via entrepreneurs access to examples and lessons of other entrepreneurs, (3) *mastery*, via the development of concrete new skills as a result of publishing on the site, and (4) *physiological states*, via the way entrepreneurs can be energized during crowdfunding campaigns. Yet not everyone receives these benefits. Our results demonstrate that crowdfunding can also decrease self-efficacy from these very same features. These results point to ways socio-technical systems can be improved to develop the self-efficacy of entrepreneurs. Crowdfunding provides hope for a future where entrepreneurs can go to crowdfunding platforms to receive support and boost their self-efficacy for their work. In doing so, we can broaden participation of newcomers in entrepreneurial work by emphasizing the supportive aspects of crowdfunding.
4. CHAPTER FOUR: ONLINE GROUP SUPPORT FOR NEWCOMERS IN PBL CLASSROOMS VIA CHEERON (STUDY 2)

Study Two builds off the findings of Study One by creating a novel system, CheerOn, to help increase newcomer self-efficacy through facilitating social support from a small group of users. I focused on the mechanism of online social support for this study given that it is a highly effective way to build self-efficacy in online communities given that newcomers have access to a wider pool of supporters that are less accessible offline. However, Study One taught us that while sociotechnical systems can be utilized to provide online social support to newcomers, this online social support can be inconsistent and unpredictable. Given that sustaining online social support was difficult from a crowd in Study One, I decided to test out the effectiveness of a system that facilitated online social support from a small group of online individuals. My hypothesis was that facilitating online social support from groups would be more reliable and personalized than receiving online social support from large online crowds, particularly if newcomers feel more able to share vulnerabilities with a small online group of supporters.

4.1 Problem & Background

We decided to focus on the project-based learning (PBL) context to further our understanding of how socio-technical systems can foster self-efficacy for newcomers through social support given that PBL classrooms provides an environment where newcomers can be supported by online tools as they embark on complex innovative work. PBL communities engage newcomers with authentic [Merrienboer et al. 2010], real-world project-based work [Krajcik and Czerniak 2014; Shaffer and Resnick 1999] to develop future innovators. Authentic project-based learning work can be difficult for newcomers due to the complex and uncertain nature of the work [Blumenfeld
et al. 1991; Krajcik and Czerniak 2014], especially in the context of innovation work which is inherently uncertain [Gerber et al. 2012; Scott and Bruce 1994]. To succeed, PBL students must have sufficient self-efficacy, as defined in the introduction as the perceived ability to achieve the associated tasks [Bandura 1986], to persist in the face of complex innovation challenges [Shalley et al. 2004]. Yet, similar to professional innovators, newcomer PBL students may experience low self-efficacy when discovering, evaluating, or exploiting new opportunities [Lande and Leifer 2010], which decreases their motivation and progress [Lande and Leifer 2010].

Newcomers by definition, lack the mastery of work that provides a basis for self-efficacy given their inexperience at a task. However, it is possible to boost newcomers’ self-efficacy by providing social support [Bandura 1997]. As discussed in the Literature Review, although social support has been defined in many ways [Heaney and Israel 2008], here we define social support as receiving emotional, instrumental, informational, or appraisal support from others [House 1981]. Social support can increase motivation, which leads to increased persistence and ultimately progress [Bandura 1982]. Social support can create positive emotional experiences that reduce stress [Pearlin et al. 1981], allowing newcomers to persist despite their inexperience [Blumenfeld et al. 1991]. Furthermore, social support enhances motivation to seek help and take risks, skills that newcomer PBL students may lack [Blumenfeld et al. 1991; Krajcik and Czerniak 2014] but are necessary for complex work.

Unfortunately, in PBL settings, instructors may have difficulty providing adequate social support because they are overwhelmed by the many responsibilities of managing multiple students working on different projects, helping students deal with complexity and ambiguity in their work, and completing course preparation responsibilities [Blumenfeld et al. 1991;
Dillenbourg and Jermann 2011]. This research intends to utilize online communities to provide social support for PBL environments.

Research suggests that social support given in online communities can help participants, particularly newcomers, feel greater control and more empowered [Barak et al. 2008; van Uden-Kraan et al. 2008]. Participation in online support groups can positively influence one’s psychological state [Barak et al. 2008; Seckin 2011]. Some online learning communities like the MOOSE community [http://www.mooseworld.com.au/community] have allowed children to support one another’s progress and perceived social support [Bruckman 2006]. Online communities offer the ability to draw on an audience of diverse mentors that may radically expand the instructional resources and social support available to PBL environments, offering a better way to prepare newcomers [Zitter and Hoeve 2012]. As online communities become more widely used for learning, engagement, and behavior change [Kizilcec and Schneider 2015; Prochachaska et al. 2008; Subrahmanyam et al. 2008], they offer new possibilities for providing support for PBL students.

However, PBL is inherently a face-to-face group activity -- PBL cannot be carried out completely online because it requires a great deal of face-to-face discussion, feedback, and teamwork [Dym et al. 2005]. Even if PBL work could be done completely online, that would not mirror the real-world, face-to-face practices of innovation work that students are attempting to learn. But if online-only communities are not appropriate for PBL work, we might instead be able to design blended learning environments that integrate both offline and online interaction [So and Brush 2008; Zitter and Hoeve 2012]. In other non-PBL contexts, blended learning environments have been shown to increase learning and motivation more than traditional face-to-
face instruction alone [Lovett et al. 2008; Scheines et al. 2005]. So, utilizing online communities to support blended PBL environments could help to alleviate some of the burden on PBL instructors to support motivation, risk-taking, and inquiry of students [Blumenfeld et al. 1991; Krajcik and Czerniak 2014]. While we know that social support can help aid workers in an online context, we know little about how online social support might support PBL learners in a blended learning environment.

In this design-based research initiative [Easterday et al. 2017; Easterday et al. 2016], we designed and tested a system to build our understanding of how online socio-technical systems can utilize online groups to facilitate social support to newcomers in PBL environments. Specifically we sought build to our findings in Study One that newcomers had difficulty sharing vulnerable updates with online crowds, to examine whether utilizing smaller online groups would help newcomers share more vulnerable progress updates and, in turn, receive more personalized online social support. To do so, we first conducted a need-finding analysis to study how newcomers working in our specific PBL environment currently receive social support and sustain motivation during project work. This need-finding study helped us to create a baseline understanding of what was occurring. Based on our need-finding study as well as our findings from related work (Chapter Two) and Study 1 (Chapter 3), we developed an online support tool, CheerOn, to facilitate external supporters to provide social support to PBL student teams. Through a six-week deployment, in a PBL environment with three PBL teams (12 students), we collected interviews, log data, and observations to examine the effects of online social support on the motivation and progress of project teams. We also interviewed supporters, or individuals, giving online social support to students within the online community, to understand what factors
influenced their participation in support-giving within the online community.

This research asks the high-level question of: **How does facilitating online social support from a group of online supporters influence the self-efficacy of newcomers?** More specifically, we ask: (1) **What kind of social support was provided (if any) and by whom?** (2) **What factors influenced recruited supporters to provide social support?** (3) **(Post-hoc) What goals caused the lead to provide social support?** (4) **How did receiving online social support impact PBL students?**

As in the literature review (Chapter Two), research contributes to the field of Human Computer Interaction (HCI), Computer Supported Cooperative Learning (CSCL), and Learning Sciences (LS) by increasing our understanding of how PBL instructors can use blended online communities to provide social support to PBL student teams. Specifically, it extends our theoretical understanding of how online communities can provide social support for offline project work to promote newcomers’ self-efficacy and help-seeking and how to motivate external supporters to provide social support. The potential practical benefits include new online platforms that leverage online communities to greatly expand instructional resources available in PBL environments, offering new ways to better prepare newcomers. The general approach may also be extended to support a wide variety of learners -- from newcomer professionals, entrepreneurs in co-working or makerspaces, to students in online MOOC’s.

### 4.2 Needfinding

Specifically we sought build to our findings in Study One that newcomers had difficulty sharing vulnerable updates with online crowds, to examine whether utilizing smaller online
groups would help newcomers share more vulnerable progress updates and, in turn, receive more personalized online social support. To do so, we first conducted a need-finding analysis to study how newcomers working in our specific PBL environment currently receive social support and sustain motivation during project work. This need-finding study helped us to create a baseline understanding and assess whether our Literature Review findings and Study One findings were applicable in peer-led, project-based learning environments. On the one hand these theoretical applications could be entirely consistent in peer-led, project-based learning settings where newcomer students feel that they lack sufficient social support and self-efficacy. On the other hand, we could find that newcomer students in this context feel that they have sufficient social support and don’t wrestle with self-efficacy. To understand whether these theories apply in this context, this need-finding study asked: Do students in PBL environments receive sufficient social support to feel self-efficacy in their work, which sufficiently motivates them to persist and make progress?

4.2.1 Methods

Study Design. We conducted an observational needfinding case study [Stake 1995] in a field setting and semi-structured interviews [Drever 1995] to understand social support in PBL environments and provide a baseline for future interventions.

Research Site. We observed a 10-week, extra-curricular PBL innovation program at a medium sized private Midwestern university. We investigated a peer-led PBL environment because it has all the challenges of an instructor-led PBL learning environment but is even more likely to expose the challenges of providing proper social support. The program was created by innovation professionals and professors to prepare newcomer innovators for solving real-world
social problems. The program has chapters at 38 universities. University professors, alumnae, and local professionals advised students on their projects during their innovation process. In total, there were approximately 127 professionals across the network that volunteered as coaches for teams. Peer instructors, students, mentors, and coaches received no course credit and no pay. Participants designed solutions to real-world social challenges selected by program developers. The four-person student teams were not restricted to a particular solution, designing both services and products. Student teams presented their process and solution at the conclusion of the term at a “final expo” to other members of their university design studio. This design program provided an ideal context for studying project-based learning. On the one hand, it provided an example at the upper end on the challenge spectrum of project-based learning in universities, given that students worked full time for 10 weeks, worked with clients from real community organizations, and were led by experienced peers rather than professional instructors. It is also an ideal context because the challenge level of the problem the students are working on is higher than what students are capable of doing. This is interesting whether we’re working with pre-professionals, little kids working on projects, or professionals working on complex innovation challenges.

Participants. We observed 15 students, ages 17-25, from diverse disciplines who had between zero to four years of studying design at the undergrad level. Participation was optional. Participants were not compensated for participation in the study. All teams were assigned with an external mentor whom they would meet with in person occasionally or connect with over email.
**Data Collection.** We conducted individual semi-structured interviews with 15 PBL students to understand if they received sufficient social support to make progress. Each interview began with an explanation of the method and a description of our research interest. We explained that we would record and transcribe the interview and were not evaluating the class and guaranteed anonymity. Interviews lasted between 20-30 minutes and averaged 25 minutes. The total time of need-finding interviews was 450 minutes. Interviews were recorded and transcribed resulting in 44 pages of transcripts. Interviews were conducted at different stages of the course to understand if persistence and need for greater support changed over time. This research approach allowed us to collect in situ data, but is susceptible to self-report bias [Spradley 2016]. We also recorded time-stamped fields notes about each of the witnessed experiences.

**Data Analysis.** We used a structured-case analysis, which involved taking a constructed theoretical framework of social support and comparing whether this theory aligned with our case [Carroll and Swatman 2000]. This method allowed us to evaluate whether students in PBL communities receive sufficient social support to make progress and stay motivated. Upon examination of the data we found there were multiple kinds of social support given to students. We reviewed varying definitions of social support to understand which definition aligned most appropriately with the types of social support students reported receiving in the data. From this we choose to follow House’s [1981] definition of social support, as it most closely resembles the nature of the social support we observed in our context. Specifically, the definition allowed us to differentiate appraisal support praising certain actions or statements made, from emotional support, as well as instrumental support that provides tangible assistance from informational support that offers verbal support. These distinctions allowed us to more closely examine the
different mechanisms for providing social support online. From this definition we developed a coding manual that detailed the four types of social support according the House [1981] definition, providing agreed upon examples from our social support data of each social support type reported.

We used this literature to construct questions to understand social support phenomenon within the context of PBL teams. After conducting preliminary interviews with 15 students, we coded for instances of social support, specifically where students expressed feeling: emotional support, instrumental support, informational support, or appraisal support from members of the community including peers, faculty, student leaders, mentors, and coaches. Moving between inductive and deductive reasoning, we identified social support needs. We developed initial inferences through this iterative process. After the first round of interviews, we asked more targeted questions to individuals to test these hypotheses. We reviewed all relevant data and evaluated the strength of our evidence to inform whether initial inferences should be modified or abandoned based on insubstantial evidence. All quotations were directly transcribed from interviews without grammatical corrections.

4.2.2 Findings

This needfinding study asked: *(RQ1) Do students in PBL communities receive sufficient social support to make progress?* Study One found that social support for PBL students in the form of appraisal, informational, emotional, and instrumental support [House 1981], occurred infrequently and often came too late to support students’ progress. This occurred in part because the student’s progress was not visible to instructors.
Specifically, our needfinding study found that students: (a) felt motivated by social support in the forms of appraisal, informational, emotional, and instrumental support (as shown in Table 3), yet rarely received any of these social support types until the very end of the project when they externalized progress; (b) often felt stuck, but rarely externalized their progress and need for help; and (c) often lacked a clear sense of progress while working on their project, influencing their persistence and ultimately progress (as detailed in Figure 1).

**Fig. 1. Causal Model of Challenges from *CheerOn* Needfinding Study:** When students don’t externalize progress or prompt help-seeking, supporters are less able to offer social support, which hurts self-efficacy, impacting persistence and ultimately progress.

<table>
<thead>
<tr>
<th>Social Support Type</th>
<th>Description</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emotional support</td>
<td>Provides empathy, trust, and care</td>
<td>“They said, ‘Don’t freak out, it’s ok’.”</td>
</tr>
<tr>
<td>Instrumental support</td>
<td>Provides tangible aid and services to assist</td>
<td>“She [coach] did some stuff for us for interior design.”</td>
</tr>
<tr>
<td>Informational support</td>
<td>Provides advice, suggestions, and problem solving</td>
<td>“Someone said ‘...go forward with that. Do more of this.’”</td>
</tr>
<tr>
<td>Appraisal support of...</td>
<td>Provides affirmation on the appropriateness of acts or statements</td>
<td>“[A lead staff member] came by and said ‘This [project solution] is really smart!’”</td>
</tr>
</tbody>
</table>
Table 3. Offline Social Support Given to PBL Newcomers from Needfinding: Our needfinding found that students receive all types of social support, but too little and too late.

(a) Motivations of Newcomers in PBL: PBL students felt motivated by receiving appraisal, informational, emotional, and instrumental support, but rarely received these forms of social support until the end of their project when their progress was externalized.

PBL students reported feeling motivated when they received appraisal support that affirmed their project work and instrumental support that offered help, especially when coming from high-status individuals. As one student explained: “[We were motivated] when people are really excited about what [we’re] doing and want to help and share their expertise.” This demonstrates how PBL students found it motivating when supporters offered appraisal support that affirmed their work and instrumental support that showed a willingness to help. Another student explained feeling motivated by people affirming their work at the final presentation: “People in the [final] presentation were very impressed. [The founder of the program] actually came by and said ‘This is really smart’ and I felt really good about that... During the presentation, several other professors came by... and said, ‘This is awesome. You guys did a great job.’ – and it felt great.” Students expressed feeling particularly motivated when they were given appraisal support from high-status individuals such as instructors, mentors, and domain experts. As one student working on food waste in cafeterias said: “The affirmation is bigger
when it comes from more experienced members.” These students highlighted that the impact of social support was stronger when it came from high-status individuals.

Informational support providing advice and emotional support expressing care helped motivate students to persist and make progress. Students expressed how helpful it was when external supporters shared advice and perspectives on student projects. One student noted the benefits of feedback from expert external supporters: “I always appreciate having a third party who knows the process extremely well to come in to speak to my team. I just remember... we had outside feedback come in [to their classroom for a critique session], it was so helpful.” This student explained that having external helpers provide informational feedback on what to do next helped them to make progress. Students also noted that emotional support from external supporters reassured them that they were on track. As the student explained, “There was a time when my team felt particularly stuck, and the professionals came in and gave us some amazing advice and said ‘Don’t freak out, it’s ok. You don’t need to make this amazing solution that will change the world, just solve the problem’... It was one of those moments where it was not good... but then they said, ‘Back it up and it is all good... Then you get reassured and take a break for a hot sec and come back and it works.” In this case, appraisal and emotional support reassured and motivated the team to persist.

Despite these instances of social support from external helpers, most social support (of all forms) rarely came until the end of the project when students were finished. PBL students reported that they did not often receive social support from instructors and mentors during the project. As one student said, “We weren’t getting feedback reinforcing that this was exciting... the affirmation only came at the end from some of the staff and faculty when we were presenting
"our final projects." Given instructors’ and mentors’ limited time, students infrequently received social support on their work during the program. As another student said, “It [our project] wasn’t really recognized until our final expo [presentation]. When we gave our pitch they said, ‘Wow, you have a lot of passion.’ When we were recognized then, people on our team said ‘Wow, hearing that feedback was helpful’.” Here the students point to the fact that they hadn’t received social support until after their project was complete. Many other students we interviewed expressed receiving little social support before the end of their project, and some did not feel that they received social support even then.

The lack of social support, while unfortunate, is understandable. While PBL students had access to 127 mentors across the network, only nine local mentors were actively engaged in supporting project teams. Given the many demands of orchestrating PBL environments, instructors and mentors have limited time to provide social support, which is not unique to this specific PBL environment [Lande and Leifer 2010].

(b) Newcomers felt decision uncertainty but rarely sought help. PBL students were often unsure about how to move forward. During these times, they reported having trouble asking for help and discussed problems only internally with their team, despite the fact that in cases where students did receive external support, they felt more motivated to persist.

Students reported often experiencing decision uncertainty during the PBL project process. One student working on an urban planning project said: “If you don’t know where to go, if you don’t know your next step, you’re completely stuck.” Students reported feeling uncomfortable moving forward when they didn’t hear from their partner organizations. As one student said: “We didn’t feel comfortable moving to ideate stage because it’s for our user and
we’re not getting [user] input. How do we jump to a solution? We got stuck." Students reported also feeling conflicted by the multiple options they could take. One member working on building comforting rooms for newly adopted kids said: “Right now we all feel a little stuck because we’re discussing what we want to do with the room and there are so many ideas and possibilities about what the style of the room is.” Students also reported struggling with defining the problem they were trying to solve. As one student said: “A big problem with this project was actually trying to figure out what the real problems were.” Students often went back and forth between multiple problems and solutions, experiencing uncertainty.

When students faced decision uncertainty, they did not seek help. As one student working on a project for cancer patients described, “When we got stuck it was more of a ‘Let’s see what we can do this week and come back the week after.’ I usually didn’t reach out to people when we were stuck... We didn’t really let other people know that’s where we were at.” Most students said that project status was only shared privately via Google docs, if at all. One student said: “We’re not really checking in with anyone about our progress... we kind of forgot to keep them [mentors] in the loop... we didn’t really tell them [mentors] about anything until working up till the final product. It would have been nice [to share our progress with them].” Students gave several reasons for not seeking help, including evaluation apprehension, time constraints, and the infrequency of meetings. Teams noted how part of not reaching out to mentors stemmed from them not being sure if they were on track, and thus not wanting to admit that they were behind. As one member said, “You get wrapped up in your projects. You get nervous of where you are or where you should be.” One project team described how the mentors for her project-based learning team rarely were in the loop with her group given that they met infrequently due to their
mentor's schedules. She said: “Our mentor didn’t really know what was going on because meetings were irregular. We met only two times.” Given the infrequent number of check-ins, students expressed feeling separated from their mentors and reported being less willing to ask others for help.

(c) Students reported feeling a low sense of progress while conducting project work. PBL students often felt they were making little progress and were unaware of how their progress compared to others, demonstrating the lack of appraisal support, which influenced persistence.

Students often felt they were making little progress in their project work. Given the time-intensive nature of PBL work and multi-step design process, students reported feeling a low sense of progress throughout the project. Students discussed how they would get “deep in the weeds” and a low sense for all that they had accomplished. As one team working on designing a room described: “The discussions we’re having are all really good and valid but we’re not making too much concrete progress. Because we have a lot of ideas to discuss but designing within a whole room is kind of hard because we don’t know all of the themes, because figuring this kind of stuff [design decisions] out is hard.” This illustrates one of the challenges of project-based learning work that comes as a result of difficult decisions with no single answer and a lack of clear progress as a consequence.

Teams reported being unaware of their progress relative to other teams. One student described how he rarely knew how other teams were progressing. As he stated: “I have no idea where other students are.” One expressed reason for being unaware was due to the time burden on students as a result of project time constraints as well their other homework assignments and extracurricular activities. In addition, students also expressed uncertainty around whether they
were on track compared to others given that students are working on different projects and struggle to collaborate. As one student described: “It takes too much time to look at other student’s project updates—I like seeing what they are doing at the end, not a thing that students collaborate that much.” Given that it takes time to check in with other teams, students reported being unsure of how their progress compared with that of other students. Teams also noted that not many members of the community were aware of their work accomplishments. One member working on building sustainable coffee shops talked about how none of the other students knew about his team’s progress during the term. As he said, “Other studio members don’t know about the success [of our team],” suggesting students often operate internally and are not making use of their support resources around them, which can influence persistence. The primary time that students seemed to be aware of their relative progress was at the end of the program. As one member stated, “Not until the end of the [10 weeks] did we have a sense for where you are compared to other students.” The lack of appraisal support validating the appropriateness of their acts along the way influenced student persistence. That being said, the students still did make some progress, which boosted persistence.

Perceived progress influenced persistence on project work. Students felt that making progress increased their persistence. As one student described, “Having faculty come in [during final presentations] and say: ‘Wow, you’re on the right path.’ That helped us a lot.” Teams were encouraged when people offered appraisal support through recognizing the progress they were making and confirming that they were working in the right direction. Yet this happened infrequently and often came too late in the process, influencing retention. As one student working on a dementia project noted: “We wanted to find progress, but we were struggling...
it’s hard to have motivation… our team kind of died out at that point.” These students lost motivation when they were having trouble making progress. The lack of being able to feel a sense of clear progress influenced motivation and influenced some members desire to persist in project work. Other mediating factors that influenced this decision to persist or terminate projects included: project timing and busyness of student schedules amidst other responsibilities, personality of students who felt more or less interest in the topic or desire to conduct this type of work, as well as poor team dynamics that left teams not wanting to work together in the future.

4.2.3 Discussion

This needfinding study found that students often faced decision uncertainty during project work, but social support came infrequently and often too late, in part because students did not externalize progress nor seek help, leading to decreased persistence and progress. While students did produce some tangible outputs, which has been shown to help promote a sense of forward progress and strengthen beliefs of creative ability [Gerber et al. 2012], students still often felt unsure as to if they were on track and unclear of what steps to take next. While some students continued to persist on their projects amidst this uncertainty and lack of social support, others decided to terminate their projects at the end of the quarter. Other mediating factors could have influenced this decision including timing, interest, personalities, and team dynamics. While some of these factors cannot be controlled, social support is a factor that has the ability to be better monitored to help boost increase self-efficacy of students, influencing persistence and performance.

The findings from this needfinding study were consistent with the expected theoretical challenges and relationships between social support, and persistence hold in blended
environments for newcomer PBL students. However, we found that when students did receive appraisal support confirming the importance of their work, even at the end of their project, they reported feeling more motivated on their projects. This is contrary to empirical research suggesting that positive feedback is unhelpful in the classroom because it does not provide feedback that helps the learner judge their knowledge and skill [Hattie 2007]. In a PBL environment where persistence cannot be taken for granted, appraisal support may provide needed motivation. In addition, the lack of instrumental and informational support led to students feeling unable to ask for help given that they were unsure how others could help them.

The study identifies a number of opportunities. Although it is unlikely that the peer instructor could provide as much social support as a team desired, there was in fact a larger community of potential supporters that did interact with student teams. Accessing this community to provide social support in the forms of informational, instrumental, emotional, or appraisal support depends at least in part on overcoming student teams’ reluctance to externalize progress. Students may, in fact, be willing to externalize progress and monitor other teams for reasons such as comparing progress with others. Study One both corroborates the usefulness of providing social support in the forms of appraisal, emotional, informational, and instrumental support. It also suggests a potential role for online communities to provide social support based on externalizations of student progress so as to help students receive more social support throughout the learning process.

4.3 CheerOn Field Study

The needfinding study indicated that although a peer instructor may not be able to provide frequent social support to students throughout the PBL process, we might be able to enlist a pool
of external supporters in online communities to provide social support through online tools that prompt teams to externalize progress and prompt supporters to provide social support. Study Two asked: (RQ2) *How might we design a socio-technical system that incorporates external supporters to provide online social support to increase student persistence in project-based learning environment?*

We propose that such a system can be designed to provide social support by engaging students in intrinsically motivating practices whose side effect is to externalize progress to an online community of supporters who are then likely to provide social support, circumventing students’ disposition to not explicitly seek help. Specifically, online communities for providing social support to students in blended PBL environments for innovation should: (a) Engage learners to externalize progress through collaborative to-do lists and stand-up meeting templates that help teams track and review progress and that post progress to an external, online community, (b) Recruit external supporters from the local design community to provide social support to specific teams, and (c) Facilitate external online social support by periodically prompting supporters and providing features that allow supporters to respond to teams’ externalized progress.
Fig. 3. User Flow of *CheerOn* Social Support System: External supporters in the online community received prompts and progress reports from teams’ project management activities to enlist them to provide online social support.

### 4.3.1 *CheerOn* Design Argument

We expect the intervention described by the design argument in Figure 3 and Table 1 to work as follows:

1. **Recruit**: the community manager, such as an instructor or TA, recruits members from the local design community such as senior students and alumnae to become external supporters. The community manager relies on the effectiveness of word-of-mouth recruiting from social networks [Kraut et al. 2012] to identify a group of external supporters with strong identity-based commitment to design teams and bonds-based commitment to the manager, when members feel socially or emotionally attached to particular members of the community. This is further supported by allowing online photos and profile pages [Festinger et al. 1950; Kraut & Resnik 2010; Ren et al. 2012].

2. **Train**: the community manager trains design teams in two project management techniques: collaboratively tracking tasks and daily *stand-up meetings*, daily updates in which teams quickly identify whether they are on track and what obstacles are in their way [Rasmussen 2010]. Crucially, these practices are seen by teams as having instrumental value to the team’s success so teams will engage in these activities spontaneously after a relatively small amount of formal training [Kraut et al. 2012].

3. **Externalize work**: the online platform provides tools for tracking to-dos and communicating stands that scaffold their work [Reiser 2004] and make their thinking
visible [Bransford et al. 2000]. The purpose of the externalization of progress is to make supporters more aware of the state of the students to increase the offering of social support.

4. **Highlight progress online:** The system uses the to-dos and stands to track progress and obstacles and post this on the activity stream.

5. **Broadcast progress online:** The system routes information about progress and obstacles to supporters of a specific team, effectively selecting and externalizing communicating [Kraut et al. 2012] of progress.

6. **Prompt online social support:** the community manager periodically reminds supporters (if necessary) to provide online social support -- these requests are likely to be fulfilled because they are simple and made to specific supporters from a liked requester [Kraut et al. 2012].

7. **Provide online social support:** Supporters offer online social support regarding the team’s progress displayed on the team’s activity stream.

8. **Broadcast online social support:** The activity stream is communicated to the team, again effectively externalizing communication [Kraut et al. 2012] of online social support.

### 4.3.2 *CheerOn System Description*

We implemented this design argument in the *CheerOn* system with the following features in Table 4:

<table>
<thead>
<tr>
<th>Feature</th>
<th>Description</th>
<th>Design Principles</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Community manager</td>
<td>Community manager (an instructor or teaching assistant): (a) Recruits online</td>
<td>Recruiting from manager’s bond-based, social network through word of mouth</td>
</tr>
</tbody>
</table>
supporters from local community, (b) Trains student teams in project management practices and tools, and (c) Prompts supporters to provide social support.

2 User profile and team pages
Online community features allow students and supporters to create user and team profiles with real names, photos, team and community purpose, and conversation threads. These online community features support identity and bonds-based commitment between supporters and students [Ren et al. 2012].

3 To-do list
Collaborative task management tool helps team track tasks, task owners, and task status. Each student team had an online collaborative to-do list which teams used to track the tasks, task owners, and task completion status. Positive production externality. The To-Do list and Stands help to scaffold [Reiser 2004] an intrinsically motivating activity that students will spontaneously engage in [Kraut et al. 2012]. This process also helps to make thinking and needs more visible [Bransford et al. 2000] to external supporters, an activity students would ordinarily avoid (see Study One).

4 Stands
Stands would include the following 5 prompts: (a) What’s your sprint goal for this week? (b) Are you on track to achieving your sprint goal? (c) What specific progress have you made toward the goal since last stand? (d) What will you achieve between now and the next stand? And (e) What obstacles are in the way of achieving your sprint goal and whom do you need to talk to or what will you do to overcome these obstacles?

5 Activity feed
Activity feed records completed to-dos, stands and cheers and broadcasts to supporters and teams. Posts could also be ‘liked’. Supporters following the feed receive email notifications when teams complete items on the to-do list or complete a stand along with a link to the feed. Activity stream selects and highlights progress and facilitates external communication between teams and supporters [Kraut et al. 2012]. The externalization of progress on the activity feed is intended to make supporters more aware of the state of the students to increase the offering of social support.

6 Social support
Underneath completed to-do items and stands posted on the feed is a cheering icon, text field and a prompt to “Give them a cheer!” (Figure 4). Automatic email notifications to followers of completed to-do items and stands also prompted supporters to cheer for their teams. Social support appears on the activity feed and is broadcasted via email to the team members and others following the feed. This feature scaffolds appraisal social support [Reiser 2004] and makes social support easy to provide increasing likelihood of providing it [Kraut et al. 2012].
Table 4. CheerOn System Design Features: We blend theoretical and empirical research in HCI, learning sciences, and psychology to inform the design of socio-technical system for group supporting newcomers in PBL.

Fig. 4. Examples of Online Social Support Provided via CheerOn: Through the CheerOn platform, project-based learning students can post progress on their projects to a group of facilitated supporters. Online social support can then be posted to students after accomplishing their to-do’s and stands via CheerOn within the online community. On the left, we highlight the core features of CheerOn. On the right, supporters give online social support on a post reporting team completion of a to-do item.

4.3.3 Methods

Study Design. Study Two consisted of an observational case study in a field setting to test the effectiveness of the design argument at providing online social support in a PBL environment.

Research site. We conducted this research with the same extracurricular design organization used in the need-finding study, this time focusing on a group of PBL students who worked on projects during the summer. PBL teams worked on pro-social design projects on: diabetes, food programs for the homeless, and refugee assistance. The students presented their
projects at the conclusion of the 6-week-long project at a “final expo” to other members of their design community.

**Participants.** The program included 12 design students (seven female, give male) and 15 designated online supporters. Students were placed in three interdisciplinary teams of four students each. Student’s majors included: Chemical Engineering (1), Art, Theory and Practice (1), Manufacturing and Design Engineering (1), Mechanical Engineering (4), Comparative Literature (1), Engineering Sciences and Applied Mathematics (1), Computer Science (2), and Computer Engineering (1). The summer program was led by an experienced undergraduate “lead” who served as an instructor and coordinator. Each team had one to two experienced design professionals who served as design coaches, although two of these coaches dropped out of the program midway due to travel obligations. We recruited 15 professional designers, graduate and undergraduate students studying systems design, experienced members and alumnae of the local design community network to give weekly social support using *CheerOn* to the three student teams. There were 15 supporters (nine female, six male). Five were undergraduate peers engaged in design work, five were PhD design students, two were design professional trainers, two were startup founders, and two were recent graduates with design research experience. All had some understanding of the projects and had some level of previous design experience. Recruited supporters did not receive credit or pay.

**Intervention.** On the first day of the program one member of the research team informed each student team that community members (called supporters in this paper) would comment on the team’s *CheerOn* page (two to three minute conversation). Supporters were asked to participate over a preliminary email and then were reminded to give social support to students in
weeks one, three, and six of the program as students progressed on their work. In addition to the recruited supporters, two of the graduate student researchers served as community managers (which in a traditional classroom would be a responsibility held by a teaching assistant). The two researchers and two undergraduate research assistants also played the role of supporter in addition to the 15 recruited supporters. We explained the limitations and decision to take this approach in our Limitations section. The CheerOn system was a closed system and only open to invited external members who were asked to participate. In addition, there were other community members already in the system (ex: coaches and staff) who participated in the CheerOn system and gave social support after seeing the prompts without being asked to give social support. While we asked the 15 recruited supporters to offer social support, some other online community members still participated in offering social support without being asked (ex: coaches, staff, and team members who were already invited into the system).

**Data Collection.** We conducted interviews with each of the 12 students at the beginning, middle, and end of the program (weeks one, three, and six) for a total of over 600 minutes of interviews. Our interviews focused on understanding how using the CheerOn tool influenced students perceived community support, sense of progress, task direction, and self-efficacy. We also interviewed the 15 supporters midway through the project and at the conclusion of the project for a total of over 690 minutes of interviews. These interviews with supporters focused on understanding what factors motivated the supporters to participate and offer social support to students, as well as how supporters perceived using CheerOn. Over 500 pages of interviews were transcribed for analysis. We collected and analyzed 135 social support posts.
**Data Analysis.** We conducted four analyses to understand how *CheerOn* affects the provisions of online social support in a peer-led, blended PBL environment. Our analyses asked:

1. *What kind of online social support was provided (if any) and by whom?*
2. *What factors influenced recruited supporters to provide online social support?*
3. *(Post-hoc) What factors caused the lead to provide online social support?*
4. *How did receiving online social support impact PBL students?*

To assess our inter-rater reliability and Cohen’s Kappa scores we first developed a codebook based on House [1981] definition of social support. Next we had two raters independently code all of the data (295 social support comments) to assess the validity of the codebook. Once we reached 100% agreement on the coding, we revised the codebook to ensure that these specificities were revised. Next we found a separate, unbiased rater to code 60 randomly generated social support comments, or roughly 20% of the data, which is higher than the recommended 10% of data [Campbell et al 2013, pg. 300]. We ensured that a variety of social support comments were present in the 60 social support comments to ensure that all types of data was coded and compared. We compared the 60 data points with the agreed upon codes that had been created, and the measured inter-rater reliability and Cohen’s Kappa scores to assess reliability of the data. Following Miles and Huberman’s [1984] inter-rater reliability formula, we reached an inter-rater reliability score of .816 (81.6%). According to Miles and Huberman [1984, pg. 63], a score between 80 to 90 percent is seen as reliable. Thus we felt confident in our inter-rater reliability score. Our Cohen’s Kappa score was 0.76. According to Landis and Koch [1997, pg.165], a Cohen’s Kappa score between 0.61 and 0.80 signifies substantial strength of agreement. As such, we felt satisfied with the reliability of our coding scheme.
For analyses two to four, we used the interview data, we conducted structured qualitative analysis where we organized the data and then worked to draw conclusions from the data [Miles and Huberman 1994] to assess the effects of using CheerOn on the persistence of PBL students. We grouped the comments of the student interviews into the emergent themes of: value of work, identity, and help-seeking. These were compared to the key themes that emerged in Study One related to struggles of PBL students. To examine what motivated supporters to offer social support, we examined the data from our interviews with supporters and developed a second coding protocol related to what motivated supporters to offer social support. Themes emerged related to why supporters contributed, including: (1) commitment to project and community, (2) perceived ability and understanding of how to help, and (3) sense of reciprocity.

4.3.4 Findings

In this study of CheerOn we asked (RQ2): How might we design a socio-technical system that incorporates external supporters to provide online social support to increase student persistence in project-based learning environment?

Analysis One: What kind of online social support was provided (if any) and by whom?

While CheerOn was designed for external supporters and community managers to provide online social support to teams, which they did, almost half of the social support came from leads and coaches who were not explicitly asked to provide online social support. Recruited supporters, coaches, researchers, team members, and the project lead gave online social support to the project teams (see Figure 5 and Table 5).
Fig. 5. *CheerOn System User Flow*: Recruited supporters and researchers provided online social support comments to Project Teams via *CheerOn*, and unexpectedly, so did the undergraduate studio lead and professional coaches.

<table>
<thead>
<tr>
<th>Support Type</th>
<th>Description</th>
<th>CheerOn Example</th>
<th># posts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emotional</td>
<td>Provides empathy, trust, and care</td>
<td>“I hope the team is all healthy by Thursday!”</td>
<td>37</td>
</tr>
<tr>
<td>Instrumental</td>
<td>Provides tangible aid and services to assist</td>
<td>“Hey Team - I emailed my contact. I'll loop you folks in as soon as he agrees to help.”</td>
<td>37</td>
</tr>
<tr>
<td>Informational</td>
<td>Provides advice, suggestions, and problem solving</td>
<td>“Today it might help to start sketching out the different ideas you have. This will help flesh out some of the details.”</td>
<td>81</td>
</tr>
<tr>
<td>Appraisal of…</td>
<td>Provides affirmation on the appropriateness of acts or statements</td>
<td>“Super excited to see you guys working on the important problem.”</td>
<td>17</td>
</tr>
<tr>
<td>… project value</td>
<td>States qualities about the project</td>
<td>“Hey guys! Great job at crit today. Love how in-depth you are going with the research.”</td>
<td>137</td>
</tr>
<tr>
<td>…work</td>
<td>Says something about the correct (right/wrong) approach to work</td>
<td>“You guys are great!”</td>
<td>8</td>
</tr>
<tr>
<td>… person</td>
<td>Makes statements about qualities of the team members</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Table 5. Counts of Online Social Support Types Given on CheerOn:** Appraisal support, in the form of appraisal of work, was the most common social support given. Comments that did not fit into the coding scheme were removed.
Table 6. Online Social Support Numbers By Position via CheerOn: Informational support came from those with instructional roles, while appraisal support came from leads and managers.

Table 6 shows that the lead provided the most social support (29%), followed by managers (researchers and RA’s 28%), followed by the three coaches (22%), and the 15 assigned supporters (21%). Note that as the instructional responsibility of the role increased, the number of people in that role decreased, for example, the single studio lead had the responsibility to oversee all teams, each of the five coaches was responsible for mentoring one team (though not all did), and 15 assigned supporters who only occasionally provided support to one team online. Those with greater instructional responsibility provided more social support, so the cumulative amount of support from each group was roughly equivalent.

This relation also affected the type of support given. The most common type of social support given was appraisal support, which validated the progress students had made on their work and reinforced the importance of their work, for example, comments such as “great job synthesizing your research.” Recruited supporters mostly gave appraisal support or offered
instrumental support, given that they knew less about the state of the students and their work. The lead, coaches, and managers gave more informational and emotional support. We believe that this was in part because they saw the students more frequently and knew more about their progress and emotional states.

The type of online social support given changed throughout the project. At the beginning of the PBL assignments, online social support comments were mostly appraisal support validating the importance of the project and instrumental support offering to help out in any way. The type of online social support then shifted to offer more informational support providing guidance and suggestions and appraisal support validating progress. Towards the end of the program, we observed more emotional support online expressing care and empathy, as well as continued appraisal support online validating work. Of course, not all online social support is of the same “value.” We describe how these differences affected students and the implications for designing online social support systems later in Analysis Four.

**Analysis Two: Factors Influencing Provision of Social Support by Recruited Supporters**

Creating online social support communities for PBL students depend on the extent to which online supporters participate and offer online social support to students, so: *what influenced recruited supporters to provide online social support?*

Recruited supporters described three conditions that increased their provision of social support, when: (a) they had a commitment to the community and felt peer pressure; (b) they understood a team’s need for help and had the ability to help; and (c) they received gratitude from students who heeded their assistance. Unfortunately, these conditions were not always present.
(a) Community commitment. Supporters provided more online social support when they had identity-based commitments to the design community and bonds-based commitments to the project members. Supporters provided online social support, particularly appraisal and instrumental support, when they identified with the design community. As one community member familiar with design network said: “I know they are trying to do a quick development of a project that solves a problem. That, in itself, is something I can relate to and appreciate. The problems [the design community network] students are trying to solve--I support that larger mission, by relation I support the team.” Supporters who identified with the design community felt empathy for students and provided instrumental support by offering their services and appraisal support by encouraging the process. Another supporter said, “I’m very familiar with [the design network community] and their process.” This led to offering appraisal support by giving teams advice. When supporters didn’t identify with teams, they wondered what they shared in common with students and were less motivated to provide social support: “If I had seen what was in common that might have been a bit more motivating.” Feeling a personal connection to the larger mission of the community or understanding and respecting the students design process increased their willingness to participate.

Supporters provided online social support, particularly appraisal and instrumental support, when they felt bonds to the design community. As one member stated: “I feel like an honorary member - I’m very familiar with the process and a lot of the students in there. It didn’t feel strange I felt like I was familiar with most people...” Familiarity with the community increased supporters’ willingness to contribute. Supporters outside the organization who didn’t have a personal bond to the student teams often found it difficult to provide social support for
people they did not know. As one community member said: “It was hard to cheer for people I had never met before, I felt kind of awkward doing that.” Supporters without a connection to the community, online or offline, seemed less willing to give social support to students online. Some supporters noted how it felt “artificial” to give social support to students they didn’t know. While CheerOn allowed users to see profiles of the students, supporters said that this was not enough for them to feel connected to them. As one supporter said: “I would have liked to know a little more about them... I guess it doesn’t really build a connection with the people that I was going to be cheering [giving online social support]. If I knew more about them I might have commented more.” Supporters also desired to know more about the students to whom they were giving online social support.

**(b) Peer pressure.** Social facilitation (peer pressure) amongst supporters increased social support. While many of the external supporters did not initially know their teams, they sometimes knew other supporters. Supporters were moved to participate when they saw other supporters giving online social support. As one supporter said on their purpose of commenting: “I think it might be partially because I knew those people who were cheering [giving social support]. I knew the [design network] community and it had the community aspect to it and they were participating in something I also wanted to participate.” Some supporters said that they felt that it was a bit less odd to give social support to those they didn’t know when they saw other supporters also commenting on the site. As one member stated: “When I first got the email, I thought it was going to be a little awkward because I don’t know these people. At the same time, I felt a little less awkward when I saw others on there, so it’s totally cool.” Seeing other supporters posting helped them feel more willing to participate, as they felt less alone. In
addition, supporters tended to mirror the social support type of those who had gone before them. For example, if someone gave appraisal support, others would mirror similar appraisal support comments. One student noted how they were more motivated when they noticed others comment: “It was cool to see the posts from other people--I felt that it was good that I cheered and that I wasn’t the only one. When I didn’t see interactions from other people, I felt like I didn’t have to do it as much.” Supporters were heavily influenced, both positively and negatively, by the others participation within the online community. By seeing the other participants within the community actively giving online social support that they knew, supporters wanted to in turn also participate.

(c) Supporter saw clear need for help. When external supporters received specific help requests or saw a clear need for help they provided informational support by giving concrete advice or provided instrumental support by offering their services. Perceived ability to provide help increased giving of informational and instrumental support. Supporters tended to offer social support only if they felt they could help students, and responded with both informational and instrumental support. As one supporter said: “I would really comment if I had some value to add - if I had a question that I thought they should consider or a connection that I knew if I could help them.” Supporters who felt that they had informational or instrumental support to share were more likely to participate. Another supporter noted that she was eager to offer informational support when she saw that the team was facing a problem that she knew a lot about. As she expressed: “There was one stand that I saw people had commented on and then I jumped in on it. I saw the question about blockers... I had some experience with that... I felt really good being able to share that with them. Felt like easy pickings.” This supporter was
motivated by the fact that she could share something that she knew about and it was an easy way for her to offer informational support.

Supporters perception of their ability to provide social support was influenced by the examples of previous social support comments given by others online. Supporters were also motivated to give informational and instrumental support when they felt that they had something new to add that was not already being voiced. Members noted that they were eager to participate when they had something they felt they could share and the proper skills or experiences to help. However, when members were not clear what the students needed or didn’t feel like the students needed informational or instrumental support, they were less likely to help.

Supporters participated when they felt like the team genuinely needed help. If the team noted that they were doing fine, they felt less obliged to give them informational or instrumental support. As one community member who does design research work stated: “They say: “We’re on track. We’re good” so it makes me think they’re fine--it keeps saying ‘Oh we’re fine, we’re fine, we’re fine’. If they said ‘Oh no, we’re struggling with this’, what information can I give them to help them.” We found that even when students were struggling, they often reported that they were “on track”, which confused supporters trying to offer social support. As another community member expressed: “If it looked like they were doing fine, I just kind of let them go. If there were times when I felt they needed a little booster…” It was harder for me though… I felt the team is struggling more than I expected. I think there’s nothing I can do via [online support] to help them, in that sense, it was much more beneficial for me to sit down in person and give insights that way.” Supporters were not always sure of what exact challenges the students were facing and where they needed informational or instrumental support. Informational and
instrumental support, as well as other forms, was thus influenced by whether supporters had a clear understanding of the project and the needs of the students.

We also found that supporters often didn’t want to simply give vague appraisal support, but wanted to give more direct informational or instrumental support that they felt could help the team meet their needs. Despite this desire, supporters tended to give appraisal support rather than other forms of social support.

Supporters could not always tell what help was needed, negatively influencing the instrumental or informational help they offered. As one supporter stated, “It’s hard for me to directly give useful feedback without having more context.” Some students said that they were working on the same thing from the day before. Thus, supporters were not always sure what had changed between the days. As another supporter stated, “But sometimes it’s a little unclear to know the difference between their stands [progress posts]. It takes a bit more effort.” Supporters were not always sure where students were in their project process and what they needed help on. This influenced their willingness to offer informational and instrumental support. The vagueness of the progress posts frequently left supporters unsure how they could actually give instrumental or informational help. As one supporter who was a graduate researcher familiar with the design process stated, “What’s missing in this daily process is specificity in terms of what exactly they’re doing. The stands are so vague so it’s hard to pinpoint what they’re working on and need help with.” Some supporters struggled to understand what the students were saying through their daily posts and updates. Another supporter stated: “If I had been given some kind of notification that this is something they need help or feedback on. This would help with giving them a frame for what they need help on.” Supporters were not always sure what kind of help was needed,
which influenced their willingness to give positive online social support and participate within the online community.

Stands were more likely than to-dos to elicit instrumental or informational support. Supporters provided instrumental or informational support in response to a stand more often than to a to-do post (Table 7). When supporters responded to to-do posts, it was almost exclusively with a form of appraisal support. Whereas when supporters responded to stands, it was typically with instrumental or informational support. In other words, stands elicited informational or instrumental support whereas completed to-do posts did not. This is likely because to-do posts do not surface any problems or need for help, so appraisal support is the only type of support that supporters can provide in direct response to the post.

<table>
<thead>
<tr>
<th>Reply to</th>
<th>Emotional Support</th>
<th>Instru. Support</th>
<th>Info. Support</th>
<th>Appraisal support of...</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>value</td>
<td>work</td>
</tr>
<tr>
<td>Stand</td>
<td>20</td>
<td>20</td>
<td>62</td>
<td>5</td>
<td>70</td>
</tr>
<tr>
<td>To-do</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>34</td>
</tr>
</tbody>
</table>

Table 7. Distribution of Online Social Support Between Stands and To-Dos: Stands were more likely than to-do posts to elicit the types of online social support that provide useful feedback and resources.

(d) Supporter received gratitude for previous online social support: When external supporters felt that the students appreciated their efforts, they felt more willing to offer additional online social support. This online social support came in all forms, but was often increased emotional support given to students.

Supporters were more likely to provide online social support when students responded to or expressed gratitude for their comments. As one supporter for the diabetes team stated: “I went back to the [online community] to see if there were any responses. But then I saw that someone
who had read the post had responded and said, ‘Hey, thanks so much’ and that felt really good. I went back and was eager to see whether my input was considered... After that I started to read the stands again. I became re-interested again.” Another member said that he felt good knowing he was in dialogue with the members of the team he was supporting. As he remarked: “Having someone respond in text felt good. It was like we were engaging in a conversation... Made me feel good that they appreciated it.” Supporters felt higher levels of social support when students gave them some type of recognition, such as appraisal support for their efforts.

When supporters did not receive a like or reply from students for instrumental or informational support they offered, they wondered if their online social support was actually seen. As one member stated: “I was really curious ‘are they even going to see this?’ That demotivated me a little bit. Even if I gave them [appraisal support]... then they wouldn’t see it.” Another supporter noted that she was unable to know if she was being helpful when she didn’t hear back from the students. As she said, “Well no one is responding to me, I have no way to know if it’s useful.” We also had several instances where supporters asked questions or made comments and no one replied to them. This led them to feel less willing to give social support to students via CheerOn. There were only a few scenarios where supporters did not care if they received confirmation. One community member commented: “It would be nice if they responded but I’m just putting out there to take it or leave it. It wouldn’t make a difference to me. Unless they want to have a conversation.” This instance tended to be far less common than those who felt offended if no one responded to the instrumental or informational support they offered and decided in turn to stop offering online instrumental or informational support in the future.
Supporters who didn’t feel that their informational or instrumental support was helpful to students had less desire to participate afterwards. For example, one supporter who gave informational support to her team became frustrated when the social support didn’t seem to help the team and they expressed continually having the same issue. As she stated: “I saw that they were struggling with the same issue [supporter had given team informational support on before]. I thought maybe they need more support but at that point I didn’t feel as motivated to help again, I guess it was demotivating to see that my support didn’t help them.” In this scenario, she was both upset that she couldn’t help and she felt that the team was neglecting to follow her informational support. This led her to stop participating within the online community. In addition, some supporters did not participate because they didn’t feel like their informational support would help. As one member explained: “Having been on design students as mentor and participant, the kind of feedback they’re getting is truly dependent on the feedback process and whom they are giving it to. I don’t feel they have any connection with me. It’s hard to believe anything I’m saying is beneficial.” Overall, our results showed that if a supporter did not feel that their informational or instrumental support had been noticed or heard, they were more likely to feel less motivated to give online social support and would give less time-consuming appraisal support as a result.

**Analysis Three: The Lead’s Goals to Provide Online Social Support**

While CheerOn was designed to promote online social support from recruited supporters, the undergraduate studio lead unexpectedly provided more social support than any other group including recruited supporters, coaches, and managers, so we ask: *why did the studio lead to provide online social support?*
Studio lead goal one: Boost morale. The studio lead saw her role as monitoring teams in order to provide social support, particularly emotional and appraisal, to boost their morale, which CheerOn allowed her to do: “For the most part it has been one of the more memorable parts of my Loft experience this summer. I think in part because it’s part of my role in overseeing them. So, I’m reading their stands and motivating them and trying to create a positive environment. So, I think it’s particularly helpful for me, or those in a similar position of mine.” The lead saw social support, particularly in the forms of appraisal and emotional support, as a humorous way to boost morale. She saw boosting morale as her responsibility: “My role is so much more focused on what their experience is like. Since that’s my role I’m more attuned to morale boosting.” At first, cheers provided a humorous, gratuitous way to provide support: “It kind of started as a joke - [students] were like ‘oh we just got cheered,’ which I thought was awesome, it got them to laugh.” However, it became a useful way to show support: “Why I’ve been doing it a lot is that it gets them to smile but it lets them know that I see how much work they’re doing and notice how awesome it is.” The lead could perform this role through generic posts as well: “I realized [team members] were low on morale so I went in to post a more ‘great work, keep it up’ and that was more on a post. Why I did that separate from a cheer was because I didn’t have a specific to-do... I wasn’t posting advice or suggestions, it was just wholly for the sake of boosting morale.” Providing social support thus provided a convenient online means of helping boost student persistence: “I think cheering or posting some sort of morale has been a good account of that.”

Studio lead goal 2: Providing assistance. The lead also used CheerOn to provide more substantive informational and instrumental support to students. As she reported: “I’m not picky
about my likes but definitely with commenting if they have an obstacle that I can help with, I will comment, or if there is an obstacle that I can help with. I will elaborate and say, hey I can help with this.” This informational and instrumental support often started a face-to-face interaction. As the lead explained: “I try to … comment on that to create a conversation.” For example, after one team was disheartened after a critique session, the lead attempted to normalize the situation and offer emotional and informational support online to the team: “I felt like it was kind of necessary to be like ‘brainstorming can be frustrating’ and trying to follow-up the conversation we had, which was like what can we do to get better feedback from crit.”

Studio lead goal three: Support routine. CheerOn became an online complement to the ongoing support routine of the lead. The lead reported using both online and offline for monitoring teams: “I kind of do both. I check in with the teams regularly and a few times throughout the day. I feel most of my time is spent checking in with the teams.” The online system provided another support channel: “I try to change their Loft pages every few days and cheering is a part of that. Just every couple of days I’ll cheer a few things. So for the most part it’s just been generally pretty routine.”

Analysis Four: The Effect of Social Support on PBL Students

Analysis One found that external supporters did indeed provide online social support and analysis Two and Three identified factors that influenced supporters’ behavior, but we must also ask: how did receiving online social support impact PBL students self-efficacy, impacting persistence and ultimately progress? In this section we will show how we found that receiving appraisal support helped to increase students’ perceived value of their project work, influencing their work persistence; and instrumental, informational, and emotional support, helped students
to feel a sense of progress, greater identity in the community, and lowered hierarchical barriers within the community which increased online and offline help-seeking.

**Social support increased perceived value of project work.** Students perceived their project as valuable when online supporters and community members wrote comments offering emotional and appraisal support on the activity feed. One student said it “makes you think that people care about what [the work] you’re doing.” This appraisal support also led the students to feel that they were not alone in caring about their topic. As one student working on the diabetes project, “[Receiving appraisal support] facilitated this [online] atmosphere that you are doing something and what you are doing is important.”

The number of external supporters magnified this effect. One member on the diabetes’ team highlighted how seeing the large number of online supporters led him to feel that he was making a real-world impact. As he stated, “Because so many people cared about this project [online] and it feels that I am making a difference.” Teams noted that seeing the number of followers supporting their project online was impactful for recognizing how many people valued their work, which made them feel that they were making more impact. As a student working on the food truck project remarked about being a part of the online community stated, “It [appraisal support] made me realize that other people [online supporters] actually really, really cared about all these [food] issues.” Through receiving online appraisal support, students better recognized that other people also felt that their problem was meaningful to a larger community working towards a big problem. The fact that support came from external supporters also mattered. As one student said: “When someone comments on your page that you don’t necessarily know, it’s more... encouragement.” Another student pointed out a similar feeling
related to receiving appraisal support from strangers: “The fact that people we don’t even know are interested in our problem... The fact that an entire network of [the national student design network] people were following your project [online], that made it feel more official.”

Dedicated, open, online space for project content and comments from online supporters and community members increased the students’ perceived value of the project: “I felt that the [website] sort of gave that feeling of importance to whatever I was doing, especially since there’s a whole site devoted to whatever project you’re doing. A page with your specific feedback questions that you could modify or your own [to do list] for instance.” Receiving online appraisal support from an extended network helped to increase students’ perceived value of their project work, influencing their work persistence.

**Online social support sometimes increased perceived progress:** Although the social support features were designed to enlist external supporters to motivate progress [Amabile 2011], which in turn should have boosted student self-efficacy and in turn increased persistence [Bandura 1994], online social support affected progress in a different way. Making progress explicit increased students’ public commitment, and more detailed descriptions of obstacles elicited substantive online instrumental and informational support from supporters on what to do next, which helped students make and perceive progress.

Appraisal of work and emotional support did not always seem to encourage progress as might be expected from social models of motivation and work on online communities. For example, unlike Wikipedia Barnstars, appraisal support did not seem to provide a strong extrinsic incentive for PBL teams, likely because teams are already highly intrinsically motivated to work on their design projects [Restivo and Rjit 2012]. Online social support in the form of
emotional or appraisal support seemed to function similar to praise [Hattie 2007] that is, they did not provide useful or believable information useful for making progress. As one student stated: “I think just the types of comments... like, “Oh, great job,” like, “Looks like you guys are doing really well.” Yeah, like they just didn’t say anything that substantial...” Or as another student said in reference to less specific, impersonal comments: “It almost seems forced because comments that are a bit cheesy, at times.”

At other times, appraisal support did seem to positively affect students’ self-efficacy by helping students judge their progress: “It’s a nice thing to see, like, oh, we’re on the right direction.” As one student stated that appraisal support increased “confidence in what we’re doing, that we know what we’re doing, ... that we’re working towards this goal and it’s going to be fine”. This student reinforced that appraisal support helped students to feel that they were working on the right path and that “things would be okay.” In these cases, appraisal support helped them feel like they were successfully taking steps toward their end goal.

Whether or not students found appraisal support beneficial, tracking progress online did increase public commitment. Posting progress did helped students track and publicly commit to their work. Students noted how posting their work online helped them to keep track of their results: “Seeing [goals online] there and saying that these are my goals for the week, in a way, it makes it easier to track them and create a schedule.” This visible record in turn created public commitment, as one student said: “As a team, having it as a public record matters, I think it’s important to have accountability... it’s more measurable.”

Receiving online instrumental and informational support (rather than appraisal of work and emotional support) influenced perceived progress. More importantly, when supporters were
able to understand students’ work and provide substantive assistance, this both helped students make progress and increased expectancies. One student said that it was encouraging to receive specific online informational and appraisal support on their work, “When people [online supporters] gave positive critiques that were substantive rather than commenteting on smaller things, that indicated that we were on the right track.” Other teams also noted that it was motivating getting feedback on their work. As one student stated, “Having people who just see the work that is on the activity feed and give you feedback... it’s nice. It’s that extra motivation, like good job.”

Offering online social support, particularly instrumental or informational support, was contingent on understanding students’ progress, which was often difficult. Some students did not feel that supporters cared about their small wins or accomplishments. As one student stated about to-do posts, “Nobody cares about our small steps forward.” Some commented that they were unsure who was actually looking at their page particularly the case when they didn’t receive comments. However, many of the recruited supporters’ comments were nonspecific appraisal support on work (e.g., “good job”) and that supporters often reported difficulty understanding teams’ progress: As one supporter stated, “It’s hard for me to directly give useful feedback without having more context.” or, “... sometimes it’s a little unclear to know the difference between their stands [progress posts]. It takes a bit more effort.” Or “What’s missing in this daily process is specificity in terms of what exactly they’re doing. The stands are so vague so it’s hard to pinpoint what they’re working on and need help with.” Even if online supporters did care about teams’ progress, they would not be able to provide substantive feedback if they could not understand the progress made. By this interpretation, external online social support may indeed
affect progress and expectancies through surfacing students’ work to supporters in a way that allows them to provide substantive informational or instrumental support.

**Online social support increased community identity:** Appraisal support increased students’ connection to the larger design network and community. As one student stated about receiving appraisal support from a mentor, “It kind of makes it bigger than just our team or just [design program]… Like what we’re doing, the work we’re doing… It makes it more part of [the national student design network] as a whole.” This team noted how using CheerOn to receive appraisal support made their project work feel beyond their own team and part of a larger community. Another student said in that after receiving emotional support from supporters in the form of welcoming to the community and expressions of empathy for the design process: “I definitely felt that it made me more a part of the [national design network] community.”

Emotionally supportive comments expressing care led students to feel comfortable in the community and influenced engagement in their project work. One student described the experience of receiving a comment that expressed their care for the students as it influenced her comfort level and engagement. She said that receiving the emotional support comment impacted her “comfort level, knowing that these people are encouraging us, like are participating, like cool things coming out of this, I think that is what makes me more engaged with the project itself.” This demonstrates that students felt more engaged in their project work through receiving emotional support from others via CheerOn.

Through greater comfort in the community, students reported feeling more connected to the design network community as a result of receiving social support via CheerOn. As one student stated about a comment from a high-status person in the community, “I definitely felt
that it made me more a part of the [design network] community.” When students received social support from others, they felt greater connection to the community. However, some students reported that they still did not know who was giving them social support. As one student said, “It’d be more helpful if we actually knew who they [online supporters] were sometimes.” This suggests that social support comments were not as meaningful to students when they came from strangers, given that they did not feel they fully understood their work and cared about them personally.

Beyond the internal network of support, online appraisal, emotional, instrumental, and informational support helped students feel that there was a larger pool of social support online. As one student stated, “I feel like classes generally had an instructor or a TA to go to, so the pool of resources was less... I guess the pool [online community], like a bigger community.” This student demonstrates how social support facilitated the sense of a larger community of social support, beyond their internal network.

Online social supported lead to some offline help-seeking. Social support built community bonds that, to a limited extent, increased help-seeking. Building bonds between teams and external community members led to surprising benefits that students explicitly sought help face-to-face. Students reported that receiving online social support led them to feel that they were a part of a supportive community who wanted to help them. As one student stated about receiving social support, particularly in the forms of instrumental and informational support, “It [social support] gave me a better idea that [design network] is more of a network of people who are helping each other.” Social support helped to facilitate a culture where students felt part of a community whom they could reach out to for help.
Through receiving online social support, particularly instrumental and informational support, from online supporters, students reported feeling more able to ask for help. As a student working on the food project remarked about being a part of the online community, “It makes asking for help easier... Even though we’re not always talking to them, it’s like they’re there, so we should be able to ask help if we want.” This student demonstrates that social support helped facilitate greater convenience for asking for help as well as an increased perception of supporters being willing to help them.

Online introductions demonstrating emotional support by supporters helped to make students feel comfortable asking for help. As one student said, “Knowing that there were people [online supporters] who had introduced themselves [online] at some point, made it easier to reach out.” Students reported feeling more comfortable asking for help when there was some sort of connection built online between students and supporters stating their emotional support and willingness to give instrumental and/or informational support. We had some comments that when students did not know who was providing social support for them, these comments had less value given that they seemed more artificial.

Expressions of emotional, instrumental, and informational support online helped break down hierarchy and led some students to feel they could reach out to more experienced members of the broader community. As one student working on the diabetes project stated, “I think it [receiving social support] makes it less of a hierarchy, I guess, in a way that you can interact with anyone... it’s more like just go to anyone for help. They all are able to contribute in some way or another.” Another student affirmed that help-seeking came more easily after receiving social support comments online: “It makes the whole asking and communicating with superiors
easier.” This helps demonstrate that social support helped make superiors more approachable to students. Receiving social support from higher status members shows students that these members were “willing to give their resources.” We didn’t find evidence of the contrary.

As a result, supportive comments that demonstrated emotional, instrumental, and informational support led to instances of in-person help-seeking by students to supporters. One student from the diabetes project team explained that a supporter offering informational support led to an in-person meeting. As they stated, “Well, when [design network leader] commented on our [team page], she posted a comment about us interacting with our community partners. That sort of brought something up, just like we started talking about it. And then eventually, we were like, ‘Oh, well let’s just go talk to [the network leader] in person,’ so we brought her in... I think the [social support] comments sort of facilitated it as an implicit, like, ‘Hey, if you have more questions, you can talk to us.’... the comment was kind of the reason that there was the connection there.” Here online social support in the form of informational support helped to establish communication channels. This in turn led project students to feel more willing to go in and ask for help and receive in-person feedback providing the team with new insights for their project work.

However, online social support did not fully remove barriers to help-seeking for all students. It is important to note that some students still expressed ambivalence about asking strangers for help. As one student working on the diabetes project stated, “You don’t really ask strangers for help. You’d rather ask people that you interact with a lot or someone that you’ve been commenting with.” This reinforces that, despite receiving online support, some students still preferred to ask for help from those who was familiar. We coded all comments using a
Codebook Manual, which helped us to identify what categories of social support each comment fit into. When the comments provided sufficient detail we would code them according to the social support category that they fit into based on House’s 1981 definition. We found no negative comments posted using CheerOn. We believe this was the case because it was a system specifically designed to support positive comments.

4.3.5 Discussion

Study Two asked: *(RQ2)* *How might we design a socio-technical system that incorporates external supporters to provide online social support to increase student persistence in project-based learning environments?* We predicted that a system that externalized teams’ progress would prompt online supporters to provide social support, and that this social support would motivate students to make progress in their work. We found that the CheerOn system did indeed successfully prompt social support that teams found beneficial (Figure 6). The CheerOn system succeeded in increasing social support for PBL students. The combination of engaging teams in useful project management practices that externalize progress and minimal prompting was sufficient to enlist the online, external community of supporters in providing online social support. Supporters were motivated by predictable factors such as their identification with the community, social facilitation (peer pressure), clear needs for help, relevant expertise, familiarity, and students heeding informational or instrumental support.
Fig. 6. Revised CheerOn Causal Model: CheerOn facilitated some online social support, which increased persistence through heightening the perceived value of the project rather than students’ expectancies, while the connection to external supporters unexpectedly facilitated face-to-face help-seeking and a stronger identification with the community.

However, there were also a number of surprises. First, the surprising amount of online social support provided by the lead, and to a lesser extent, the coaches. We had assumed that instructors would not have time to provide social support, based on Study One and previous research on PBL, thus the need for an online community to provide social support. However, it seemed that in providing the tools to elicit social support from recruited supporters, CheerOn also lowered the barrier for the lead to provide social support, which she saw as part of her responsibility as an instructor. The lead and coaches provided social support even without being explicitly asked.

Second, teams often desired substantive informational support that would provide feedback on what to do next. While the system was designed to surface completed to-dos to elicit online social support, these to-do posts elicited primarily appraisal support rather than substantive feedback. Rather, the stand posts, which effectively surfaced problems, showed clear help needs that were more likely to elicit substantive informational support. Appraisal support
did sometimes give teams a sense of progress that increased self-efficacy, but it sometimes was perceived as unhelpful or too superficial to be credible.

Third, online social support increased some persistence through increasing the perceived value of the project, rather than through increasing team’s expectancies. Social support in PBL functions differently than in online communities where it encourages members to perform small tasks they would not already do—as shown by Study One, PBL teams persist in their project work even in absence of social support, albeit with decision uncertainty and stress. Nor does it have as little effect as praise had in a classroom, as predicted by learning sciences research [Hattie 2007]. In this PBL environment where students are motivated by, but have serious doubts about, their project’s real-world impact, appraisal support from external supporters signal that the project is important enough to warrant the attention of an external audience, increasing the value of the goal and thus students’ persistence. While substantive appraisal and emotional feedback on progress (indicating mastery or nearness to goal) can also increase persistence [Amabile 2011], the appraisal and emotional support comments given on CheerOn were sometimes too superficial to communicate this progress, likely in part because the externalizations of progress did not provide sufficient detail to supporters.

Fourth, online social support also resulted in some unexpected positive side effects such as in-person help-seeking and community commitment. Providing a community of external supporters to offer emotional, appraisal, informational, or instrumental support online helped to increase the psychological safety [Edmondson 2006] of asking some external supporters for help. When external supporters became aware of the need for help, they often offered to help students. This, in turn, led to students being willing to ask for instrumental or informational support. There
were several scenarios where students reached out to supporters only after a simple introduction on CheerOn, but most help came from formal offerings to provide informational or instrumental support. Furthermore, students reported that receiving online social support, particularly emotional and appraisal support, from external supporters made them identify more strongly to the larger design community. This stronger sense of identity in the community increases the likelihood that they would participate in the larger PBL network and is itself an important learning goal in adopting an identity of an innovator.

Nevertheless, there is room for substantial improving of the intervention. Most notably, supporters often wanted to give more substantive informational and instrumental support to students, instead of merely appraisal of work such as “good job” – though research does suggest that even a ‘like’ of validation on Facebook can be of value to users’ self-esteem [Scissors et al. 2016]. Part of the difficulty of supporters providing substantive informational and instrumental support was that the externalizations of progress were not always clear to supporters, and students did not always accurately articulate obstacles. Furthermore, even when supporters gave substantive instrumental or informational support, students did not always heed this social support, decreasing supporters’ motivation to provide social support. In addition, both students and supporters reported hesitancy communicating with strangers, perhaps impeding a greater amount of help-seeking and giving.

### 4.4 General Discussion

This project explored the potential of online communities to provide social support to motivate students in real-world, project-based learning environments. Our needfinding study asked: (RQ1) *Do students in PBL environments working on real world problems receive sufficient social*
support to sustain persistence? We found that, given the large orchestration burden on the peer instructor facilitating the PBL environments, students did not feel that they received sufficient social support. Unfortunately, this was compounded by the fact that students did not explicitly ask for help or spontaneously externalize their progress so that instructors and coaches could provide appropriate social support. Our needfinding corroborates that expected challenges of real-world project-based learning [Solomon 2003] did indeed arise in a PBL environment.

Based on the needs identified in our needfinding, Study Two then asked: (RQ2) How might we design a technical system that initiates externalizing team's progress prompt online social support, and how does this in turn motivate students to make progress? The CheerOn system was intended to enlist outside supporters to provide cheers as a way to highlight progress and increase persistence. The system successfully elicited social support that positively impacted students, but often in unexpected ways. First, CheerOn facilitated social support not just from recruited supporters, but also from the peer instructor and professional coaches for whom the system offered another channel by which to perform their roles of monitoring and supporting teams. Second, CheerOn stand posts elicited instrumental support from supporters through externalizing problems. Third, appraisal support did not provide much of an extrinsic reward, sometimes increased self-efficacy, and more importantly, increased the perceived value of the project, especially when from an unfamiliar external supporter. Fourth, by connecting students to external supporters, students built bonds to the larger design community, which they reported increased their likelihood of explicitly seeking help (unlike the needfinding).

Of course, there is also room for improvement. The system was not designed to specifically address many of the factors that influenced supporters to provide the right kind of
social support. Specifically, the system was not designed to influence social facilitation (peer pressure) amongst supporters, consistently make student help needs and progress clear to supporters, or sufficiently encourage students to thank or show how they heeded assistance, all factors that influence whether supporters provide social support. Thus, accounting for our findings related to the way users experienced CheerOn and “designing the user experience” to allow a greater feeling of appreciation could be of use to improve this system in the future [Forlizzi et al. 2000, pg. 419; Zimmerman et al. 2007].

Nevertheless, these findings point towards a clear difference between how to design online communities for blended PBL environments. Whereas “likes” and “barnstars” can serve as effective extrinsic incentives in communities such as Facebook and Wikipedia [Restivo and Rjit 2012; Burke et al. 2009; Scissors et al. 2016], these are not effective strategies for blended learning community platforms where participants have very different needs and relations to supporters. In the social media and peer production platforms described in related research [Restivo and Rjit 2012; Burke et al. 2009; Scissors et al. 2016], participants do not have difficulty making contributions such as posting pictures or making edits—the problem is simply to increase activity on the platform by incentivizing them to do so, often through public recognition. In PBL however, students’ greatest needs concern ambiguity about whether their offline work is succeeding, how to work more successfully, and overcoming the motivational challenges associated with real-world project work [Blumenfeld et al. 1991]. Therefore, online social support communities for PBL need to instead focus on helping students see the value of their work to a larger community, help them surface problems so that supporters provide
substantive assistance, and demonstrate that supporters are eager for students to ask for help (online or offline).

4.5 Design Implications

The needs of PBL environments suggest that social support communities for blended PBL would do better to utilize external supporters within online communities to assist in offering social support for students, as opposed to encouraging social recognition as an extrinsic incentive as in other online communities.

We propose that the system should engage students in intrinsically motivating practices that externalize progress to an online community of supporters (which students will not do through explicit help-seeking) who are then likely to provide social support. It is also important for such platforms to apply a principle of educing requests, in which the system should engage students in intrinsically motivating practices whose side effect is to externalize progress to an online community of external supporters so that they offer assistance, thus overcoming students’ initial aversion to help-seeking to crowdsource help-giving. The implications of these findings extend beyond the PBL context to provide social support for others experiencing trying experiences where social support is helpful—from medical patients and families in need of social support as they go through a trying operation, to entrepreneurs running stressful crowdfunding campaigns, political candidates in need of social support to endure challenging elections, individuals in need of social support as they work through addictions, or individuals working on stressful projects in a company in need of social support, to name a few.

These studies provide a grounded causal model explaining the mechanisms by which blended PBL environments communities can “jump-start” help-seeking. While newcomers show
initial reluctance to surface problems and seek help [Argyris 1974], indirectly surfacing problems to external supporters through stands prompted support to provide assistance. This help-giving built bonds-based commitments to the larger community which, in turn, facilitated explicit help-seeking. The model also bridges HCI and Learning Sciences literature by showing where we can apply well-researched CSCW principles for promoting online contributions [Kraut et al. 2012] and well-researched LS principles for scaffolding more substantive feedback and learning. The process model of social support, and analysis of remaining obstacles from Study Two, point to a number of specific design recommendations (Table 8). Based on this model, a principle of educating help-requests, how might we redesign the online social support system?

<table>
<thead>
<tr>
<th>Need</th>
<th>Rationale from Study Two</th>
<th>Feature</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Distribute orchestration burden</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 Distribute coaching</td>
<td>Study Two found that leads and coaches provided a great deal of assistance.</td>
<td>Recruiting coaches - Reframe supporters task as coaching rather than offering social support and focus efforts on recruiting coaches.</td>
</tr>
<tr>
<td>2 Reduce orchestration burden of prompting</td>
<td>System required manual prompting by manager and found some supporters cheered infrequently.</td>
<td>Automated management - Rather than have community manager track and remind supporters, could automatically track and prompt. Escalate to manager only when prompts fail.</td>
</tr>
<tr>
<td>(b) Community-based social support</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 Highlight support network to teams</td>
<td>Students were motivated by being part of community.</td>
<td>Highlight network - show students larger community and network supporters and connect teams working on similar topics.</td>
</tr>
<tr>
<td>4 Highlight support given to teams</td>
<td>The quantity of social support increased the perceived value of the student’s project.</td>
<td>Highlight social support - highlight cumulative number of followers and cheers.</td>
</tr>
<tr>
<td>5 Facilitate bonds</td>
<td>Lack of familiarity hindered help-seeking and social support.</td>
<td>Supporter matchmaking - match supporters and teams by interest and facilitate more extensive introductions and discussion perhaps through face-to-face or video meeting.</td>
</tr>
<tr>
<td>(c) Externalize help needs to supporters</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6 Externalize progress</td>
<td>Supporters didn’t understand what progress students were making and thus could not give feedback on progress.</td>
<td>Stand goals - expand stands to also externalize current goals, tasks completed and tasks remaining to give better indications of progress.</td>
</tr>
<tr>
<td>7 Externalize help</td>
<td>Supporters didn’t understand what help</td>
<td>Stand obstacles - expand stand by requiring</td>
</tr>
</tbody>
</table>
help needs: students needed and students would not always surface obstacles in stands.

8 Externalize affect: Students valued messages that “it will be OK” but only communicate anxiety face-to-face. (d) Encourage supporters to provide online social support

9 Increase perceived bonds-based commitment: Expertise, identification to community, and impact on teams all increase contributions, but supporters sometimes did not perceive these factors. Highlight bonds - highlight personal factors in prompts to provide support, remind supporters of their expertise, their connection to the design community, and their impact on teams.

10 Increase social facilitation (peer pressure): Supporters more likely to provide social support when they see other supporters providing support. Highlight social facilitation - highlight other’s social support using prompts to provide support, show leaderboard of supporters.

11 Increasing thanks: Supporters more likely to provide social support when teams heed their advice. Prompt gratitude and appreciation - prompt/scaffold teams to thank supporters.

(e) Shift from vague appraisal support to more specific instrumental or informational support

12 Scaffold value. Facilitate face-to-face help: Supporters and teams both wanted more substantive social support beyond cheers, which research indicates promotes greater learning and progress. Prompt substantive assistance - rather than simply scaffold cheers, scaffold supporters to also convey: the value of project; feedback on task, process and regulation; that on track and not to worry; offers of help; and need for clarification.

Table 8. Design Recommendations from CheerOn: Proposed features to improve usability of an online social support system based on the needs and rationales found in Study Two related to (a) distributing the orchestration burden, (b) providing community-based social support, (c) externalizing student help needs, (d) encouraging supporters to provide social support, and (e) increasing guidance for supporters related to how to give specific social support.

4.5.1 Distribute orchestration burden (features 1-2, Table 8). Online communities of external supporters promise to reduce the orchestration burden of PBL environments [Mergendoller and Thomas 2005; Dillenbourg and Jermann 2011]. Research in CSCL and CHI has shown that help can be distributed to other peers in the community within online learning communities [Bruckman 2006; Kizilcec and Schneider 2015], but less is understood about how this might work within a blended learning context and the effects of calling on specific people to support throughout a research project. This study shows that PBL classes can utilize external supports to distribute the instructors’ task of providing social support. However, given the amount of social
support provided by those who assume instructional responsibility (leads, coaches, and managers) community managers may do better to reframe the supporters’ role to that of assistant coaches and perhaps even focus effort on recruiting experienced coaches. The amount of social support provided by coaches implies that even a small number of online assistant coaches could result in greater amount of social support. Program alumnae might fulfill this role well. For example, the studio lead suggested that senior undergraduate leaders in the design network see their role as curating teams’ experience and seek greater interaction with teams, and online coaching provided a desirable channel for them to carry out this role. In this study, managers’ reminders seemed to be sufficient to encourage recruited supporters to provide social support, so future systems might automate this prompting to reduce the orchestration burden on PBL teachers. This includes tracking which supporters do not provide social support and surfacing social loafing to the manager only when automated prompting fails.

4.5.2. Community-based Social Support (features 3-5, Table 8). CSCW research suggests that familiarity increases contribution within online communities and that people tend to relate and connect with others similar to them online [Bachrach et al. 2012; Sosik et al. 2014]. Our findings build on this work suggesting that connecting PBL students to external supporters requires drawing on people with related interests and a sense of project familiarity. Teams described the importance of getting social support from a larger community of people with similar interests. This might be enhanced by better visualizing the network of external supporters to teams; highlighting the cumulative amount of support provided by the network; facilitating bonds-based commitments (familiarity) between individual students and supporters; by facilitating a more extensive introduction process; and perhaps by matchmaking between
teams and recruited supporters. Perceiving the network and identity- and bonds-based connections to the network all positively affected social support and persistence and the system could highlight these factors to more quickly impact teams.

4.5.3. **Externalize help needs to supporters (features 6-8, Table 8).** Students and supporters desired more substantive social support (such as the sorts of feedback known to enhance performance and learning), but supporters were unable to understand enough about teams’ current status to provide that support. Past research suggests that externalizing specific questions can help students initiate answers [Klemmer and Carroll 2014; Sawyer 2005; 2008], but this can be difficult in PBL settings when students are unsure of how to ask or have difficulty publicly saying that they need help. We found that with relatively small modifications, the system could externalize more useful information to supporters. This should include externalizing: high-level goals; tasks completed and remaining show progress; clearer descriptions of obstacles by asking students to explain progress; and surfacing teams affective state to indicate when morale boosts are needed.

4.5.4. **Encourage supporters to provide online social support (features 9-11, Table 8).** Supporters are more likely to provide social support when they see that they have relevant expertise, identify with the larger community and understand the positive impact on teams. Past research in CSCW suggests that interaction between users online can decrease over time and many users never interact, thus some sort of prompting or notification is important as a reminder [Viswanath et al. 2009; Resnick 2001]. In addition, research suggests that users contribute more within online communities when they feel that they can uniquely help others within a community [Ling et al. 2005]. We found that supporters could easily be reminded of these factors when they
were prompted to provide social support via e-mail and when they realized that students needed their unique expertise. Likewise, supporters were also more likely to provide social support when they saw others providing online social support, which could be increased by displaying leaderboards of top supporters. More importantly, supporters were influenced by teams that heeded their advice, so it is important for the system to also prompt teams to thank supporters the same way that supporters are prompted to provide support.

4.5.5. Shift nonspecific online social support to substantive informational and instrumental support (feature 12, Table 8). Students and supporters desired to receive and give more substantive informational and instrumental social support (such as the sort of feedback known to enhance performance and learning) so it is important to allow and scaffold social support beyond nonspecific appraisal support comments such as “Good job.” Research suggests that it’s hard to give honest and good feedback [Miller et al. 2005], yet we found that creating more specific prompts conveying the value of project; feedback on task, process and regulation; that are on track and not to worry; offers of help; and need for clarification can help to increase more honest and specific social support.

This research helps to build our understanding of how to design features within socio-technical systems that prompt external supporters to offer social support to PBL students. These features can be applied to building social support systems for workers and users of all kinds. This research also shows how online communities can provide emotional support for students that can help to foster feelings of psychological safety [Edmondson 1999]. The findings provide evidence for the fact that social support online can help to prompt feelings of safety and the perception that one is able to take risks and thus ask for help.
4.6 Limitations & Future Work

This research provides an exploratory, comparative case study of how we might design hybrid online/offline communities to provide social support to build self-efficacy, impacting persistence and ultimately progress. However, given that we found through *CheerOn* that students still had difficulty sharing vulnerabilities and help needs to online groups of supporters (as found in Study One for those working on crowdfunding platforms), future work should address whether individual online mentors might facilitate more specific and personalized social support than crowds or groups. In addition, future work could address how shared reflection on progress might elicit more vulnerable sharing between pairs to lead to more personalized social support. A related issue concerns students’ reactions to praise. Hattie [2007] shows us that nonspecific praise is not helpful for learning, but research also suggests that the need to feel a sense of social support and belonging from others is critical to persistence [Baumeister et al 1995].

The intervention presented in Study Two also relied on researchers to manually track supporters’ participation and prompt them to provide social support. While this did not take an exorbitant amount of time (approximately two hours for recruitment, four and a half hours sending email reminders over six weeks), this time must be reduced sufficiently so the cost of managing the community is worth the benefits that social support provides in orchestrating and motivating students. In addition, researchers contributed to upward of 35% of comments within the CheerOn tool, suggesting that more support will need to be prompted by external supporters. Fortunately, most of this prompting can be automated and future field trials should test whether this sufficiently reduces the teacher’s orchestration burden. Furthermore, researchers participating in the intervention by helping provide social support is an additional limitation of
this study. We chose this method as it allowed us to ensure that students received sufficient social support according to our hypotheses. This is a common method for participatory action research (PAR), where research is a collaborative, participatory process that requires involvement from the community of interest as well as the researchers [Walker 1993]. Furthermore, within intentionally designed learning environments, instructors and teaching assistants (TA’s) will always be working behind the scenes, similar to a community manager. Thus we felt that this approach is less of a concern than if this were a purely voluntary online community (where even there, the manager is often doing work to encourage participation). In addition, as we were conducting the research, we were in the context. Therefore we felt that it could have been even more polluting to the results not to comment as it might have been viewed as tacit disapproval of the system and of giving social support. Additionally, we believed it to be more natural and realistic than students receiving support from artificial sources, such as Mechanical Turk workers [Deeflets et al 2015].

Finally, as described in the design implications section, future work should explore how to better externalize newcomer progress and obstacles and how to scaffold more substantive social support, such motivating investigation in shared reflection in pairs online to prompt more substantive social support (Study Three). Nevertheless, this study provides an important starting point in exploring these interactions in hybrid communities that value both design and learning.

**Summary:** Providing sufficient social support to students in real-world project-based learning environments places a significant orchestration burden on instructors and is hindered by students’ reluctance to seek help. However, this research suggests we may be able to use online communities to create blended learning environments where students interact with an external
online community to provide social support for offline project work. This research shows that we can design such online communities in which external supporters conveyed the value of students' work to a larger community through appraisal support and facilitate PBL student help-seeking and a stronger sense of identity in the community through emotional, instrumental, and informational support messages. We can create these communities by applying a principle of educating help-requests and recruiting a local community of supporters to offer online social support. Blended coaching platforms for social support lowers the bar for instructors, coaches, and supporters to provide social support; elicit informational support by surfacing problems to supporters; motivate teams by showing the value of their work to a larger community; and build social bonds that encourage explicit help-seeking within the community. Such blended PBL communities have broad applications across higher education as well as any professional context in which innovators must improve their processes to solve real-world problems.
5. CHAPTER FIVE: ONLINE PAIRED SUPPORT FOR NEWCOMERS IN CORPORATIONS VIA PAIRACHUTE (STUDY THREE)

Study Three builds on the findings from Studies One and Two to help increase giving more substantive online social support for newcomers to build their self-efficacy through paired reflection on progress and learning. We identified in Studies One and Two that help-seeking and sharing vulnerabilities can be difficult for newcomers with crowds and groups, thus we designed Study Three to examine whether being paired with a mentor online would make it easier for newcomers to seek help and share vulnerabilities online. We hypothesized that reflecting with a partner would help to facilitate deeper reflection than reflecting in groups, given the benefits and ability for increased depth in paired reflection on newcomer self-efficacy [Anseel, Lievens, and Schollaert 2009]. We also hypothesized that connecting online would increase check-in frequency between pairs, given the busyness of work schedules and geographical distance between pairs [Jossi 1997, Jokisaari & Nurmi 2009].

As such, this study sought to increase the social support given to newcomers through pairing with a mentor to reflect online at a time when they have lowest self-efficacy and feel less identity within an organization [Scott & Bruce 1994; Gerber 2011, Fisher 1985; Meister et al 2014]. We investigated how facilitating reflection between pairs might initiate contact to increase the social support and help-seeking of newcomers in order to build their self-efficacy. To do so we first conducted a needfinding study with 22 newcomers, 18 mentors, and two HR staff in a corporate mentorship program to examine what key challenges newcomers in mentorship programs faced and to develop a baseline. We focused on a corporate mentorship program as it allowed us to examine how mentorship took place in more formal setting where
staff are paid, in comparison to the informal environments we studied in Study 1 (crowdfunding) and Study 2 (informal project-based learning) where supporters are not formally paid staff but informal, voluntary supporters. We conducted a needfinding study to create a baseline of the key challenges that newcomers in the Tech Co. corporate mentorship program faced. We sought to compare our findings from our Literature Review suggesting that newcomers in teams have low self-efficacy and have difficulty receiving sufficient social support, to assess if this was the case for newcomers at Tech Co. Next, we drew from our findings -- in CheerOn, suggesting that vulnerably asking for help online and offering genuine online social support from online groups is difficult, as well as our needfinding at Tech Co. suggesting that newcomers lack getting the support they need upon entering and don’t know who to ask for help -- to develop a prototype of Pairachute, a tool designed to facilitate online social support for newcomers, and conducted user testing with 15 participants in a lab setting of the prototype. Finally, we revised the Pairachute design based on our lab testing findings and tested the revised system with 100 participants in a corporate mentorship program at a medium size technology firm in the Midwest. Participants were placed in one of three conditions (solo, paired, and control conditions). We found that user’s online social support and online help-seeking was infrequent via Pairachute, however we found that when pairs externalized their progress, they increased the likelihood of getting offline social support. While we cannot make causal claims, these findings help to increase our understanding of how technology can be used as a mediator, or a tool to help notify and remind mentors on when and how to give social support, to newcomers. We draw practical design implications from this work, as well as an increased understanding of the possibilities and limitations of facilitating online social support.
5.1 Problem & Background

As discussed in the literature review (Chapter 2), newcomers are critical to the advancement of organizations and society at large [Bessant 2003; Hansen & Levine 2008; Kraut et al., 2009]. However, newcomers often struggle to ask for help when they join new organizations as they have low self-efficacy given their lack of experience, expertise, and identity within a new organization [Scott & Bruce 1994; Gerber 2011, Gerber et al. 2012; Fisher 1985; Meister et al 2014]. Historically, organizations have relied on interventions such as face-to-face peer mentorship programs to build newcomers’ self-efficacy during their onboarding experience [Ostroff & Kozlowski 1993; Bandura 1977]. These programs were informed by an extensive 40 years of empirical research on the role of social support and reflection on growth and learning in building newcomers’ self-efficacy leading to performance and persistence [Bandura 1977; Krajcik & Shin 2014, Blumenfeld et al 1991, Stefano et al. 2014; van den Boom et al. 2007; Dunlap 2005; Kogurt & Zander 1992]. While offline mentorship programs are shown to be effective in supporting self-efficacy development, mentors find them difficult to sustain due to their lack of time beyond day to day activities [Jossi 1997, Jokisaari & Nurmi 2009] and human resource (HR) managers find them difficult to properly support and monitor mentorship pairs to know how frequently they are meeting and who needs social support [Meister 2013]. Furthermore, since newcomers have trouble asking for help, mentors struggle to know when and how to support [Van Maanen et al. 1979].

Socio-technical systems that integrate offline with online interactions [Orlikowski 2000, Leonardi & Barley 2008] offer a possible approach that demands less time and effort from mentors and HR staff -- given that mentorship programs are difficult to monitor, support, and
sustain offline and online platforms have the potential to allow people to connect quickly across geographical distance as well as receive training online around how to give social support [Meister 2013]. Initial research suggests that when newcomers publicly post goals and progress online, others can more easily and quickly provide feedback [Klemmer & Carroll 2014; Harburg et al. 2015]. However, questions remain around how to help newcomers feel the support is genuine when they do not know their mentor, as well as how mentors can know newcomers need help when they are not sharing goals and progress.

As the literature review for this dissertation (Chapter Two) examined, the process of reflection, or purposeful thinking oriented toward a goal, can have an impact on newcomer self-efficacy, ultimately impacting performance [Dewey 1933; Stefano et al. 2014]. Reflection typically involves identifying underlying values, beliefs, assumptions and allowing people to see that they can impact a situation by the way they frame and act on it [Marsick & Matbia 2009]. Research found that when newcomers reflected on their progress toward their project goals, their self-efficacy increased and they changed their perception of their potential professional abilities [Dunlap 2005]. Reflection on progress and learning goals can also help to improve the articulation and codification of past experiences on a task, influencing how workers interpret work difficulty [Kogurt & Zander 1992]. Newcomers who see difficulty as normal can help to increase their sense of resilience and persistence, impacting self-efficacy [Oyserman, Destin, & Novin 2015; Fisher & Oyserman 2017]. Stefano et al. [2014] found that having users reflect on two key learnings each day throughout a training increased self-efficacy and performance on learning assessment tests at the end of the training. The results of reflection on key learnings were found to be more powerful in building self-efficacy and increasing learning than having
additional skills training [Stefano et al. 2014]. In addition, research showed that when newcomers were given feedback on past performance through reflection with a peer or instructor they showed increased levels of self-efficacy [Anseel, Lievens, and Schollaert 2009]. Furthermore, research found that reflecting on progress combined with feedback from peers and tutors helped to build self-efficacy through helping build perception of being self-regulated, or feeling in control of one’s self and able to monitor and motivate a set course of action [Bandura 1991, van den Boom et al. 2007]. To our knowledge, nothing has been done specifically with mentorship pairs reflecting on a tool for corporate mentorship programs to date.

Despite its benefits, offline reflection is an effortful action that takes time and purposeful effort or guidance to do effectively [Harri-Augstein & Thomas, 1991]. For example, it requires asking the right thoughtful questions to prompt deep replies, as well as the resources including the right materials and sufficient time to step away to reflect. In addition, reflecting with a pair offline can be difficult due to busy schedules or geographically distant partners. Thus, building a technical intervention that guides workers through the process of reflection, as well as one that allows asynchronous communication between pairs, could be incredibly beneficial to improve the mentorship progress and likelihood of offering online or offline social support.

Online reflection systems, such as online journaling, peer reflection, and instant messaging have begun to address some of the challenges that offline reflection systems face including allowing for increased guidance, reminders, and increased abilities for asynchronous reflection [Hawkes and Romiszowski 2000; King 2002]. However, reflection technology can present possible issues of privacy and willingness to be vulnerable in an online setting [Ensher et al. 2003]. For example, users can feel that they are being tracked or have a feeling of permanence
with their comments online. Thus, finding ways to promote comfort, privacy, and safety in such online environments is critical. In addition, online reflection systems can make it difficult for participants to pick up nonverbal cues, information about members’ presence, self-image, attitudes, moods, actions, and reactions [Short, Williams, & Christie 1976]. The consequence for this is that newcomers fail to get the social support that they need when entering new organizations. Finally, as examined in the literature in Chapter Two, while research suggests that offline reflection can help to boost self-efficacy [Dunlap 2005, Stefano et al. 2014], it is less clear how reflecting with a partner online might impact the exchange of offline or online social support, and how this in turn might impact self-efficacy.

As such this research seeks to examine: How does externalizing progress and learning through reflection online with a partner influence the frequency of online social support newcomers receive and what impact does this have on their self-efficacy? To do so, we ask the following three research questions:

1. **RQ1 (Needfinding):** What key challenges do corporate mentorship programs face in sufficiently providing social support to increase the self-efficacy of newcomers?

2. **RQ2 (System Design & Lab Test):** How might we design a socio-technical system that facilitates online social support from mentors to build self-efficacy in newcomers?

3. **RQ3 (Field Test):** How does online paired reflection with mentors via Pairachute influence the online social support newcomers receive when entering new corporations, and how does it in turn impact newcomer self-efficacy?

To answer these questions, we first confirmed and expanded upon the literature through a needfinding study with 26 newcomers, 19 mentors, and 2 human resource managers at a mid-size technology innovation company in the Midwest. We conducted a needfinding study to better understanding and create a baseline of the key challenges that newcomers in the Tech Co. corporate mentorship program faced. Similar to what was expected, we found that: (1)
newcomers have difficulty navigating social dynamics, seeking help, and revealing vulnerability; (2) busyness and/or geographic distance lead to infrequent check-ins between newcomers and their mentors; and (3) lack of mentor training lead to insufficient social support provided for newcomers. Drawing from these findings and Study One and Two described in earlier chapters, we developed the following design argument: To design an online system that supports social support and reflection to foster self-efficacy for newcomers, systems must: (1) increase ease of help-seeking through use of reflection prompts to facilitate check-ins -- given the difficulty that newcomers have asking for help, (2) increase ease of giving social support by guiding mentors on how to provide social support -- given that mentors lack training in mentorship and don’t always know how to provide proper social support, (3) mutually share vulnerabilities and build trust between mentors and newcomers to increase ability to share vulnerably -- given that newcomers can have difficulty sharing vulnerabilities due to imposter’s syndrome and lack of connectedness with mentor, and (4) show check-in frequency to help HR managers know when to support -- given that HR staff often don’t know when to step in and who is in need of greater support.

Using this design argument, we developed Pairachute, an online system to support newcomers through facilitated paired reflection with peer mentors. We first conducted lab testing of the low fidelity Pairachute prototype with 15 users in a lab to inform key design features. Next, we built a working Pairachute system that facilitates reflection and social support between pairs. We conducted a field test with 100 newcomers and mentors assigned through a corporate mentorship program to assess the effectiveness of the tool based on how participants responded when placed in one of three conditions (paired reflection, solo reflection, and no reflection or
control). We selected these three conditions as it allowed us to understand the effects of using the tool with another person compared to reflecting alone and its impact on self-efficacy. The paired condition allowed us to see how users engaged with Pairachute while being prompted to use it for reflection in pairs. The solo condition allowed us to see how users engaged in Pairachute while being prompted to use it for reflection alone. This solo condition allowed us to assess if reflection alone helped build self-efficacy, or if doing so in pairs was more helpful in building self-efficacy. The control condition allowed us to see what happened to those who didn’t use the tool as a comparison.

We found that Pairachute did not facilitate significantly more online social support from mentors compared to the control and solo conditions, nor did it facilitate significantly more online help-seeking from newcomers in the control and solo conditions. Furthermore, changes in self-efficacy were not significantly different from those using Pairachute in comparison to those in the control and solo conditions. Through interviews, we found that the following factors discouraged some pairs from using the tool (in order of most prevalent to least prevalent): (a) existing offline social support from mentor, (b) existing offline mentorship program participation, (c) partner’s level of participation on Pairachute, (d) keeping Pairachute notifications turned on, and (e) perception of Pairachute prompts as either too broad or repetitive. However, we found that Pairachute was useful for prompting some offline check-ins between some newcomers and mentors, as well for helping some mentors know when newcomers needed more support through externalizing reflections on progress. For newcomers in these pairs, Pairachute helped to build a sense of self-efficacy that was less visible for those in the solo and control conditions. In addition, Pairachute provided a space for some pairs to share
learnings and progress, which was particularly helpful for some newcomers to better understand the roles of their mentors and build a sense of self-efficacy around their work expectations in comparison to the control and solo conditions. We found in the solo condition that most newcomers and mentors reported rarely using the tool as they did not feel social pressure to do so, however some who replied on the tool gave more personal replies on Pairachute as they felt that they were alone. In addition, some users noted how the notifications in the app reminded them to take time to pause and reflect. Participants in the control condition reported meeting only if they happened to run into one another in the office, whereas pairs geographically far relatively met unless they had already established meetings.

This research contributes a novel system and revised design argument for designing online socio-technical systems to build newcomers’ self-efficacy to improve performance. This research also helps us better understand how deploy a new socio-technical system for social support within the context of corporate mentorship programs, and the impact that this can have on newcomer self-efficacy. Additionally, this research contributes a more nuanced understanding of the ways in which newcomers lack social support and provides insight into the challenges of help-seeking and existing workplace mentorship systems and how we might increase newcomer self-efficacy through increasing access to mentorship support [Bandura 1977; Nelson-Le Gall 1981; Klemmer & Caroll 2014]. We also contribute an increased understanding of some of the limitations of socio-technical systems for promoting reflection and social support. The research also uniquely explores the way in which socio-technical systems can foster some social support through facilitating paired reflection between mentors and mentees via Pairachute, which can help to build self-efficacy in newcomers and reduce managers’ efforts to monitor and sustain
important mentoring programs [House 1983; Rees Lewis et al. 2015; Harburg et al. 2013; Klemmer & Caroll 2014].

5.2 Needfinding

As with Studies One and Two, we began Study Three by conducting a needfinding study to create a baseline of the key challenges that newcomers in the Tech Co. corporate mentorship program faced. We sought to compare our findings from our Literature Review suggesting that newcomers in teams have low self-efficacy and have difficulty receiving sufficient social support, to assess if this was also the case for newcomers at Tech Co. Given the strength of their mentorship program where all newcomers received mentors as an active HR manager paired them and newcomers were conscious of the organization’s desire for them to be supported, we were not sure if they experienced the same problems. We followed a design research process as it allowed us to examine the roots of the problem – or the challenge of providing social support to newcomers and their challenge asking for help – in order to build a more effective design [Easterday et al. 2014]. This process involved drawing on past research and conducting an exploratory needfinding study with newcomers, peer mentors, and HR managers to understand key challenges for newcomers in the onboarding process. Using these insights, we designed and tested a prototype of the Pairachute system before building a fully functioning design what we tested in the field.

5.2.1 Methods

Field Site: We conducted our needfinding study at a software development consulting company (referred to as “Tech Co” in this paper to protect participant privacy) headquartered in
the Midwest. Tech Co has office locations in eight major U.S. Cities, with collaboration and mentorship across offices. The company was founded in 2007 and has approximately 300 employees, 100 of which came from a merger that the company had in 2016. The gender ratio at the company is approximately 30% female and 70% male, consistent with averages across the tech industry. At the time of our testing the company was preparing for and completed a large merger with another web development consulting firm. The new company did not have an active mentorship program and planned to merge with the mentorship program at Tech Co upon entering the merger. Tech Co has an active mentorship program where newcomers are placed with more experiences team members who mentor them upon entering the firm to answer their questions. Mentorship pairs are sent an e-mail introducing one another and are encouraged to meet at least once during the first week of the newcomer’s time at the company but no training is given for mentors. Mentors in the same city are connected in the introduction meeting, while those geographically separated often never meet unless one pair travels to the same city of their mentorship pair. We chose our field site as a partner for this research for the following reasons: (1) the company was hiring a large number of newcomers during a short amount of time so that we could test the tool more rapidly, (2) the company was doing technical innovation work that required a high degree of self-efficacy, and (3) the company had an active mentorship program for newcomers and was willing to test Pairachute with their employees and the HR staff wanted to see how the program could be improved, which meant that we could test the tool on their mentorship program and assess the differences with and without using Pairachute.

Participants: We conducted needfinding interviews with 22 newcomers, 18 mentors, and 2 HR managers. We recruited participants through the HR manager of the mentorship program
who sent us the names and emails of participants who were involved in the corporate mentorship program, either as newcomers or mentors. The HR director picked pairs based on whether they had previous experience working together at another company or whether they were on a similar team doing similar work. We were connected with participants who were geographically located in the same office as their pair, as well as participants working in different locations from their partners to understand the impact of geographical distance.

**Protocol:** We conducted 30 minute needfinding interviews in person and by phone. We began each interview with written or verbal consent from the participant followed by open-ended questions about mentorship and specific questions about key challenges. Interviews were audio recorded and notes were transcribed during and after the interview – approximately 30 pages of transcribed notes were collected from the interviews.

**Analysis:** For data analysis, we used inductive coding methods to understand how to design a socio-technical system that provides social support to newcomers in a corporate mentorship program [Miles & Huberman, 1994]. To do so, we examined the data collected from the needfinding interviews to assess what patterns or structures emerged related to promoting self-efficacy for newcomers and the role mentors played. We ensured we had collected when we saw the same themes reoccurring from subsequent interviews and had reached data saturation.

### 5.2.2 Results

Our needfinding investigation sought to answer (RQ1): *What key challenges do corporate mentorship programs face in sufficiently providing social support to increase the self-efficacy of newcomers?* Consistent with our past research, the three most frequently reported include: (1) newcomers have many questions but struggle with revealing vulnerabilities and seeking help, (2)
time constraints and geographic distance lead to infrequent check-ins between newcomers and the mentors assigned to support them, and (3) lack of peer mentor training and monitoring lead to insufficient social support provided for newcomers. We discuss implications of the findings for the design of social support systems for newcomers as they enter new corporations.

**1) Difficult for newcomers to navigate social dynamics, seek help, and reveal vulnerability.** Newcomers have many questions related to their role, organizational processes, culture, and new technology. As one newcomer explained that one week after he started: “I would say most of the questions have been around my role.” Another newcomer explained the confusion around organization processes. “You feel lost when you first get here... it can be confusing... even just the way we work on projects- team makeup, how things are staffed, there is a lot to learn...” In addition to question about roles and processes, newcomers expressed challenges of adopting new technologies: “We have so many disparate systems here... So I find myself really confused about what to do.” Another questioned, “Do you use Skype? When do I use Yammer versus Slack versus email?”

More broadly, newcomers were often confused about the organizational culture. One newcomer said he wondered: “What’s the culture? How do people interact?” Newcomers had many questions upon entering Tech Co related to their organizational culture. One newcomer working on software development at Tech Co compared the novelty she felt entering the company equivalent to learning to drive a car for the first time. As she said about learning the new organizational culture at Tech Co., “I feel like I’m learning to drive a car for the first time again... things flying everywhere. But you’ve just got to go.” Many newcomers expresses this
sentiment of feeling overwhelmed upon entering Tech Co and trying to navigate so many new dynamics.

To complicate the many questions newcomers faced, some newcomers expressed not wanting to ask for help. As one newcomer stated in response to why they asked few questions of their mentor: “I don’t want to bug people.” Another newcomer stated that they did not ask for help because they wanted to seem that they were fully capable. As he said, “It’s hard when you’re new, you want to see that you can hold your own.” In addition, some newcomers did not want to ask for help lest they bother their mentor or, worse, seem incapable. As another newcomer said: “I would say most of the time it’s hard to find help, hard to go up to someone and say – ‘Hey, can you help me?’ You can find the person is busy or not in the mood.” In sun, newcomers expressed hesitancy to ask for help given that they did not want to bother or showcase their own need for help.

We also found that newcomers reported feeling lower self-efficacy when entering the company. One newcomer in a higher position stated, “I worried ‘Can I do this job? Am I qualified? I’ve read that it’s something that women do. Men don’t do this as much – there was the deep down in the night: Can I do this? This company wants people to be successful… It’s more of the imposters syndrome.” Another newcomer commented on his low self-efficacy when he entered: “I see a lack of confidence [in newcomers]. It happened to me when I came here… There is this sense of ‘Man, there are really smart people. I hope I do well and fit in.’ That was my thought.” Newcomers said they refrained from asking for help because they struggled with social comparison and feelings of belonging. Thus, newcomers would benefit from a system that
helps ease the help-seeking and sharing process break down barriers between newcomers and their mentors so as to increase social support and build newcomer self-efficacy.

(2) Busyness of mentors: Our needfinding revealed that it can be difficult for newcomers to get sufficient social support given the busyness of the corporate environment and the time demands on employees. Many mentors noted how they are often unavailable to be present to support their mentees because they were paid for their client hours at work and had busy schedules. As one mentor stated: “I’m never at my desk anymore.” Yet even when mentor/mentee pairs were at their desks, checking was still difficult. As one HR manager stated, “I think some people get caught up in what they have to do so they forget to check in.” She later suggested that it would be helpful to make check-ins more automated: “It would be nice to remind people or like some way of automatically checking in with people. Making sure that they are talking, or sending specific reminder that there is a social event coming up, make sure to introduce them to people.” Thus, creating a system that helps to facilitate more frequent check-ins between newcomers and their mentors would be helpful.

(3) Geographical distance between newcomers and peer mentors. Some mentor pairs noted how geographic distance makes communication between mentor pairs less frequent. As one mentor said: “[Mentoring] is harder when it’s cross geography- we’re also not particularly good about communicating... I feel that I’m not doing as much as I can. It’s geo.” Another mentor commented on how geographical distance between mentor and mentee pairs can lead to less frequent check-ins: “You can pick up [communication] when you are closer in proximity, someone mentions something, ... it puts more of a burden on the person to bring it to you.” This mentor noted how being closer in proximity can help force greater likeliness of checking in due
to feeling some peer pressure to respond when running into one another in the hall. One mentor noted how geographical distance led her to together need to check-in with her newcomer, in comparison than those working in the same office who naturally run into one another and feel peer pressure to check in. As she stated: “If the mentor is offsite, distance is a challenge - out of sight out of mind.” She noted how not being able to run into her newcomer or see them in the hallways, led her to forget her need to check in together.

(3) Lack of training mentors and monitoring pairs mentorship. Our needfinding also revealed that even within an active mentorship program, it can be difficult for mentors to know when or how is best to offer social support. Many mentors said that they were unsure when to check in, as they were unsure of the needs of their newcomer as well as what kind of social support they needed to give. One of the HR staff members expressed a similar concern: “I’m not sure everyone knows how to be a [mentor].” She went on to note that some mentors are more naturally empathetic and better coaches: “I think some people are more empathic than others in anticipating what people feel.” She later noted that she would love to have some way to evaluate if mentors are doing an adequate job, as she currently is often left guessing what her newcomer is feeling given that her newcomer rarely shares. This implies the need for a system that helps guide mentors of all personality types to be more effective through externalizing newcomer states and needs.

HR managers reported difficulty of knowing the frequency of mentor and newcomer pair check-ins. As one HR manager stated, “One of my challenges is making sure that these connections are happening... there’s no formal moderating, it’s usually just me walking around the office once a week and checking in with the new hires. I ask: ‘Did you check in?’” HR
Managers expressed a desire to better know which mentor pairs are checking in and when. As one HR manager stated, “We don’t know if they’re reaching out periodically... I would want to have insight of whether connections are being made, feel confident that some kind of interaction is happening, troubleshoot, ensure a more engaged onboarding.” HR managers noted that they could better support newcomers if they knew they were not being properly supported by their mentors and who needed additional help. As such, it would be helpful to have some way for HR to monitor engagement between mentors and newcomers, and help HR staff know when additional check-ins with newcomers are needed. This could help HR staff ensure that check-ins are taking place as well, encourage additional check-ins, as needed, etc.

Our needfinding study revealed three primary challenges for fostering social support and reflection to build self-efficacy in the Tech Co. environment including: (1) newcomers at Tech Co. have difficulty navigating new organizational dynamics, yet rarely seek help or express their vulnerability because they want to seem like that they know what they are doing; (2) mentors and newcomers at Tech Co. have difficulty finding time to connect due to busyness and geographic distance, particularly for pairs working in different offices, thus decreasing the likeliness of social support; and (3) mentors at Tech Co. expressed a lack of training on how to mentor and HR leaders expressed difficulty in knowing how frequently mentor pairs are checking in. Furthermore, our findings from Study One and Study Two in this dissertation helped to frame the need for a system that could help to prompt more personalized support, given that receiving social support from crowds and groups was quite impersonal.
5.3 System Design & Lab Test

Through systems design and lab testing, we asked (RQ2): **How might we design a socio-technical system that facilitates online social support from mentors to build self-efficacy in newcomers?** To answer this research question, we drew on learnings from the needfinding study to develop a design argument and key supporting design features. Incorporating these design features and key learnings, we built the *Pairachute* prototype, which we tested with 15 pairs in a lab setting. We incorporated the feedback to build the working *Pairachute* mobile system for testing in the field.

(a) Design Argument & Features

Inspired by the challenges identified in the needfinding, we developed the following design argument: **To design an online system that supports online social support and reflection to foster self-efficacy for newcomers, systems should:** (1) increase ease of online help-seeking through use of prompts to reveal needs for newcomers, given that it is easier to reveal challenge when it feels normal [Holland 2009], (2) increase ease of giving online social support by training mentors how to coach, given that coaches need help knowing how to give support and online instructions can help guide [Morris et al. 2010], (3) share mutual vulnerabilities and build shared bonds between mentors and newcomers, given that mutual sharing can help to build bonds, trust [Coppola et al. 2004], and (4) show check-in frequency to managers to help identify pairs that are not checking in together and in need of support, given showcasing status can help to make more dependable King et al 2006]. Below we outline the specific system features to support the design argument for the online social support system for newcomers:
1. **Reflection Prompts (Bi-Weekly):** Users are sent bi-weekly reflection prompts where they are asked to reflect on their present state (Ex: “Reflect on one task, project, or relationship that you made progress on yesterday. What did you learn from this experience?”) This question was rooted in research suggesting reflecting on progress and learning can help to boost self-efficacy [Bandura 1981, Stefano et al. 2016]. Both newcomers and mentors were encouraged to answer the reflection prompt to foster mutual sharing in order to promote vulnerability and prompt help-seeking or help-giving.

2. **Prompt Chatting:** Users can respond to prompts or message freely in the chat window section of the Pairachute system. This was intended to allow for more vulnerable and honest communication between pairs. Users are also able to select from suggested replies to help aid in the comment process, and can also give a thumbs up for a quick reply.

3. **Notification Reminders:** Users are both sent a push notification at 9:15am on Tuesdays and Thursdays to respond to the reflection prompt. We chose 9:15am as the HR staff recommended it as a time when people are more settled at work and are getting ready for their day, and thus may have more time to look at their phone. We chose Tuesday and Thursday as they are both days in the week when staff are usually at work and we felt that the frequency would allow for biweekly check-ins. If they do not wish to answer at that time as they were busy or unable to use their phone, they can *snooze* the reminder and it will be sent again at 12:15pm given that it’s a little bit after the most common lunch time and when many are sitting down and have time to look at their phone.
4. **User Profiles:** Users create a profile with their e-mail address, password, and profile photo. This was intended to help the chat to feel more personal by seeing a photo, and more secure through having a safe self-created password.

5. **Meeting Requests:** Users can request in-person meetings via the “*Want to get coffee?*” button where they can then set up a time to meet and get coffee. We used this prompt to facilitate a more easy process of checking in and setting up time to informally meet. In addition, the culture at the company also often had coffee breaks.

6. **Check-In Metrics:** Users are shown how many times they connected with others. This data is also shared with managers so they are aware of how often users are interacting. This is intended to help build accountability and commitment between pairs [Nelson-Le Gall 1981].

Before investing time in extensive coding, we first developed a web prototype using the AxShare prototyping software (see Figure 7) where we outlined the key design features and system flow of the *Pairachute* design based on our design arguments. This design allowed users to test out: (1) receiving a notification reminder, (2) swiping the notification to answer the reflection prompt, (3) giving a thumbs up or response to the user based on their answer, and (4) setting up a time to meet for coffee. Users were asked a variety of questions related to reflecting on their mood and feelings in the organization.
Figure 7. Pairachute Prototype used for Lab Testing: To test an early version of the Pairachute prototype, users were asked to answer the prompt and send a coffee request to meet in person. The design allowed users to: (1) receive a notification reminder to reflect and give social support, (2) swipe in to answer the reflection prompt and build self-efficacy through reflecting on learning and progress, (3) give a thumbs up or response to the user based on their answer to give social support, and (4) set up a time to meet to facilitate offline social support (ordered left to right).

We developed our AxShare prototype for lab testing drawing on our key learnings in the needfinding analysis and the key design challenges we observed through coding interviews at Tech Co. Each of these challenges and resulting design characteristics and features are outlined below in Table 9.

<table>
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<tr>
<th>Design Challenges from Needfinding at Tech Co.</th>
<th>Design Characteristics</th>
<th>Design Features</th>
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| (1) Newcomers enter with many questions and low self-efficacy, have trouble asking for help and revealing vulnerabilities because they want to preserve their reputation and seem knowledgeable | - **Externalize help-needs to increase ease of help-seeking** [Bransford et al. 2000].  
- **Build shared bonds to build comfort and increase communication and normalize help-seeking to support and increase self-efficacy** [Bierema 1996]. | ➔ Reflection Prompts that encourage reflection on progress and learning [Morris et al. 2010]. ➔ Encourage mutual sharing of reflection to build trust and normalize help-seeking [Kale & Singh 2007]. |
| (2) Busyness and geographic distance lead to infrequent check-ins between newcomers and their mentors, decreasing likelihood of social support and ultimately negatively impacting self-efficacy | - **Ease time-intensive nature of checking in and giving social support** [Nelson-Le Gall 1981].  
- **Help set up meetings for mentors with busy schedules** [Nelson-Le Gall 1981]. | ➔ Allow for quick check-ins by phone via Pairachute and facilitate ease of setting up coffee meetings  
➔ Create notification reminders to remind newcomers and mentors to check in, allow snoozing to later times to increase likeliness of |
(3) Lack of mentor social support from mentors leads to less frequent possibility of social support for newcomers, impacting their self-efficacy

- **Train mentors and scaffold mentorship process** [Kram & Isabella 1985].
- **Help mentors see what state newcomers are in through externalizing their progress** [Holland 2009].
- **Guide mentors in how to give social support** [Restivo, M. & van de Rijt 2012]
- **Facilitate reflection prompts that externalize newcomer challenges** [Harburg et al. 2015].

Table 9. **Pairachute Design Argument & Features:** The design challenges that emerged from the needfinding study helped us to build a design argument and proposed design features for the Pairachute system.

### 5.4 Usability Lab Test

#### 5.4.1 Methods

We tested the initial Pairachute prototype with 15 participants in a lab setting to understand their experience using the system. Participants were selected given their experience working as newcomers and as more experienced workers in tech firms (ex: healthcare, computer software, interface design) and asked to focus on their newcomer perspective throughout the duration of the interview. Our lab testing involved a combination of interview questions followed by prototype testing using a talk-aloud, with more pointed questions about the prototype afterwards. All interviews lasted approximately 30 minutes and were video recorded. Interviews involved a combination of prototype testing and follow-up interview questions on the design and ease of use. We began each interview with participants signing a consent form and then being asked background interview questions related to their work experiences as newcomers and more experienced tech workers to understand their background and what experiences impacted them as newcomers for approximately ten minutes. Next, users were shown an online prototype of
Pairachute and asked to do a talk-aloud while testing out the prototype [Suh et al. 1993]. Before beginning, the users were shown a short talk-aloud video demonstration so they understood the process. After the talk-aloud testing, users were then asked a few follow-up questions about the tool related to the usability of the system (ex: notification reminders, reflection prompts, and metrics sketches for showing progress to pairs and HR staff) and asked for any suggestions they had for improved design and usability (using an “I like, I wish, I want” exercise where they identified featured they desired to stay the same and change, which we followed up with “Why?” to inquire into to their reasoning). For data analysis, we used inductive coding methods to examine what key themes emerged from the interviews and prototype testing [Miles & Huberman, 1994]. We video recorded all sessions and transcribed the notes from that data, which totaled over 45 pages of notes. We analyzed the data with three coders and assessed common these key themes to shape the revised Design Implications for the Pairachute tool used in Field Testing. We stopped collecting additional data when we saw the same key themes merging and had reached saturation.

5.4.2 Usability Lab Test Results

We found that: (a) participants were comfortable answering prompts but worried about sharing vulnerable reflections online with others in the company, (b) participants did not consistently engage deeply with reflections due to not feeling comfortable sharing via the tool, (c) participants desired other ways to show support beyond offering to meet for coffee because they might be working remotely or need other suggestions on input to give, and (d) participants requested reminders of when to respond and that their partner had answered a prompt to help them feel that their partner was also engaged and motivate themselves to also engage. Below we
outline each of these findings and then suggest how the system was revised based on these findings.

*(a) Difficulty sharing vulnerable reflection.* Our findings revealed that users were worried about sharing vulnerable answers with people they were not familiar with, particularly those above them at the company. For example, one user said: “I’m not comfortable saying “I’m [this emotion] -- I’m happy to update on progress or status, but not that [prompt].”” Users expressed it being easier to answer the prompt if they knew their partner well, as well as if the person was of a similar rank rather than being their boss or superior. They also noted that they were not always sure who they were answering the prompt with and if their answer was being tracked or read by others online. One newcomer stated that they were not clear who was in the chat window or if it was their partner alone: “I don’t know who I’m chatting with.” This response prompted our need to give increased clarity that only their partner was in the chat and all answers would be kept confidential. Given this need to know who one is paired with and to feel greater safety sharing, we need to design for increased feelings of safety and connection between pairs. To do so, we propose increasing the possibility for vulnerable reflection and help-seeking through the incorporation of the following design features: explicitly stating via the chat window who is in the chat and that answers are confidential, shared and mutual reflection to encourage both users respond and be vulnerable together, question prompts around learning and growth to help build mutual support and self-efficacy, as well as social support prompts to help facilitate encouragement after sharing.

*(b) Need for prompts to stir deeper reflection.* Users were concerned that the prompts would not encourage deep reflection. As one user said: “I think I ended up summarizing
something in a fairly vague way - not sure if it really precipitated deep reflection - though maybe I would keep thinking about it after sending the message and get somewhere deeper.” This newcomer felt that they could do better in answering the prompt after thought later on, but the current answer they gave was very vague. In many ways this is the intended outcome, but it also implies the need for questions that prompt reflection and the chance to continually reflect with a partner over time. In addition, allowing users to answer when they are ready prompted our “snooze” feature, to allow greater flexibility in response time.

(c) Need for guidance on how to give online social support. Users wanted a way to express support beyond the thumbs up or meeting for coffee as it did not feel entirely genuine. They also wanted to better know how to effectively support their partner. As one user stated how nonverbal cues are harder online: “How do you notice when people are frustrated [via an app]? Some people just sigh loudly or curse, so it’s obvious - you need to ask what’s going on, specifically if you can help them.” Users expressed a desire to know how their hypothetical partner was doing and thus how they could better support them. As one user stated: “I would like to know their mood and would try to be prepared for the in-person meeting.” We found that they desired to use the tool as a way to know how their partner was feeling and how to support them and also desired guidance on ways to better support them. From these learnings, we propose greater guidance in the app through the form of stickers with suggested social support comments to expand beyond a thumbs up or coffee message, to facilitate other messages of online social support [House 1981].

(d) Need to be reminded and encouraged to share. Users also expressed a concern that their partner may not respond to the prompt, triggering evaluation apprehension, and so they
would wait until their partner responded first. We found in our preliminary testing that if one user responded and their partner did not then they stopped answering for future prompts because they felt that they were alone on the app. Users in the lab testing expressed a similar concern. Thus, we suggested increased reminders to share to facilitate greater comfort for the newcomer. Furthermore, we suggested increased guidance on how to use the tool to increase likeliness and ease of use.

### 5.5 Design Implications

Our findings provided a few important design implications for building an improved system including: (a) need for increased connection to be vulnerable, (b) need for stronger prompt to stir reflection, (c) need for increased guidance on how to properly provide online social support, and (d) need for reminders of when to respond and that partner has answered prompt. Given these learnings from our needfinding study and usability lab test we proposed four key revisions in the Pairachute system to improve the design and likely use of the system. The design implications are outlined in Table 10 below:

<table>
<thead>
<tr>
<th>Lab Testing Challenges</th>
<th>Revised Design Argument</th>
<th>Revised Design Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Pairs have trouble sharing vulnerabilities when don’t know one another</td>
<td>Increasing feelings of safety and connection between pairs can help to increase help-seeking and offering social support [Sameh et al 2012].</td>
<td>Mutual sharing, profiles, questions that initiate learning and growth.</td>
</tr>
<tr>
<td>(b) Pairs did not share deeply in replies given prompt</td>
<td>Asking questions that prompt reflection learning and growth can help to build self-efficacy and prompt social support [Halfaker et al. 2014].</td>
<td>Reflection prompt asking question to reflect on learning and growth (ex: Reflect on one project, task, or relationship you made progress on this week. What did you learn from this experience?)</td>
</tr>
<tr>
<td>(c) Pairs need better guidance on how to provide online social support</td>
<td>Guidance on how to support can help to build feelings of self-efficacy and psychological safety, to further promote help-seeking [Mehrotra et al 2016].</td>
<td>Stickers to help send more specific social support messages.</td>
</tr>
<tr>
<td>(d) Pairs need to be reminded and encouraged to</td>
<td>Reminders to share and also when partners have commented can help to encourage users to engage with the</td>
<td>Snooze and reminder notifications to encourage users to engage with the</td>
</tr>
</tbody>
</table>
Table 10. *Pairachute Revised Design Argument and Features*: Our lab testing helped us develop a revised design argument for the *Pairachute* system.

5.6 Revised System & Field Test

5.6.1 Revised Design

Drawing on these findings from the Lab Test we modified the *Pairachute* design to create an improved system to support newcomers, as exemplified in Figure 8. To so, we added the design features of (1) profile photos in the chat window -- given that pairs had trouble feeling close to one another via the tool as it did not feel personal, (2) reflection prompt encouraging reflection on deeper learning and growth -- given that pairs did not feel that the prompt was personal, (3) social support stickers to aid in offering social support and follow-up -- given that pairs desired better guidance on how to give social support, (4) reminder notifications to encourage answering -- given that pairs needed to be reminded to use the tool. Overall, these findings contribute to our understanding of how to build social support systems for newcomers.

*Figure 8. Revised Pairachute Design for Field Test*: The revised *Pairachute* system allows users to sign in and pair with their assigned partner at Tech Co. The pairs are then sent biweekly reflection prompts and encouraged to give social support via the suggested messages in order to help build self-efficacy and to increase persistence and progress. The pairs do not receive
anything from the offline mentorship program besides a preliminary note that they have been paired and with basic expectations for engagement.

5.6.2 Hypotheses

To understand how mentorship pairs engaged in *Pairachute* in the real world, we conducted a field test. The field test would help us to know how people actually engaged with the tool on a day-to-day basis outside of a lab. In this field test, we asked (RQ3): *How does online paired reflection with mentors via Pairachute influence the online social support newcomers receive when entering new corporations, and how does it in turn impact newcomer self-efficacy?* Our three hypotheses included:

1. **Hypothesis 1 (Social Support):** Externalizing paired reflection on progress and learning as well as online social support suggestion prompts will help to facilitate online social support for newcomers via *Pairachute* and help to build newcomer self-efficacy. Hypothesis 1 is motivated by literature suggesting that reflection can help to showcase one’s present state between pairs and increase vulnerability, prompting social support [Boud 1999]. In addition, our learnings from Studies One and Two suggest that externalizing progress can help to facilitate instrumental, emotional, informational, and appraisal support [Harburg et at 2015]. Thus we hypothesize that externalizing reflection on progress and learning in pairs can help to increase the quantity of online social support of all four kinds given to newcomers, impacting their self-efficacy.

2. **Hypothesis 2 (Help-Seeking):** *Pairachute* use in pairs will facilitate newcomer online help-seeking (in comparison to online help-seeking in the solo condition) as the pairs will
feel more online social support from their partner via *Pairachute*, impacting their self-efficacy and increasing communication through shared online reflection.

Hypothesis 2 is motivated by literature suggesting that mutual sharing can increase comfort and likeliness to seek help [Coppola et al. 2004; Bierema 1996]. In addition, studies one and two taught us that externalizing progress online can prompt some online help-seeking [Klemmer & Carroll 2014; Harburg et al. 2015]. Thus we anticipate that sharing between pairs could allow for an even more comfortable setting for online help-seeking in comparison to doing so offline.

3. **Hypothesis 3 (Self-Efficacy):** *Pairachute* reflections on progress and learning for the solo and pair conditions will help to build self-efficacy at work, ultimately impacting their performance.

Hypothesis 3 is motivated by self-efficacy literature suggesting that reflecting on progress and growth can help to increase self-efficacy, impacting performance [Dewey 1933; Stefano et al. 2014]. Thus we hypothesize that online reflections twice a week will help to increase self-efficacy in newcomers.

5.6.3 **Field Test Methods**

To assess the impact of *Pairachute* in a real-world setting [Czerwonka 2006], we partnered again with the mid-size tech company in the Midwest to test out the effectiveness of tool with 100 employees. Below we outline the key details of the field study.

*Field Site:* As discussed in the needfinding analysis, we ran our study with a software development consulting company (referred to as “Tech Co” in this paper to protect participant privacy) headquartered in the Midwest. The details on company size and organizational composition are all described above in the Needfinding methods (5.2.1).
Participants: Our criteria for selecting newcomers for the study was open to those who had been at the company for two weeks or less, given that they were brand new at the company and most novice. Most enrolled in the study during their first week of work. Prior to testing, the company sent us emails of all pairs to allow us to connect in with mentors and newcomers. The HR staff made mentorship pairs at Tech Co based on trying to connect people who had past experience working together at other companies or who were on the same time. We recruited study participants on a rolling basis, given that only a few employees were hired every few weeks. In total we were able to run our test with 100 participants (50 newcomers and 50 mentors) at Tech Co over a period of seven months. 33.8% of our participants were female and 63.9% of our participants were male. Of our 50 newcomers in the study, 27.5% were female and 72.5% were male. Of our 50 mentors in the study, 40% were female and 55% were male. The age of participants ranged between 21 and 51 years old. These numbers were representative sample of the company.

Conditions: Pairs were placed randomly in one of three conditions for testing: (1) Paired Condition, where users could engage in Pairachute reflection and chat via Pairachute in pairs alongside all mentorship program activities at Tech Co; (2) Solo Condition, where users could engage in Pairachute reflection alone and have ability to chat via Pairachute in pairs alongside all mentorship program activities at Tech Co, and (3) Control Condition, users were not given the Pairachute system to use in their mentorship process, but did participate in any mentorship program activities at Tech Co. We selected these three conditions as it allowed us to understand the effects of using the tool with another person compared to reflecting alone and its impact on self-efficacy. We also sought to compare our findings to what we found in past literature related
to the impact of reflecting alone on progress on self-efficacy and comparing this to what happens when reflecting alone. The paired condition allowed us to see how users engaged in the Pairachute while being prompted to use it for reflection in pairs. The solo condition allowed us to see how users engaged in the Pairachute while being prompted to use it for reflection alone. This solo condition allowed us to assess if reflection alone helped build self-efficacy, or if doing so in pairs was more helpful in building self-efficacy. The control condition allowed us to see what happened to those who didn’t use the tool as a comparison. In total we ran our study with 21 mentor/newcomer pairs in the paired condition (n = 42 participants), 20 pairs (n = 40 participants) in the solo condition, and nine pairs (n = 18 participants) in the control condition. We had nine pairs in the control condition as we were given a limited number of pairs to recruit and felt that we needed at least 20 pairs in each of the testing conditions. While not an extremely large sample size, these numbers helped us to understand what general patterns emerged across conditions.

**Protocol:** To begin the field test, we first conducted 30-minute pre-interviews with willing participants, with 56% yield of participants. Participants were then left for six-weeks to use the tool (or not, if in the control condition). Participants using the tool were sent notifications on their phones from Pairachute twice a week at 9:15am stating: “Reflect on one task, project, or relationship you made progress on yesterday. What did you learn from this experience?” Participants were sent a text notification message on their phones from Pairachute as soon as this came in and soon as their partner reflected or sent a chat.

**Data Collection:** We had three major points of data collection for this study: (1) pre and post interviews, (2) log data of Pairachute use, and (3) pre and post surveys.
(1) Pre and Post Interviews: At the beginning and conclusion of the six-week study, we conducted 30-minute interviews with some mentors and newcomers separately to hear about their experiences using the tool or in the mentorship program generally. Our questions involved asking background questions about the participant and conducting a pre-survey that asked questions around self-efficacy, perceived social support, as well as organizational commitment and resilience. All interviews were audio recorded and transcribed. In total, 45 single-spaced pages were transcribed for pre-interviews and 38 single-spaced pages were transcribed for post-interviews. We asked all 100 study participants to conduct pre and post interviews, but only 56 of the 100 participants were willing to have pre-interviews and 28 of the 100 participants were willing to conduct post-interviews. This was in part due to the fact that the participants at Tech Co work for billable hour and thus had limited time. Some participants were also unsure of the program and did not know if the research e-mail that came to them was legitimate. This lack of data presented some limitations to our study and demonstrated the clear need to establish new protocol for participant engagement as we continue with this research moving forward, as referenced in the Limitations and Future Work section.

We conducted pre-interviews with 47 participants: 28 newcomers and 21 mentors. For the paired condition, we conducted post-interviews with 18 newcomers and 16 mentors. For the solo condition, we conducted post-interviews with five newcomers and three mentors. For the control condition, we conducted post-interviews with five newcomers and two mentors.

We conducted post-interviews with 25 participants, 14 newcomers, and 11 mentors. For the paired condition, we conducted post-interviews with 11 newcomers and 10 mentors. For the
solo condition, we conducted post-interviews with 3 newcomers and 5 mentors. For the control condition, we conducted post-interviews with 3 newcomers and 3 mentors.

(2) Log Data: All messaging exchanges via Pairachute were logged and analyzed to understand how the tool was used between mentors and newcomers. This included frequency, word count, and content exchanged between users. In total 117 messages were exchanged on Pairachute, which is far lower than expected given that if participants used the tool as expected (two reflections per week per participant over six weeks), each participant would have sent at least 12 messages over six weeks, or 744 messages over six weeks for 62 participants (in solo and paired conditions). 82.9% of the messages (97 out of 117) were written by participants in the paired condition, 8.5% in the solo condition (10 out of 117) and none in the control conditions (as expected) as participants did not engage with the tool. The longest message was 140 words and the shortest was one emoji. 59% of the messages were in reply to a reflection prompt and 41% of messages were chat messages between partners.

(3) Pre & Post Surveys: Participants took pre- and post-surveys to gauge any changes in self-efficacy, perceived social support, help-seeking, as well as organizational commitment and resilience. We conducted pre-surveys with 29 participants (15 newcomers and 14 mentors) and post-surveys with 42 participants (29 newcomers and 11 mentors). In total, we had only six newcomers and three mentors who completed both pre and post surveys in the paired condition; two newcomers and two mentors who completed both pre and post surveys in the solo condition; and two newcomers and two mentors who completed both pre and post surveys in the control condition.
Data Analysis: For data analysis, we again used inductive coding methods to understand what key themes emerged [Miles & Huberman, 1994]. We grouped our themes around our hypotheses and topics that came up most consistently in the realm of social support, help-seeking, and self-efficacy. The common themes helped us to gauge the effectiveness of the tool and areas of concern, which informed our revised Design Implications. We also analyzed the log data for frequency, word count, time sent of messages, and content exchanged between users. Pre- and post-surveys were collected and analyzed to examine key differences in scores between users in different conditions. Means and standard deviations were calculated to examine the effects across conditions.

5.6.4 Field Test Findings

In this field study we sought to answer (RQ3): How does online paired reflection with mentors via Pairachute influence the online social support newcomers receive when entering new corporations, and how does it in turn impact newcomer self-efficacy? We hypothesized that Pairachute reflections on progress and learning as well as social support suggestions would help to (H1) facilitate online social support for newcomers, (H2) increase newcomer online help-seeking, and (H3) build the self-efficacy of newcomers to increase their resilience and progress. However, we found that Pairachute reflections on progress and learning as well as social support suggestions: (F1) did not facilitate online social support for newcomers but the prompts reminded some participants of their partners and facilitated offline social support, (F2) did not increase newcomer online help-seeking but the responses to prompts helped some mentors see what their partner was struggling with and understand the duration of their difficulty which facilitated offline help-giving, and (F3) did not significantly increase the self-efficacy and
performance of newcomers, *but did allow pairs to showcase their progress and learnings to one another to increase knowledge-sharing compared to the solo and control conditions*. The revised causal model below (Figure 10) highlights these findings from our field test. We see that while we hypothesized that Pairachute would impact online social support and online help-seeking, it was more helpful in facilitating offline social support and offline help-giving. In the findings section below we outline these findings by showcasing the evidence from the log data, interview data, and survey data.

**Figure 10: Pairachute Findings Revised Causal Model:** We found that *Pairachute* reflections on progress and learning as well as online social support suggestions did not help to facilitate significant online social support, online help-seeking, and or self-efficacy for newcomers. However, *Pairachute* notifications reminded mentors of their newcomers and facilitated offline social support (F1), increased mentor’s awareness of existing blockers for newcomers which facilitated offline help-giving (F2), and increased knowledge-sharing between mentors and newcomers (F3).

(1) *Impact of Pairachute on Online Social Support*
We hypothesized that externalizing paired reflection on progress, learning and social support suggestion prompts would help to facilitate online social support for newcomers via Pairachute. Through our log data we found that externalizing paired reflection on progress and learning as well as social support suggestion prompts did not drive significant online social support for newcomers via Pairachute. Through interviews, we found that the following factors discouraged pairs from using the tool (in order of most prevalent to least prevalent): (a) existing offline contact between pairs, (b) lack of participation in established corporate mentorship program, (c) partner’s participation on Pairachute, (d) active Pairachute notifications, and (e) perception of Pairachute prompt as either too broad or repetitive. However, our interviews also revealed that the online Pairachute notifications helped to remind some pairs of the need to check in with the other, and prompted mentors to reach out to newcomers to give offline social support. Our survey data showed slightly higher ratings of perceived social support for solo and control conditions, but larger sample size is needed to determine significance.

(A) Online Social Support Was Minimal: Our log data demonstrated that participants in the paired and solo conditions rarely used or gave social support through Pairachute. The few social support messages logged from mentors to newcomers (ex: “The work you are doing is important!” or other comments that fit into the House 1981 definition of social support) were primarily emotional or appraisal support messages. To begin, we found that engagement on the Pairachute tool was low for the paired and solo

![Figure 11. Comments Distributed per Pair on Pairachute](image)
We found that Pairachute participants in the paired condition participated more than those in the solo condition. The highest pair connected 12 times over the six-week period, while the lowest connected only once.
conditions. Pairachute prompted pairs to reflect and respond to each other’s reflection twice a week for the six-week deployment. If participants used the tool as expected, each partner would have sent at least 12 messages, or 24 messages per pair. Instead we observed that the average number of messages over the six-week deployment for 21 pairs of the paired condition was 5.71 messages, with a (SD = 6.84 messages). Seven of the 21 pairs in the paired condition engaged with Pairachute only once and then disengaged. 10 out of 21 pairs that used Pairachute exchanged more than three message total, while only three out of 21 pairs exchanged more than 10 messages total collectively on Pairachute. For a pair, the highest number of messages exchanged in the paired condition over the six-week deployment was 22 messages, which is two less than the expected 24 messages (assuming communication 2 times/week).

The solo condition was even less active on Pairachute than those in the paired condition. Only three of the 20 pairs in the solo condition (which had solo reflection space and a chat between pairs) exchanged any chat messages on Pairachute. The highest number of messages exchanged for a pair in the solo condition was seven messages exchanged and the other two pairs exchanged messages only once. The average number of messages over the six-week deployment for pairs in the solo condition was 1.6 messages (SD = 3.05 messages) which is lower than the average 5.7 messages (SD = 6.84) during the six-week deployment for the 17 pairs in the paired condition.

Mentors and newcomers in the paired condition on Pairachute sent roughly the same number of messages. We found that mentors in the paired condition who sent at least one message on Pairachute (n=10) sent an average of 4.5 messages (SD = 3.2 messages) or .8 messages per week over the six-week deployment. Newcomers in the paired condition who sent
more than one message on *Pairachute* (n=11) sent an average of 4.3 messages (SD = 4.03 messages) or .7 messages per week over the six-week deployment. Newcomers initiated the first conversation more often than mentors on *Pairachute*. Newcomers in the paired condition initiated the first prompts 10 out of 16 (62.5%) pair conversation, and mentors initiated the first prompt 6 out of 16 (37.5%) pair conversations.

We found that the most popular time to post on *Pairachute* was in the morning, followed by the evening, and lastly, during the day. Through our log data we found that 47 of the 91 messages (47%) were posted in the morning before noon, 30 of the 91 messages (33%) were posted in the evening after 5pm, and 14 of the 91 messages (15.4%) were posted in the afternoon between noon and 5pm. The reflection prompt was sent at 9:15am on Tuesdays and Thursdays.

Mentors in the paired and solo conditions rarely gave online social support to their newcomers on *Pairachute*. The 10 active mentors in the paired condition sent an average of 1.5 (SD = 1.59 messages) of original online social support messages (ex: a personalized social support comment that fit into the House 1981 definition of social support, ex: “Here if you want to talk.”) via *Pairachute* and 0.3 of prepared social support stickers (preprogrammed social support message, as described in Design Features section, ex: “The work you’re doing is important!”) to their newcomers during the six-week test. The 11 active newcomers in the paired condition sent an average of 1.27 social support messages (SD = 1.61 messages), and the 11 active newcomers sent an average of 0.4 social support stickers to their mentors during the six week test. We found that the most common types of social support given on *Pairachute* were appraisal support (14/28 of the social support messages were appraisal, or 50%) and emotional support (9/28 of the social support messages were emotional, or 32.1%). Some participants gave
online appraisal support through validating past actions and progress. For example, one mentor wrote to his newcomer on Pairachute: "I learned that Git doesn't play nice and it may even hate you. But you got past it." This mentor used Pairachute to give online appraisal support validating his newcomer’s persistence to push through difficulty. Some participants expressed online emotional support by recognizing and expressing appreciation for their partner on Pairachute. For example, one newcomer in the paired condition reflected in the Pairachute chat with his mentor: "Had issues setting up the right environments to work between MAC and windows. You [mentor] helped me navigate to find the right solutions. Your input was crucial in moving forward with my day." The newcomer recognized his mentor through this post and the way he had helped him overcome setback. These illustrations provide two examples of when Pairachute was effectively used to facilitate online social support, though the instances of these interactions were rare in our field test.

We found that participants in the solo condition sent even fewer online social support messages via Pairachute than those in the paired condition. Only one of the five mentors sent a social support message, and one sent a social support sticker over the six-week deployment. Similarly, one of six active (based on using Pairachute more than once) newcomers in the solo condition sent one social support message to their mentors over the six-week deployment and one social support sticker. We found that newcomers and mentors sent similar number of messages expressing social support to each other. However we did have some members in the solo condition suggest that while they didn’t answer the reflection questions, the prompts led them to take a few moments to reflect on their own. As one mentor said, “It [the Pairachute reflection prompt notification] does kind of make you think for a minute. That part is valuable
just having a little ping to reflect for a moment … It would pop up and I would think how has this week been going to the week before, more generally but for a moment it would stop the rat race and think.” This mentor noted that while Pairachute in the solo condition did not prompt online reflection for them, in did prompt some offline reflection.

(B) Online Social Support Interview Data: While our log data revealed behavioral use of Pairachute, the data we collected through semi-structured interviews help to explain participant utilization of Pairachute. Through interviews we found that participants did not engage with Pairachute to the extent we expected when (in order of prevalence): (a) the pairs were already meeting in-person or located in the same office, (b) the mentor or newcomer’s partner did not participate on the tool, (c) the pairs did not participate in the mentorship program actively, (d) the mentor or newcomer turned notifications off by choice, or (e) the mentor or newcomer found the prompt overly broad and repetitive. Positively, we found that pairs used Pairachute when: (a) they could not meet in-person and were not working in the same office, (b) their partner participated on the tool, (c) their partner participated in the mentorship program, (d) they had progress to reflect on, and (e) they were signed on to the tool with notifications turned on. While Pairachute did not effectively promote online social support, interview data suggest that did help remind and prompt some mentors and newcomers (mentors more consistently) to check in together offline.

We found the following factors impacted Pairachute use for participants in both the paired and solo conditions:

1. **Existing offline contact between mentors and newcomers impacted Pairachute use.** We found that pairs in the paired and control conditions were more likely to use Pairachute
when they were not in the office together and working from client sites. 9 of the 21 paired and solo participants interviewed (42.9%) said they used Pairachute more frequently when they were out of the office to check in with their partner from afar than when they were near each other in person. One newcomer noted how Pairachute was more helpful when he and his mentor were working in different locations and on different projects during the week. As he stated: “[I used it most when] we’re not hanging out at the office, so not communicating as much when we’re off site and working on totally different projects." On the other hand, nine of the 17 interview participants (52.9%) in the paired condition noted that they didn’t use Pairachute when they were already meeting with their partner or seeing them offline. Another newcomer expressed a similar sentiment: “The main problem [of using Pairachute] was that we are in the same office so I didn’t get the chance to use this very much.” This newcomer noted that seeing one another frequently in person decreased their perceived need to check in via Pairachute online.

2. **Existing offline social support from mentors impacted Pairachute use.** We learned in interviews that some pairs who didn’t use Pairachute felt that they had sufficient offline social support. As one newcomer said about being located near his mentor: “I didn’t use it a ton ... because I was constantly in [physical] contact with [mentor], I could see [us using Pairachute] if there was more [physical] distance between us.” Other participants across conditions commented on meeting on an ad hoc basis if in the same office. As one newcomer stated: "He’s [my mentor has] been working on my project. I’m talking to him every day. No set meeting times, but we sit 10 feet from one another and say: how’s it going man? Do you need something?" In these cases, newcomers received offline social support naturally without the assistance of the Pairachute tool. Across all three
conditions, 10 out of 23 newcomers interviewed (43.5%) commented on receiving social support during regularly set up meetings with their mentors. On the other hand, eight out of the 23 of newcomers (38.4%) said that their mentor was too busy or unavailable to meet with them.

3. **Existing offline mentorship program participation impacted Pairachute use.** Four of 14 (28.6%) newcomers interviewed noted that they never connected with their mentor through *Pairachute* or any other channel after being paired. We did know from the needfinding study that it was common for some pairs to never connect. As one newcomer stated: "I haven’t needed to reach out to her... unless something else comes up but nothing has come up." Another mentor noted how he rarely heard from his newcomer, even after saying he was willing to help. As he said: “I’d get responses days or weeks later... I don’t know if people don’t need help or don’t know what they need.” These mentors noted how they were in infrequent contact with their partner and the pairs did not participate fully in the mentorship program.

4. **Partner’s participation on Pairachute impacted their partner’s engagement on Pairachute.** We found that participants were more likely to not participate or to stop participating if their partner didn’t respond. Seven of the 17 (41.2%) pairs engaged with *Pairachute* only once and then stopped using the tool when one partner didn’t reply. In interviews, four out of 21 (~19%) paired and solo participants said their partner never replied. As one newcomer said: “I posted twice and he didn’t even respond.” We found that when partners did not hear back from their partner after a few posts they stopped responding to prompts. This further validated their notion that their partner was not available for them.
5. **Presence of Pairachute notifications impacted some participant’s Pairachute use.**

Predictably, we found that some participants who were logged into Pairachute and kept their notifications turned on were more active on Pairachute than participants turned their notifications off: seven of 31 (22.6%) of participants interviewed from the paired and solo conditions commented on the notifications being a good reminder to use Pairachute. However, eight of the 31 (25.8%) of participants in the paired and solo conditions commented that they never turned their notifications on at the start of the test.

6. **Perception of prompt as broad and thus difficult to answer impacted Pairachute use.**

Another common reason participants stated for not using Pairachute was because the prompt felt too broad. A number of mentors and newcomers (8 out of 29 paired and solo participants, 24.1%) commented that the question were too broad. As one newcomer stated: “It [Pairachute reflection prompt] should be less open-ended... I think a more direct question would be more provoking. Currently [the Pairachute reflection question is] too broad. It doesn't feel like it’s trying very hard to pull stuff out of me.” Another newcomer shared this sentiment and suggested that more specific questions would make answering easier: “The questions were really general. I was almost expecting those questions to get more specific as you went on... If they were so specific that I could have an answer immediately in my head, but just when it’s so broad it’s hard to make the response actionable.” This newcomer noted how the broadness of the questions made it difficult for the Pairachute task to be easily done during the day. This points to a need that we highlight in future work for perhaps greater balance of lighter questions that build to more broad and in-depth questions once a relationship has developed.
Participant’s perception of prompt as too repetitive impacted Pairachute use. 8 out of 29 paired and solo interview participants (27.6%) commented on the prompt (Prompt: “Reflect on one project, task, or relationship you made progress on yesterday.”) feeling too repetitive when asked why they decided not to use the tool frequently. One mentor said that she disliked the repetitive nature of the questions as she felt that she was answering the same way over and over given that she was working on the same project for some time. As she said: “If I answer it, I will be saying the same things over and over. Because I’ve been working on the same project, sometimes tasks last a few days or weeks.” We found that the repetitive nature of the question led to the loss of novelty of the tool for some and decreased replies over time. As one newcomer remarked: "Early on I was kind of interested to see how this would work, what kind of an impact it may have, but as it continued it started feeling more like a chore, something you had to do, and that was mostly due to the monotonous nature of the questions… After a while it just becomes tedious - that gives me a chance to be lazy, then I just type things out quickly." The repetitive questions led some to take the questions less seriously with time. As he stated: “In the beginning I took the questions relatively literally, but after a while I just thought about it as a reminder to talk to him [my mentor] – and I’d then just take the question less seriously and then I typed in something quick... it seemed like a way to facilitate communication. So a status update seemed more on point.” This participant said that he took the questions less seriously on Pairachute due the redundancy in the prompts over time.

While engagement on Pairachute was lower than anticipated, we did find that there were a number of activities that Pairachute positively influenced. To begin, Pairachute notifications
reminded pairs to check in with their partners offline. Through interviews, we learned that *Pairachute* notifications helped to remind pairs to send a message online via *Pairachute* with their partners to arrange an offline meeting. Seven of the 21 (33.3%) newcomer and mentor interview participants in the paired condition said that *Pairachute* notifications reminded them to check-in with their partner offline -- between mentors and newcomers: five of 10 (50%) of the mentors interviewed said that *Pairachute* reminded them to check in with their newcomer and two of the 11 (18.2%) newcomers interviewed said it encouraged them to check in. As one mentor said, “*There were multiple times when it [Pairachute] led me to check in... It [Pairachute] kept us in touch and made me think ‘Oh I gotta ask him to lunch and know how he’s doing.’*” This mentor noted how seeing the reminder led him to send a chat message on *Pairachute* to his newcomer and set up a time to meet. A newcomer expressed a similar sentiment: “*There were a few times we’d schedule something after a prompt. It [Pairachute notifications] definitely led to me keeping in touch with him more and they led to a lunch at least once.*” From the notifications, seven of 29 participants (24.1%) said they set up their offline meetings with their partners via *Pairachute*. We don’t know if the rest were set up offline in person, or led to them to send an email.

Responses to *Pairachute* prompts provided conversation starters for offline meetings. Eight out of 15 (53.5%) mentors noted how the tool eased starting conversations with their newcomer. As this mentor stated, “*I’ve personally struggled with the mentor role in the past. I’m good with having meetings and making time, but it’s been a lot of ‘So what do you want to talk about.’ But that’s what I love about this, it’s [reflection prompts and replies are] a conversation starter.*” This mentor highlighted how he often had trouble thinking of questions to ask the
newcomer, and how the tool prompted discussion based on the replies of his newcomer. Users noted that the tool was helpful for initiating conversations and having questions to discuss together, despite the questions feeling repetitive. Another mentor noted how seeing his newcomer’s Pairachute replies helped him better understand his values and desires. As he said: “Reading his answers [to reflection prompts on Pairachute], it was good to know what he [newcomer] was working on. He’s been on one product this whole entire time it was nice to get some insight into if is he doing the work he wants to do, that he cares about, so that was nice and it led to in-depth conversation [about the project he was working on].” This mentor noted how seeing the progress helped lead to increased discussion between his newcomer and him offline.

While participants in the paired condition were able to converse through the tool together through shared reflections, there was little engagement between pairs in the solo condition. In fact, participants in the solo condition did not comment on offering online social support to their partner via Pairachute. One out of the three mentors (33%) that were interviewed from the solo condition said they gave online social support via Pairachute (which in this case was sending a social support sticker saying “I’m glad you’re here!” to their newcomer). Zero of the three mentors that were interviewed from the solo condition reported that Pairachute encouraged them to set-up a meeting offline. One mentor from the solo condition expressed that his newcomer did not ask him question offline or online via Pairachute. As he stated: "I actually rarely ever talk to him, he’s had little to no onboarding questions for me. When he does, he asks in person via a live convo [conversation], but typically it’s more about technical stuff. He dove right into projects that he’s on." While newcomers did not ask questions to their mentors, we did learn from newcomers that they did not know what questions to ask their mentor. As one newcomer stated
that she didn’t ask for help as she didn’t know if it would be relevant to their mentor: “I wasn’t sure if I had questions on my team and how would it be relevant to [my mentor].” This newcomer expressed not wanting to bother her mentor given that she was not sure if the questions would be relevant to them.

Some participants in the control condition (who didn’t use Pairachute) received offline social support, while others said that they received none. One of four of the newcomers (25%) interviewed from the control condition said that he were meeting offline with his mentors. Another one of the four newcomers interviewed said that his partner was too busy to meet and so he relied on his own ability to figure out how to solve the problem on his own. As he stated: "He’s (mentor) busy doing his thing. I have not relied on him much at all." This newcomer noted that he could not rely on his mentor due to his busyness. These divergent results could be in part also a result of pre-existing relationships between mentors and newcomers as well as level and age of the mentor. For example, we found that one pair in the control condition had been friends before joining Tech Co. and thus had a pre-existing relationship which increased their likeliness of meeting in person without a reminder. While other pairs had no pre-existing relationship or significant contact and never met throughout the six-week mentorship program. Further investing of different modes of communication outside of Pairachute and prior relationships would be helpful to examine this further, as discussed in Limitations and Future Work.

(C) Social Support Survey Data: Our newcomer pre and post surveys showed slightly higher scores in survey questions that relate to social support for solo and control conditions in comparison to the paired condition. Small sample size does not allow for testing of statistical
significance. Given the low sample size of participants who completed both pre and post surveys (six newcomers in paired, three newcomers in solo, and three newcomers in control), we could not draw conclusions about the survey data. However, as demonstrated in the table below, we saw slight gains in social support ratings between newcomers in the solo condition’s ratings around mentor reliance and helpfulness. Control condition participant’s ratings showed slight increases in all three social support questions. Newcomers who took both pre and post-surveys in the paired condition (n=six) showed little to no shift in average pre and post surveys related to perceived social support. Newcomers who took both pre and post-surveys in the solo condition (n=three) and control condition (n=three) showed slightly higher changes in perceived social support. On average, the paired newcomer participants rated social support as the same in their post surveys, participants in the solo condition rated slightly higher, and those in the control condition rated the highest change in perceived social support.

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<tr>
<td>1) My mentor is willing to listen to my work related problems.</td>
<td>6.5</td>
<td>6.5</td>
<td>6.5</td>
<td>6.5</td>
<td>4.5</td>
<td>6</td>
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<td>2) My mentor can be relied on when things get tough at work.</td>
<td>5.3</td>
<td>5.3</td>
<td>6</td>
<td>6.5</td>
<td>4.5</td>
<td>5.5</td>
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<tr>
<td>3) My mentor is helpful to me in getting my job done.</td>
<td>5.7</td>
<td>5.5</td>
<td>6.5</td>
<td>7</td>
<td>4</td>
<td>5.5</td>
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<tr>
<td>Averages of 1, 2, &amp; 3</td>
<td>5.8</td>
<td>5.8</td>
<td>6.3</td>
<td>6.7</td>
<td>4.3</td>
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Table 10: Changes in Pre and Post Social Support Surveys (for newcomers in paired, solo, and control conditions): Newcomers who took both pre and post-surveys in the paired condition (n=six) showed no shift in overall social support after the six-week deployment, while those with pre and post surveys in the solo condition (n=three) and the control condition (n=three) showed slightly higher changes in perceived social support on average.

(2) Impact on Online and Offline Help-Seeking
We hypothesized that *Pairachute* use in pairs would facilitate newcomer online help-seeking (in comparison to help-seeking in the solo and control conditions) as the paired reflection would increase online communication between pairs. We found from our log data that *Pairachute* use in pairs did not significantly increase newcomer online help-seeking relative to the solo and control conditions. If they chose to post, newcomers most frequently posted status updates to their partners. Our interviews revealed that this was in part because newcomers reported that they felt they were being monitored online, given that they knew they were a part of the research study. In addition we found that while newcomers did not ask for help online, *Pairachute* prompt responses did help some mentors see what repeated challenges newcomers reported struggling with and prompted more offline help-giving than the reported offline help-giving in the solo and control conditions (four out of the eight mentors, 50%, interviewed who participated in paired reflection). *Pairachute* also helped to provide a quick tool of communication for users to connect.

**(A) Help-seeking Log Data:** Our log data showed a low frequency of online help-seeking by newcomers via Pairachute, as operationalized by comments for the mentor asking for an in-person meeting (Ex: “*Let’s get lunch tomorrow?*”), as well as comments from a newcomer to a mentor asking for help (Ex: “*Can you help?*”). Surprisingly, no users in the solo condition sought help from their partner via *Pairachute*. Only 11 of the 21 (47.8%) newcomers in the paired condition were active with more than one message on *Pairachute*. Only 1 of 11 active newcomers (9.1%) in the paired condition asked a mentor to meet via *Pairachute*. No newcomers in the solo condition (zero out of 11 total solo participants, zero of the three active over one message) requested a meeting through *Pairachute*. We are unable to use log data for
participants around online help-seeking in the control condition given that they did not use Pairachute, however in the next section we describe how members of the control group describe help-seeking behavior without Pairachute through our semi-structured interviews.

(B) Help-seeking Interview Data: Our interviews showed that newcomers in the paired condition rarely participated in online help-seeking via Pairachute. Some participants said that it felt like an impersonal space to connect around problems. However, Pairachute reflection answers by newcomers helped some mentors know what problems their newcomers were working on and the duration of these problems. This in turn led to some offline help-giving from mentors to newcomers.

We found low online help-seeking in the paired and solo conditions. When asked if Pairachute impacted their communication with their mentor, only two of 11 (18.2%) of the newcomers interviewed from the paired condition responded positively. Slightly more reported getting help offline -- with five of 11 of the paired newcomers interviewed reported that they met offline to get help (45.5%). Four of 11 (36.4%) of the paired newcomers interviewed commented on feeling comfortable asking their mentor for help when they were experiencing a challenge or roadblock at work. In the solo condition, none of the newcomers interviewed (zero of three) discussed asking for help on Pairachute when asked about this in the interview protocol, and the log data did not suggest this either (as discussed above). However, one of three (33.3%) newcomers in the solo condition who were interviewed commented on connecting with their mentor for offline help. Similarly, one of three (33.3%) of the participants in the control condition who were interviewed said that they only got help if they ran into mentor in the hallway or had a pre-set meeting time. One of three (33.3%) newcomers interviewed from the
control condition said that his partner was too busy to meet and so he relied on figuring things out on his own. As he stated: "He’s (mentor) busy doing his thing, have not relied on him much at all. I’m learning on my own." The busyness of his mentor led him to practice self-reliance rather than asking for help.

Newcomers in the paired condition expressed not explicitly help-seeking via Pairachute as connecting by mobile application felt impersonal, robotic, and less conversational than doing so in person. Five of 11 (45.5%) of paired newcomers interviewed said that they preferred to talk in person rather than through Pairachute. Three of the 11 newcomers (27.3%) commented on how connecting through a mobile application felt impersonal. As one newcomer stated: "It [Pairachute] feels very impersonal." Another newcomer said: “It [Pairachute] currently feels kind of robotic.” One newcomer in the paired condition said that he felt that he was being monitored when he used his phone to reflect on Pairachute. As he stated: “I noticed that I tended to prefer [talking in person]. I think it was a psychological thing where I knew I was being monitored [on Pairachute]. I felt weird having no filter.” Another newcomer commented on how connecting over an app took away from discussion and he preferred connecting in-person about problems he was experiencing at work. As he said: “I found that the app [Pairachute] can take away from the conversational, you know, aspect of coming to my [mentor] with problems. I prefer in-person communication with that.” This newcomer noted that connecting via Pairachute felt less natural than communicating offline.

While there was low help-seeking, some mentors in the paired condition noted how seeing the reflection updates from newcomers via Pairachute helped them better identify what their partner was struggling with and the duration of their difficulty with the issue, in comparison
to no participants reporting this in the solo and control conditions. Three of 10 mentors in the paired condition (30%) said that the reflections helped them to build a better understanding of the challenges that their newcomer was experiencing and the duration of their difficulty with their challenges by the frequency with which they brought up the same tasks they were working on in their reflection prompt answers. Understanding these challenges led to offline help-giving. For example, one mentor saw that his newcomer mentioned that he was struggling with the same problems for two posts in a row, which helped him realize that he needed to support. As he stated, “He [newcomer] had said something twice and it had been a while of basically saying the same thing, and so I asked -- ‘are you still doing the same thing?’, and he said he was, then I asked if there was a problem, and then we met and talked about it later.” In this case the mentor was able to see challenges the newcomer was experiencing through the reflection so he could help to support the newcomer.

Four out of the 10 mentors (40%) interviewed from the paired condition noted that reading content of the reflection prompts encouraged them to set up times to meet with their newcomer offline. No participants interviewed in the solo condition commented on Pairachute reminding them to check in offline or online with their partners. However, two of the five solo pairs (33.3%) active (i.e.: sending more than one message on Pairachute) did send messages to one another through the chat window of Pairachute. One mentor in the solo condition sent a message in the chat window using a social support suggestion sticker that said: “Great job on that task!” and their newcomer partner replied with: “Thanks for your support!” Another newcomer started a message with his mentor saying: “I think we should use this app right?” but
the mentor never replied. These were the only two instances where solo pairs chatted on
Pairachute; the rest were all solo reflection answers.

Furthermore, Pairachute provided an ease of communication on status updates between
partners as they could quickly find their partner online via Pairachute and send them an update.
Six out of 21 of participants in the paired condition (28.6%) commented on Pairachute making
communication easier with their partners through allowing pairs to more easily find partners via
Pairachute and send them a message than using e-mail or another outlet. As one newcomer
stated, “The main advantage of using the app [Pairachute] is that I don’t need to search for the
person I’m talking to, I can just go straight in [in Pairachute] and don’t have to search the name
and I can send.” This participant used the tool to send quick messages to his mentor, such as
saying where they were or reporting that they would be arriving to the office later than usual. It
allowed a quick way to send updates from their phone in a way that seemed easier to them than
other forms of email or messaging as they did not have to search for a name but were in direct
chat already with only their partner via the Pairachute tool. “I was using the app [Pairachute] if
I wanted to inform her [mentor] that I want to be out of the office, I was using the app. It was
very helpful.” This user said that Pairachute provided a quick way to notify his mentor that he
would be away from the office. We found that two solo participants out of eight (one mentor and
one newcomer) commented to their partners in the chat feature, but only one of the two received
a reply back from their partner to their chat -- specially, when the solo mentor posted, she
received a reply back from her newcomer, but when the solo newcomer posted, he never
received a reply back from his mentor. Our findings suggest that some mentors and newcomers
in the paired condition used Pairachute as a way to send short messages to their partner about
their status -- such as where they were going to be physically located that day, or what task they were working on at that time.

(C) Help-Seeking Survey Data: Our help-seeking pre and post surveys showed that all conditions increased slightly in reported ability to bring up problems with their mentors after the six-week deployment. Newcomers who took both pre and post-surveys in the paired condition (n=six) and the solo condition (n=three) showed slightly higher changes in ability to ask for help and bringing up challenging topics after the six-week deployment. Newcomers in the control condition (n=three) showed a decrease in their willingness to ask for help from their mentor. Surveys were based on agreement with the sentence on a scale from one to seven (one= "strongly disagree" to seven = “strongly agree”). On average, the paired and solo newcomers rated their help-seeking as slightly lower after the six-week deployment, while those in the control condition stayed at the same level.

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<tr>
<td>I don’t ask for help from my mentor, even if the work is too hard to solve on my own.</td>
<td>2.5</td>
<td>2.2</td>
<td>2.5</td>
<td>1</td>
<td>3</td>
<td>4.5</td>
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<tr>
<td>If I get stuck on a work problem, I ask my mentor help so I can keep working on it.</td>
<td>5</td>
<td>4</td>
<td>5.5</td>
<td>4</td>
<td>5</td>
<td>3</td>
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<td>I am able to bring up problems and tough issues with my mentor.</td>
<td>5.7</td>
<td>6.3</td>
<td>6.5</td>
<td>7</td>
<td>3.5</td>
<td>5.5</td>
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<tr>
<td>Averages of 2 &amp; 3</td>
<td>5.3</td>
<td>5.2</td>
<td>6</td>
<td>5.5</td>
<td>4.3</td>
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*Table 11: Changes in pre and post help-seeking surveys (for newcomers in paired, solo, and control conditions):* Newcomers who took both pre and post-surveys in the paired condition (n=six), the solo condition (n=three), and the control condition (n=three) showed slightly lower ratings of perceived help-seeking.

(3) Impact on Self-Efficacy
We hypothesized (H3) that *Pairachute* reflections on progress and learning (solo and pair conditions) would help to build self-efficacy towards participant views of work and increase resilience in newcomers. We found that *Pairachute* reflections on progress and learning in the paired and solo conditions did not significantly help to build self-efficacy in newcomers in comparison those in the control condition who did not use *Pairachute* for reflection. We found that the participants in the paired condition who chose to reflect rarely answered the prompts with deep reflection and instead wrote short status updates. However we found that solo participants reflected in greater depth than those in the paired condition. We learned from interviews that some participants in the paired condition found *Pairachute* helpful for showcasing their progress and learning to their partner. This was particularly helpful for allowing newcomers to hear what kinds of problems and skills their mentors were developing and to learn from their learnings.

**(A) Self-Efficacy Log Data:** Our log data found that *Pairachute* participants in the paired condition mostly posted status updates to their partners, though some posted reflection on learning and growth -- for themselves and their mentors. Participants in the solo condition engaged in reflection about constructive problems and learnings at work.

Our log data showed that *Pairachute* provided a platform for some mentors and newcomers in the paired condition to showcase their individual progress and mastery (46 out of 49 of total reflections answers posted on Pairachute, 93.9%), as well as to recognize the progress their team. When asked to reflect on progress and learning (Prompt: “Reflect on one project, task, or relationship you made progress on yesterday.”), 46 out of 49 of total reflection answers posted on *Pairachute* (93.9%,) in both paired and solo conditions were reflections on progress.
"Made a lot of progress yesterday fixing bugs on this project that needs to be done by Friday."

This newcomer was able to demonstrate the progress he was making with his mentor. In turn, his mentor expressed encouragement back to him via Pairachute. We found that 20 out of the 49 reflections (40.8%) were reflections on building mastery. For example, one newcomer in the paired condition posted on Pairachute about building interpersonal skills over time with his clients. As he stated: “Anxious new client wanted to hop on an ad-hoc call in a few hours’ notice. After an hour conversation we had started to build a rapport that felt natural + empathetic. Could feel the trust being built. Coming from the in-house world, this kind of relationship building is new to me... it's complex! And exciting when you see progress.” 12 out of 49 reflections (24.5%) involved reflecting on the progress of their team. As one newcomer wrote: “It’s been quite a pleasure to see how committed everyone on the team is to produce great work. It’s motivating to be around this group.” This newcomer used Pairachute to praise his team and recognize his motivation being a part of it.

Our log data also showed that some newcomers and mentors in the paired condition used Pairachute to share their personal technical learnings. 15 of the 49 reflections (30.6%) involved sharing technical learnings. For example, one mentor in the paired condition shared via Pairachute a technical learning he had with his partner. As he stated: “Today I spent time figuring out how to query a Twitter account to get the latest tweet from the [Client] Twitter account and embed it into a SharePoint site. Since we could not connect to the Twitter API due to technical constraints, we were forced to use Twitter's default embed script which pulls the Twitter data and embeds it on the page in an iframe. I learned that you cannot have an iframe reference web fonts since the content in the frame is coming from a separate domain, even
though the page that embeds the iframe has the fonts loaded. To work around this, I used JavaScript to query the data inside the iframe and move it out of the iframe and into the markup on the page in order to have it styled correctly according to the designs.” This mentor went into great depth to share what he learned with his partner and the work-arounds he created. We found that the technical learnings shared tended to come from men and only one of the six women shared technical learnings through Pairachute.

Our log data also showed that some newcomers and mentors in the paired condition used Pairachute to share personal self-management learnings. Nine of the 49 (18.4%) posts were around social and emotional learnings and 13 of the 49 reflections (26.5%) posted were reflections on overcoming challenge and setback. For example, one newcomer reflected through Pairachute on his learning to ask for help sooner. As he wrote: "I learned Albert Einstein’s quote of “the definition of insanity is doing the same thing over and over again, but expecting different results” is extremely relatable. I was making a mistake that kept making me redo the work I was doing for most of the day. I learned to just ask for input quicker in my problem solving stage." This newcomer revealed that while he had faced a setback he learned the importance of asking for help to overcome this challenge. In general we found that men tended to post more of these learnings than women on the Pairachute platform, and that women tended to post more in the solo condition. For the paired condition, only two of the six (33.3%) women participating actively on the tool (posting more than once) shared social or self-management learnings.

Newcomers and mentors in the solo condition posted slightly longer reflections on average in comparison to those in the paired condition. Participants in the solo condition tended to write more deep self-reflections about their work when reflecting alone (in comparison to the
solo condition reflection responses) but posted short messages to their partner in the chat window. The average word count of solo reflections was 27.9 words per post (SD = 21.5), while the average word count of paired reflections was 18.1 words per post (SD= 20.2). For example, one mentor in the solo condition reflected in the solo condition reflected on their self-persistence: "I’ve been speaking up for myself and my accomplishments. In the past I have tried to fly under the radar and let other people be my advocate which hasn’t helped me advance in my career as quickly. I am taking a different approach now and while it’s been hard, it’s been a positive experience." Participants in the solo condition tended to post longer replies on average with greater reflection on hardship and learning through challenge. As another solo participant reflected: "My role on a new project is not one I would have signed up for had I known what it would be. It’s not helping me to grow in my career. I had a frank discussion with my boss about my concerns and am now working with him to shape it into what I want the role to be." Participants in the solo condition tended to reflect more on instances of progress through difficulty when reflecting alone.

(B) Self-Efficacy Interview Data: Our interview data demonstrated that Pairachute participants in the paired condition found the progress updates helpful for knowledge sharing and increasing mutual understanding around progress, learning, and values. This in turn contributed to building their self-efficacy.

Pairachute helped to increase knowledge sharing and understanding of progress, learnings and values for some participants in the paired condition. Six of nine (66.7%) mentors commented on using Pairachute as a way to share their knowledge and demonstrate to their newcomer their own learnings. In turn, four of 11 (36.4%) newcomers in the paired condition
noted it was helpful to see the progress of their mentor. For example, one mentor commented on how he actively tried to reflect on his learnings via Pairachute to help share his knowledge and progress with his newcomer. As he stated: "I think the second piece [Pairachute reflection prompt on learning] is really important. The ‘what did you learn’ is where it gets valuable, and that’s when I have to think about what I learned and write it down. [My newcomer] can see that and maybe that will make him notice things that he may not have noticed, he may be curious about things that I’m doing every day.” In an interview with this partner’s newcomer, he expressed enjoying getting to learn about what his mentor was working on (though he did not explicitly state that he valued learning from it). As he stated: “I enjoyed reading about the stuff he was working on [via Pairachute reflections] because most of the time we are interacting face to face it’s to review the stuff I’m working on so I don’t always get to see what he’s doing. I guess I have tried to make that [checking in with mentor] more of a priority.” This newcomer noted how seeing his answer on Pairachute helped to increase his understanding and also led to him ask his mentor more about his work. Another newcomer stated that seeing progress updates from his mentor was helpful for seeing the progress of more senior roles in the organization. As he said: "I think it’s helpful to see his more senior position and what they’re doing on a daily basis, so that’s valuable." This newcomer noted how Pairachute helped him to build a better understanding of the work that his partner was doing at a more senior level, which was valuable for his development. This research helps to support how online systems can help to facilitate shared learning and role modeling.

Four out of the eight (37.5%) mentors interviewed in the paired condition commented on finding Pairachute helpful for understanding the status and progress of their newcomers. One
mentor commented on how, despite the fact that she was located in the same office as her newcomer, she was busy and did not have time to meet with him in person. However, Pairachute helped her to know what her newcomer was working on what progress he was making. As she said: “Sometimes when he [newcomer] sent messages [on Pairachute] about him not being in the office and sharing his accomplishments for the week, those really helped.... Because I was really busy during the month of April. I barely talked to anyone but my team, but seeing it pop up on my phone you know and seeing that he’s doing something productive and accomplishing something, that makes me feel better as a [mentor], knowing that he’s not just idling around.” This mentor noted that Pairachute helped her know what her newcomer was doing. Another mentor commented on how Pairachute status updates helped him to know his progress, as well as his values. As he said: “Reading his [newcomer’s] answers [reflection prompts on Pairachute], it was good to know what he was working on. He’s been on one product this whole entire time it was nice to get some insight into if is he doing the work he wants to do, that he cares about.” The mutual sharing allowed mentors to see progress and newcomers to gain greater awareness of the responsibilities of their senior colleagues. It helped some of the mentors to understand values, such as having a better sense of what their partner cares about. This highlights how the mutual sharing in pairs led to greater understanding and helped some mentors to better understand the aspirations and values of their newcomers.

While some participants reported feeling closer to their partners through reflection on Pairachute, some participants in the paired condition (particularly newcomers) expressed some reluctance to share vulnerable replies with their partner through Pairachute as they knew that they were being monitored by the researchers, despite being told that their responses would be
anonymous. More senior member of the organization who participated in the study did not express this concern and asked for deeper questions. Participants in the solo condition expressed feeling more comfortable reflecting honestly on Pairachute given that they were reflecting alone and seemed less concerned about others reading their replies. Six of 21 of participants interviewed in the paired and solo conditions (28.6%) vocalized preferring to speak offline rather than by phone. One participant in the paired condition stated that he worried that his conversations was being monitored by the researchers and their HR staff, despite the research team guaranteeing that their conversations would be kept confidential and not be shared. Another participant in the solo condition wrote to their mentor via the chat window: “I feel like we’re being monitored.” Mentors and newcomers commented on feeling worried that their answers were being watched by HR or higher-level staff, but also the difficulty of sharing personally online in such a permanent way with their mentor. Some participants noted that they preferred connecting with their partners in the hallway rather than answering via a technological tool, particularly around more sensitive topics, such as questions about managing cultural dynamics in the office. Participants, particularly newcomers, were concerned that they needed to filter what they said in the tool because it was in written and more permanent communication form online.

However we found that while mentors with higher level positions in the company were less likely to use the tool, they expressed less concern of sharing freely through their phones and a desire for deeper questions. No senior team members in the mentorship program commented on worrying about sharing freely through the phone. In fact, two senior mentors asked for more questions on Pairachute to prompt greater vulnerability sharing between pairs. He suggested Pairachute ask users to reflect with their partners on more vulnerable questions such as: “Tell
“Tell me about something you messed up” or “Tell me something that you hate doing.” He continued: “I like learning about mistakes and what they learned from it.” This demonstrates how some participants in more senior roles desired to use the tool for greater sharing of vulnerabilities, while more some participants (particularly newcomers) in more novice roles tended to reflect in person. That being said, newcomers had trouble reflecting vulnerably both online and offline.

We found that solo participants tended to feel greater comfort in reflecting vulnerably since they were doing so alone. For example, a mentor in the solo condition commented on feeling that they could share more on Pairachute because they were the only ones there. One of six participants (16.7%) in the solo condition noted how she felt stronger preference for reflecting alone than with a partner through Pairachute. As she stated: “I’d prefer to reflect alone [than with a partner on Pairachute]. If someone else was in there, I’d feel more censored.” Users noted how reflecting alone made them feel that they could share more freely, as was evidenced in the Self-efficacy Log Data section. Users in the control condition did not discuss in interviews their self-efficacy changing significantly over the course of the six week testing period.

(C) Self-Efficacy Survey Data: Our self-efficacy pre and post surveys showed slight increases in their belief in their own abilities in comparison to the control and solo conditions after the six-week deployment. Newcomers who took both pre and post-surveys in the paired condition (n=six) showed slightly higher increases in perceiving their job to be in the scope of their abilities and being capable of sticking to their goals, however their scores went slightly down on feeling overqualified for their jobs. The newcomers who took both the pre and post-surveys in the solo condition (n=three) showed an increase in feeling able to stick with goals and aims,
stayed the same on feeling qualified, and went down slightly in feeling that their job was within their abilities. Newcomers who took pre and post surveys in the control condition (n=three) showed slightly higher belief in their feelings of overqualified for their job, but stayed the same in feeling that their job was in the scope of their abilities and their capability of sticking to their aims and accomplishing their goals. Surveys were based on agreement on a scale of one to seven (one = "strongly disagree" to seven = “strongly agree”). On average, the newcomers in all three conditions (paired, solo, and control) rated their self-efficacy as slightly higher levels after the six-week deployment.

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<td>1) My job is well within the scope of my abilities.</td>
<td>5.83</td>
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<td>7</td>
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<td>2) I feel I am overqualified for my current job.</td>
<td>3.17</td>
<td>2.5</td>
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<td>3) I am capable of sticking to my aims and accomplishing my goals.</td>
<td>5.67</td>
<td>6.5</td>
<td>6</td>
<td>7</td>
<td>6.5</td>
<td>6.5</td>
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<tr>
<td>Averages of 1, 2, &amp; 3</td>
<td>4.9</td>
<td>5.1</td>
<td>6</td>
<td>6.2</td>
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Table 12: Changes in pre and post self-efficacy surveys (for newcomers in paired, solo, and control conditions): Newcomers who took both pre and post-surveys in the paired condition (n=six), the solo condition (n=three), and the control condition (n=three) showed slightly higher average ratings of perceived self-efficacy.

5.6.5 Revised Design Implications

The Pairachute tool was helpful for initiating conversation, revealing newcomer support needs, and tracking progress; it was not as useful for facilitating help-seeking, sharing vulnerability, and building self-efficacy. However, there are several lessons from our experience that will shape future modifications for design and implementation. Below, we describe the most significant implications based on our findings from our Pairachute Field Test Study.
1. **Setting up offline meetings:** Building on Olson's [2000] finding that physical proximity matters, one important finding from our study was that pairs preferred connecting face-to-face rather than online for discussion. We found that one of the best use-cases of Pairachute was that it led pairs to set up in-person meetings in which a principal outcome was help-giving and social support. Many pairs set up these meetings offline and asked that the tool do a better job at helping with this task. They also requested that the tool be modified to help them schedule connections by phone. Consequently, we recommend that online social support systems be designed to facilitate direct human interaction.

2. **Motivating Social Support & Engagement:** Our findings suggest pairs engaged with the tool to offer social support at a less than desired rate. To encourage greater use of online social support systems, we recommend sending affirming messages to those who offer support or respond to a prompt. We also suggest creating a leaderboard to stimulate deeper engagement [Hamari et al 2014]. The board will allow users to see how their level of engagement and interaction compares with that of others. In addition, we recommend displaying when a user is online and available to connect like the online displays available in Skype or Messenger, which has been shown to help increase social presence and social support [Erickson et al 2000].

3. **System Login & Notification Settings:** Given that some users never logged in properly to Pairachute, we also recommend having pairs initially log into the system together (whether in person or through a joint conference call with the facilitator) to ensure that pairing works effectively and that they commit together to using Pairachute [Cialdini et al. 2006]. We found that many users opted out of notifications when they downloaded the system and thus we recommend disabling the ability to restrict notifications in the tool [Bentley et al. 2013].
4. **Communication Mediums:** Our findings suggest that some pairs were already connecting online with their pairs via other online systems (ex: Slack, Skype, Messenger, or email). Given that companies have unique communication systems, we recommend creating an extension that allows for use of Pairachute within different systems, such as Slack or Messenger. This will allow an online web-based component, so phone is not the only way to connect via Pairachute.

5. **Reflection Prompts:** Given the reported desire for greater diversity of questions due to feeling a sense of repetitiveness in the questions and that they didn’t have much new to add, as well as a desire for questions that are easier to answer due to the busyness of employees and limited time to answer – we recommend making the questions more specific to answer rather than overly open-ended questions, as well as diversifying the questions to ask a variety of questions that allow reflection on learning and progress. We recommend prompts that help to build greater trust and understanding between pairs (ex: “How are you feeling today and why?”), as well as increase offline conversation (ex: asking about current roadblocks and overcoming setbacks). In addition, we suggest creating a feedback loop where users rate the prompts they receive, and Pairachute then resorts to the prompts that are most used and liked by a specific pair. This would help us to better gauge what kinds of questions users liked and given them more appropriate questions based on their style. We also suggest allowing users to select the prompts they desire to be asked from a list that have been commonly used in the past, as well as enter their own prompts, to increase their likelihood of engagement. While some prompts are critical to be asked (ex: reflecting on progress and learning can help to build self-efficacy), we believe this could increase likeliness of engagement based on the fact that users commented on wanting different question types and seeing that people vary in their desire to reflect. We also suggest
possibly incorporating personalization in future designs that incorporates reflection prompts dependent on the timing and needs of the newcomer. Given that we found that some users wanted to reply late at night after midnight, while others preferred it early in the morning – we believe that greater choice for things like timing could prompt increased engagement.

6. **Timing & Frequency of Notifications:** A number of users commented on desiring greater control of the timing and frequency regarding when prompts are sent. Their suggestions were split between the early morning and evening. Consequently, we recommend allowing pairs to select the time of day they are notified together, as well as choosing from weekly or biweekly joint reflection question options. We hypothesize that this will help increase likelihood of buy-in around using the tool.

7. **Online Social Support Suggestions:** We found that some felt that the online social support stickers were impersonal. We recommend allowing users to be more creative with the messages they send to their partners so that it feels less forced. Furthermore, given that users desire different types of social support, we recommend incorporating greater choice or Artificial Intelligence in future designs to help suggest different types of social support for mentors to give newcomers based on their preference of types of social support.

We plan to follow these revised design implications when designing our next version of Pairachute testing and, more broadly, when building online support systems for newcomers.
5.7 Discussion

Supporting newcomers is critical to the success of organizations and ultimately society at large. This research helps us better understand key design implications for building socio-technical systems for the workplace [Orlinkowsi 1992; Leonardi 2008], specifically to develop the self-efficacy of newcomers through facilitating paired reflection and social support through a socio-technical system. This research builds on an extensive amount of CSCW research regarding effective socio-technical systems to facilitate social support for newcomers.

(1) Facilitating Online and Offline Social Support: This research builds our understanding of how online systems can facilitate online and offline social support. Specifically we learned that giving online social support is difficult for mentors because they are often not sure when and how to step in, but online notifications can help mentors remember their responsibilities toward their newcomer and sometimes prompted online and offline social support. To begin, we found that it’s difficult to facilitate online social support via Pairachute because mentors expressed being busy and not knowing what challenges their newcomers were facing, and feeling that online communication was impersonal. This is consistent with related literature suggesting that giving offline social support is hard for managers due to busyness and not always being sure when and how to support [Blumenthal et al. 1991]. However, we add novelty to this past research by showing that even in an online context where participation is more accessible via technology, as well as more visible online and easier to monitor, many mentors still did not feel they had time to provide online social support to their partners.

However, we found that online notifications reminding mentors and newcomers to reflect together on Pairachute led some mentors to provide offline and online social support to
newcomers. Past research suggests that online notifications can help remind and provoke system engagement [Kraut et al. 2012; Mehrotra et al. 2016], however we add nuance to this research by showing that notifications can not only help lead to online social support and engagement with the tool, but also offline social support and engagement face-to-face for mentorship programs. In addition, we found that notifications reminded some mentors of their responsibilities to check in with their newcomers and increased feelings of social proof and reciprocity to engage [Cialdini 2007; Suh et al 2010]. These feelings were heightened online as failure to participate was so visible via Pairachute given that it was obvious if users were not responding to prompts [Greenberg et al 2015; Richardson et al 2003]. This encouraged some users to engage online or set up a time to meet offline with their newcomer. Thus, we found that online reminders can help to prompt feelings of reciprocity and the need to take action on responsibility either online or offline.

(2) Facilitating Online and Offline Help-seeking: Secondly, our research helps build our understanding regarding how technology can be used to foster online and offline help-seeking. While we hypothesized that Pairachute would make online help-seeking easier for newcomers, we found that newcomers were still reluctant to share their questions (particularly if they thought they should know the answer) and challenges online, even with a supportive partner. However, newcomers externalizing their progress on Pairachute helped some mentors know when to step in to provide online or offline help-giving.

We learned that it’s hard for newcomers to reflect vulnerably online, ask for help, or showcase challenges to their mentors via Pairachute due to feeling like they are being
monitored, not wanting to ask the wrong question, or feeling impersonal online. This contributed to our understanding that trust can be difficult to build for mentorship pairs online and that users can feel vulnerable showcasing setback to their mentors via our portal, even when done in pairs [Kim et al. 2017; Toma 2010]. Thus, while we had expected that Pairachute would make online help-seeking easier as it’s done with a partner (rather than a crowd or group) and we had seen some help-seeking in past studies [Harburg et al 2015; Harburg et al 2017], it was not frequently used for help-seeking. This falls in line with past research suggesting that help-seeking is hard for newcomers both online and offline [Dillenbourg & Jermann 2011; Suzuki et al., 2016]. However, we build to this understanding through our finding that help-seeking can be difficult online as it’s public-facing and can feel like a more permanent display of inadequacy [Foong et al. 2017; Friedman et al. 2000; Kim et al. 2017; Toma 2010]. Thus, showcasing failures is hard for newcomers both offline and online, particularly when it relates to a failure at work.

However, we found that newcomers were more comfortable externalizing positive progress online, which helped some supporters know when to step in and offer online or offline social support. Past research found that externalizing work progress and making newcomer thinking and needs more visible could help to facilitate support and help-giving [Reiser 2004; Bransford et al. 2000; Marlow & Dabbish, 2014]. We provide novelty to this prior work through showing how we can prompt help-seeking through having newcomers externalize their progress. In turn, online supporters can then feel better able to know how to give help based on their progress, as found in our study.

3) Facilitating Self-Efficacy Development Through Externalizing Progress: This research makes some contributions to our understanding regarding how self-efficacy can be fostered
through online platforms. We found that newcomers did not naturally want to reflect deeply on Pairachute but when they did it helped them to showcase their progress and to learn from what their mentors shared.

While reflection on learning and growth has been shown to help increase self-efficacy [Stefano et al. 2016], we found it rare for newcomers to reflect deeply on learning and progress given the busyness of their days, their offline interactions with their partners, as well as their desire to not be too vulnerable in front of a more senior mentor and in a space that felt permanently public. However, when newcomers did reflect it was usually around their progress and helped them to reflect on the progress they were making at Tech Co. This suggests that some newcomers wanted to only show the positive part of their experience (i.e. their successful progress) to their mentors, rather than sharing setbacks and other stories that would reflect negatively on them as employees. This builds on Social Cognitive Theory [Bandura 1981] and Amabile’s [2011] concept of small wins, through showing us how reflection on mastery can be facilitated in an online context, which is more accessible. This also increases our understanding of how sociotechnical systems can provide a way to prompt sharing progress with a partner in order to build feelings of mastery and competence.

In addition, mentors externalizing progress on Pairachute helped newcomers see what work their mentors were working on. This also builds to our understanding of modeling from Social Cognitive Theory [Bandura 1981; Hui et al 2018], through demonstrating how seeing mentor reflection can help to increase social learning and sharing of best practices as mentor’s model to newcomers online. This type of mutual sharing and relational learning has been shown to also increase trust and communication between pairs [Coppola et al. 2004; Clemson 1985,
Beirema 1996; Halfaker et al. 2014], which we found consistent in our research as some pairs who both shared progress on Pairachute often responded much more via the tool than those who reflected alone. This research also builds to media richness theory through suggesting that when users feel that there can be meaningful communication through a tool and that their partner is engaged on the tool, they are more likely to engage [Daft & Lengel 1984, Sameh et al 2012]. We found similarly that when both pairs engaged on the tool, they were more likely to continue commutating together both online and offline. This provides further novelty to the conversation as it demonstrates how online communities offer a unique space to showcase examples to others and increase comfort between pairs.

Overall, this research helps to build on past research to increase our understanding of how socio-technical systems can be designed to increase social support and self-efficacy for newcomers.

5.8 Limitations & Future Work

This research study had a number of limitations that inform future work. The three most significant limitations of this study included: (1) sample size, (2) corporate and worker context, and (3) measurement of online and offline communication between pairs. Below, we outline these limitations and how we propose to address these challenges and remaining questions in future work.

(1) Sample size: To begin, our sample size for the field test deployment was smaller than we had hoped to have for this study. Given the busyness of schedules, many newcomers and mentors often did not respond to repeated emails and requests to take surveys and set up times to meet for interviews given the busy nature of their work. Some participants were willing to do the
pre-survey or interview, but did not have time for a post-survey (or vice versa). Future research could require mandatory participation with users or schedule the post-interviews during the sign-up period. Future studies might also address how to attract and retain users through giving virtual cheers when newcomer or mentors participate via Pairachute, leaderboards to create internal competition between mentor pairs, and diversifying the reflection questions. Finally we plan to include HR staff in the next phase to understand how the tool impacts their experience as managers supporting newcomers. We did not get to test out the impact of Pairachute with HR staff but desire to do so and see the impact that the tool had on engagement. We desire to include this perspective in future research to examine how HR staff feel seeing how often newcomer and mentors connect throughout the onboarding experience.

(2) Corporate & Worker Context: This research also focuses on one corporate technology company and thus has natural limitations as a consequence of the singular work context. Given that most of the staff we tested Pairachute with were already comfortable with technology (as they worked at a tech company), they consequently might have higher adoption rates than those in other industries. Thus there is likely a bias for more engaged users with this user group, and it would be helpful to test this tool in other work contexts. Furthermore, technology companies naturally attract younger employees [Baron et al 2001]. While the employees we tested Pairachute with came from a range of ages (21-51 years old), most of the newcomers we tested the tool with were young. Thus it would be interesting to see utilization across other age groups. We would be also interested to test what would happen if the company had paired mentors with peers vs pairing with those higher in control, as well as the impact across genders, to gauge how tenure and gender impacted the results. In addition, the company
with whom we had the opportunity to test Pairachute had a high focus on corporate culture and supporting newcomers, as well as an ongoing mentorship program for all new staff. Thus, it would be interesting to explore the impact of this tool in a variety of settings with newcomers with formal and informal mentorship programs (ex: universities, hospitals, the military, etc.). For future work, I plan to study the impact of Pairachute for supporting newcomers in a variety of work contexts and age groups to see if paired reflection is more helpful in particular environments (ex: those in a stressful work environment might find it more helpful than those in a calm work environment) or for specific worker personality types (ex: those who enjoy journaling and reflection may find it more helpful than vs those who do not enjoy reflection and journaling). I also plan to test the tool within organizations that have no formal mentorship programs to see if such a system can be of greater help in facilitating onboarding.

(3) Measuring Online and Offline Communication Between Pairs: An additional limitation of this study was the difficulty of measuring all forms of online and offline communication between pairs during the six-week testing. Given that we did not have access to the participants’ e-mail or instant messaging (or other forms of online or offline communication), we can say very little about the ways they communicated other than what they did on Pairachute and what they reported in interviews and surveys. This impacts our full understanding of what occurred between pairs and why some pairs connected more consistently, both online and offline, than others. In future work, it will be helpful to better log communication between pairs or ask that pairs only communicate together via the Pairachute tool during testing via a diary study testing mode [Xanthopoulou et al 2009]. In addition, having a greater understanding of comfort communicating in pairs due to language barriers or past experiences together as pairs would be
helpful in understanding the impact of *Pairachute* on pairs (such as the difference between introverts and extroverts being paired together).

In sum, I plan to address each of these key limitations with future work as we continue to develop an improved understanding of how to build online socio-technical systems that foster social support for novices to build their self-efficacy.

### 5.9 Conclusion

This research helps us examine ways to better design technology to provide social support for newcomers to build their self-efficacy, ultimately impacting their performance and retention. While general engagement and offering online social support on *Pairachute* was not as significant as anticipated on supporting newcomers, we were able to witness the power that technology can have on helping to facilitate offline connection and social support. This research strengthens existing HCI research related to socio-technical systems to support newcomers [Harburg et al 2015; Easterday et al 2013], as it develops an understanding of how reflection and help-seeking can be prompted in pairs through notification reminders and social pressure. By doing so, we examine socio-technical features (ex: prompting social support through reflection, utilizing online stickers to encourage offering social support) and the way they can be better used to provide online and offline social support to newcomers and facilitate mentorship.

Our findings suggest that technology can be used to initiate online and offline check-ins between pairs, but questions still remain as to how to encourage vulnerable sharing and garner more intimate social support from a partner online. We found that pairs had trouble expressing vulnerabilities online and needed stronger incentive than we provided for reflecting regularly. In addition, while our *Pairachute* system was intended to support newcomers at work, it ended up
being more helpful for supporting those who desired to be more effective as mentor to newcomers. We found that the *Pairachute* system helped increase the understanding between mentors and newcomers, increasing their offline social support, offline help-giving, and ability to share their learnings with the newcomer. While each of these ultimately better benefit the newcomer, the tool was less immediately helpful for newcomers and the benefits were delayed. That being said, *Pairachute* provided a space where newcomers could quickly access their mentors and learn more about their mentor’s progress and lessons learned, increasing knowledge-sharing and modeling from mentors to newcomers, which has been shown to build self-efficacy [Bandura 1982]. As such, this research has important applications for society. Corporations and managers can benefit from technology that is built using what we have learned, potentially helping to decrease turnover of valued employees in corporations and associated training costs from having to train new staff. Finally, this research can help organizations better support the success of newcomers and their ability to perform their full abilities.
6. CHAPTER SIX: GENERAL DISCUSSION

Developing the self-efficacy of newcomers is critical to retention, as well as to the success of organizations and society at large given the benefits of newcomers [Cimino 2011; Bandura 1982]. This research examines the ways in which Psychology, Human Computer Interaction, Learning Sciences, and Organizational Behavior have explored the topic of developing the self-efficacy of newcomers, and presents one literature review and two empirical studies that examine the impact of sociotechnical systems intended to support newcomers through facilitating online social support to build self-efficacy. This research helps us better understand key design implications for researcher and practitioners building socio-technical systems that support newcomers [Orlinkowswi 1992; Leonardi 2008; Hui et al 2015; Rees Lewis et al 2017].

6.1 General Findings & Contributions

My findings build on existing theoretical frameworks regarding ways to increase self-efficacy and examine how these psychological frameworks can be applied within an online context. More specifically, my three studies examine how self-efficacy can be impacted through newcomers externalizing progress online to crowds, groups, and individuals. The distinct contexts of crowdfunding, project-based learning, and a corporate workplace environment allowed me to study newcomers working in three unique settings and compare findings across three contexts of newcomers. By comparing our three research studies side by side, three key findings emerged:

(1) Online social support requires sending notifications to remind but can increase the potential for offline social support for newcomers, impacting self-efficacy. (2) Online help-seeking is difficult due to the permanence of putting anything personal online, but externalizing progress can help prompt online and offline social support, impacting the likeliness of self-efficacy to
grow [Bandura 1981]. (3) When progress is externalized online, newcomers can see their progress and see examples of others paths online. I outline each of these findings in greater detail below and how they contribute to related work.

6.1.1 **Implications for Facilitating Online Social Support:** My findings across all three studies suggest that online social support from external supporters was inconsistent and difficult to facilitate without prompting due to lack of time, understanding of newcomer needs, and preference to connect and offer help offline [Harburg et al 2015; Harburg et al 2018]. However, when prompting encouraged online social support, it often came in the form of online appraisal and informational support and sometimes prompted offline emotional or instrumental support.

All three studies revealed that online social support was inconsistent and required commitment and extensive prompting from the socio-technical systems or research managers to due to supporter’s lack of time, understanding, and some resistance to connect online. This is consistent with related literature suggesting that giving offline social support is hard for supporters due to busyness and not always being sure when and how to support [Lande & Leifer 2010; Blumenthal et al 1991]. However, we add novelty to this past research by showing that even in an online context where participation is more accessible, many online supporters still did not provide online social support without extensive prompting. For example, I found that within crowdfunding communities, online social support was often facilitated through newcomers extensively prompting their supporters. Successful newcomers often went out of their way to publicly ask for support (ex: e-mailing or posting on Facebook to remind their communities to support), or prompted supports to engage through being showcased in a public online setting (ex:
main crowdfunding page or news article). In the *CheerOn* study described in Chapter X, we found that some groups received online social support but it often faded out and was not consistent without re-occurring prompting. Most external supporters on *CheerOn* only offered online social support when they were reminded to do so through e-mails and had the time to engage. For *Pairachute described in Chapter X*, we similarly found that online social support was rare and only came when pairs received notifications reminders to engage on the tool and felt committed to participating with their partner on the platform. Pairs who turned off notifications at the start of the test never engaged or offered social support online. This is consistent with CSCW research suggesting that prompting on tasks is critical for increasing likelihood of use [Kraut et al. 2012; Mehrotra et al. 2016]. However, we add evidence that online notifications can not only prompt online social support and engagement, but showcasing the progress of newcomers within notifications can also prompt offline social support and engagement, in line with research on the impact of online notifications prompting offline behavior [Kraut et al. 2012]. Furthermore, this research develops our understanding of how online notifications and a sense of commitment to the newcomer or cause are critical for facilitating positive behaviors and routines in users that are easy to forget due to busyness and laziness [Dombkowski et al., 2012; Orlankowski 1992]. These learnings build to CSCW research regarding online socialization of newcomers [Halfaker et al. 2014] as well as building an increased understanding of how to design online systems where users feel supported and willing to participate [Hollan et al. 200; Siemens 2014].

When online social support was given across all studies, it was usually appraisal or informational support online and, in some circumstances prompted offline social support
(typically emotional or instrumental support). This was likely the case because giving informational and appraisal support online and was less personally emotional. Across all three studies, I found that crowds, groups, and individuals tended to give appraisal or informational support online due to it being less personal or time consuming and easier to give online, and prompted instrumental or emotional support offline. This is novel in that it tells us that we can utilize online systems for appraisal and informational support, and also use them to prompt offline emotional and instrumental support. This adds novelty to our understanding of how online social support groups can aid people at work, and highlights a preference for offering appraisal and informational support online due to it being less personal and emotional and is thus easier to talk about in a permanent setting online [Barack et al. 2008; Cheung et al. 2011]. Across all three systems, the online social support newcomers received typically came in the form of an encouraging comment expressing the importance of the newcomer’s work (appraisal support), or suggestive advice on a specific path to take (informational support). Offline social support usually came through showing empathy in person (emotional support), or providing tangible resources to help support newcomers offline (instrumental support). Across all three studies, I found that impersonal appraisal support (ex: “Great job!”) was often the easiest for online supporters to quickly give, and informational support (ex: “Try this strategy...”) was dependent on the supporter understanding the challenge the newcomer was experiencing. I hypothesize this was the case because it was easier for users to give quick appraisal support as it required less thinking time, while the informational support required greater understanding of the actual problem. This builds on past research suggesting that online communities can offer help to newcomers, and increases our understanding of the need for online platforms to encourage
newcomers to articulate their work clearly to get social support from online supporters [Bohns & Flynn 2010; Rees Lewis et al. 2015].

In addition, I found online supporters were more likely to provide online social support when they felt a level of social pressure to respond, given the public nature of online work and the self-presentation online [Rourke et al 2007; Litt et al. 2014]. This increases our understanding of how psychological principles, such as social pressure and self-presentation, can be applied to motivate engagement and increased likeliness of offering online social support through socio-technical systems [Dellarocas 2004; Cialdini 2007; Scissors et al. 2016]. That being said, it would be far more preferable for users to be intrinsically motivated to participate. Thus, future work will explore how to give more agency and choice into the hands of the user to motivate them and incentivize them naturally. I found that the online social support sometimes prompted offline social support, particularly when receiving social support from groups and individuals. For example, I found that when newcomers received informational support online through CheerOn from their supporters, they sometimes asked to meet offline to talk further to receive instrumental support. It also suggests that people prefer meeting in-person to discuss more personal matters. This suggests that online systems should help to facilitate conversation and prompt offline meetings. In addition, I found that prompting online social support on Pairachute encouraged some pairs to meet offline for emotional support. This builds to our understanding that facilitating online social support can lead to offline social support through showing how doing so can prompt more personalized social support [Hui et al. 2014]. It also builds on research by Coppola and colleagues [2004] suggesting that mutual engagement can
increase trust and communication, and that this can be utilized in an online setting to prompt both online and offline social support.

6.1.2 **Implications for Facilitating Online Help-Seeking:** The findings suggest that across platforms and audience sizes, asking for help and revealing vulnerability online was difficult for newcomers. However, online communities could sometimes see that newcomers needed social support from externalized progress updates online and sometimes stepped in to provide online and offline social support.

Across all three studies, newcomers had difficulty showcasing vulnerability and their need for help online, impacting the online and offline social support they received. This is consistent with research suggesting that newcomers have trouble sharing setbacks and their need for help offline, and proved that online tools are not always helpful for increasing sharing vulnerabilities [Rees Lewis et al. 2015; Ensher et al 2003]. This may be in part because online tools can feel less personal and not well suited to the unique needs of individuals, impacting newcomers’ use and willingness to be vulnerable [Jarvenpaa & Lang 2005; Van Den Hoof et al. 2012; Litt et al. 2014]. A future tool might help to allow newcomers greater choice around the questions and method of asking them based on their unique preferences. I also found that part of this was because users felt that sharing online felt more permanent and was easier for others to monitor and judge. This builds on research suggesting the difficulty for newcomers when failure is publicly displayed [Greenberg et al 2014, Scissors et al 2016], and suggests that this difficulty persists even in a one-on-one situation. For example, newcomers in Study One expressed lower self-efficacy when their crowdfunding projects were showcased as having been “unsuccessful” online after not reaching their fundraising goal. In addition, participants in Study Two had
difficulty sharing that they were stuck via *CheerOn* as they wanted to present their progress only. Finally, newcomers (and some mentors) using *Pairachute* in Study Three avoided voicing challenges or issues they were facing online. This is consistent with self-presentation theory, or the behavior of presenting oneself in a specific light, and builds to our understanding of how online workers desire to present themselves online as fulfilling expectations of others [Litt et al 2014; Ellison et al. 2006; Gibbs 2006; Maddux 1988]. It also suggests that -- whether connecting with crowds, groups, or individuals -- revealing vulnerability and help-seeking is still very difficult to do online. Furthermore, sharing vulnerable information online may be even more difficult to share given the perceived permanence of online interaction [Higgins et al. 2008; Hughes 2004].

While revealing the need for help online was difficult, I found that participants across all three studies were comfortable showcasing their progress online, which helped them feel a greater sense of mastery and also helped some external supporters better understand how and when to give online or offline social support. Across all three studies I found that newcomers were more comfortable and more likely to use the respective online platforms to showcase their progress than to share their challenges and help needs. This was in part because the platforms in all three studies encouraged sharing of accomplishments rather than help-seeking needs, motivating the need for system design that facilitates greater emphasis on encouraging help-seeking. However, even when asked to reflect on learning, participants almost always chose to reflect or showcase positive rather than negative experiences. This builds to our understanding of self-presentation theory online through suggesting that newcomers wanted to present accomplishments to preserve their reputation online [Maddux 1988, Litt et al. 2014]. For
example, newcomers often posted only positive progress on crowdfunding platforms; newcomers often only highlighted success on CheerOn, and newcomers typically posted positive status updates and progress on Pairachute. In addition, I found that when users showcased their current state through these updates, supporters could better understand the current state of the newcomers and offer online or offline social support, particularly in the form of appraisal and informational support, given that these are less sensitive and easier to give with more information. This builds to our understanding of how online communities can be utilized for social support by showing that this can be done through externalizing progress [Reisser 2004; Nelson-Le Gall 1981; Foong et al. 2017].

Some differences in online and offline social support given from crowds, groups, and individual emerged. To begin, I found that when crowds saw the externalized state of newcomers through progress updates, they offered online support through the form of instrumental support (typically donations). Group supporters on CheerOn saw the updates from newcomers and sometimes offered to meet in person for offline informational or instrumental support (typically formal meetings to discuss projects and give feedback). Supporters on Pairachute sometimes saw the newcomers current state and offered to meet offline for emotional or instrumental support (typically in the form of coffee meetings showing empathy or in-person skills sharing). These findings are not unexpected given the design constraints on each system that encouraged a certain type of online social support. For example, reflecting with a partner sometimes helped to facilitate more personal emotional support. However, these findings suggest that by newcomers externalizing their progress online, online supporters (whether crowds, groups, and individuals) were able to better understand how to support and when to step in. This builds on research by
Bransford et al. [2000] who found that making newcomer thinking and needs more visible online could help to facilitate support and help-giving offline, and demonstrates the potential for hybrid environments where workers engage both online and offline [Zitter & Hoeve 2012]. This research provides greater novelty to our understanding of hybrid working environments by showing how technology can help initiate offline communication, as well as build our understanding of how help-seeking and help-giving can be facilitated through online systems that help showcase newcomer progress [Kraut et al. 2012, Coppola et al 2004].

6.1.3 Implications for Increasing Self-Efficacy Through Showcasing Progress Online: The results across studies suggest that externalizing progress online was important for helping some newcomers see progress and learn from the progress of others online and helping to build their self-efficacy in the process.

I found that through externalizing progress online with crowds, groups, and individuals, newcomers were able to see the progress they were making and increase their likelihood of building self-efficacy. Through this research I found that socio-technical systems provided a helpful space for newcomers to reflect on progress. Across all three studies I found that externalizing progress online can help newcomers showcase their achievements (ex: showing an idea on crowdfunding project progress, showing work progress via CheerOn, externalizing reflection on progress via Pairachute). This provides novelty to our understanding of Social Cognitive Theory and its applications online through showing how online communities can provide spaces for newcomers to showcase their of mastery and progress to help build their self-efficacy at work [Bandura 1982; Shea & Bidjerano 2010]. This was also the first set of studies to look at the application of social cognitive theory in online platforms [Bandura 1982]. In addition,
these learnings build on CSCW research suggesting that participants are more likely to engage when they feel participation is meaningful and beneficial [Daft & Lengel 1984, Sameh et al 2012].

I also found that online socio-technical systems where more experienced users showcased progress helped to increase the possibility for role modeling [Harburg et al 2015]. For example, crowdfunding platforms allowed users to “shadow” others virtually online and learn from their examples. CheerOn allowed teams to see the progress of other teams and learn from their experiences. Finally, the Pairachute reflections allowed users to see the replies of their partners and learn their experiences. As such, I found that connecting with a partner would help to promote important sharing of best practices. This research builds to our understanding of how online communities can be utilized for behavioral modeling and how the modeling principles of Social Cognitive Theory can be facilitated for newcomers in an online context to help increase their likeliness of building self-efficacy [Bandura 1982; Rees Lewis et al. 2016; Easterday et al. 2014]. While we knew that self-efficacy can be developed by social support, this research adds nuance to how online social support can be facilitated and most effectively given online to prompt offline social support. It also helps highlight the opportunity that hybrid online platforms, or online and offline systems as discussed in the literature, can have in helping to increase accessible opportunities for newcomers to learn from others [Hui et al 2014; Klemmer & Caroll 2014; Zitter & Hoeve 2012].

6.2 General Design Implications

My findings inform design implications for systems to support newcomers. They are specifically related to: (1) building self-efficacy online through social support; (2) facilitating social support
through prompting mentors to provide input and help, and (3) facilitating paired reflection in order to help boost the self-efficacy of newcomers. Table 13 offers design implications drawn from these three findings for building effective social support systems in the future. This research highlights the key challenges and opportunities that arise from cross disciplinary research related to offline and online social support systems and the ways in which online systems can be designed to facilitate self-efficacy through social support and reflection.

My findings suggest that online systems can support self-efficacy development through: (1) recognizing mastery and progress online, (2) providing online role models, (3) prompting online social support, and (4) encouraging resilience and normalizing setback online. My findings also suggest that the following design features can help to facilitate online social support and mentorship through: (5) distributing coaching via mentorship, (6) utilizing peers for social support, (7) increasing trust, (8) encouraging help-seeking, (9) training how to give help, (10) intentional pairing, (11) making social support easier to provide, and (12) making the platforms mutually beneficial. Finally, these findings suggest the following guidelines for designing online reflection systems including: (13) externalizing current state and help needs, (14) allowing for knowledge-sharing, (15) facilitates reflection on positive and self-distancing of negative events, (16) facilitates face-to-face help, (17) provide content expectations and coaching, and (18) promotes safety and comfort.

While this is an extensive list, I find that the most critical mechanisms for designing online social support systems that build self-efficacy include: (a) prompting social support through online notifications, (b) increasing trust and privacy through mutual sharing, (c) encouraging current state and help needs through prompting and showcasing examples, and (d)
facilitating face-to-face help when feasible. Overall, these findings have implications not only on the way we support newcomers, but also the way we build systems that support newcomers across domains and disciplines. See Design Implications in Table 13 below.

<table>
<thead>
<tr>
<th>Need</th>
<th>Behavioral Research</th>
<th>Socio-technical Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Building Self-Efficacy</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 Recognize Mastery and Progress</td>
<td>● Monitor goals and show progress [Bandura 1991].&lt;br&gt;● Provide guided mastery experiences for newcomers [Saks 1994].</td>
<td>● Show records of progress, challenges, and difficult learning areas to foster newcomer growth [Holland 2009].&lt;br&gt;● Show examples of others doing a similar task [Hui &amp; Gerber 2013; Harburg et al 2015].&lt;br&gt;● Give compliments or tokens of appreciation [Restivo, M. &amp; van de Rijt 2012]</td>
</tr>
<tr>
<td>2 Provide Role Models</td>
<td>● Utilize coworkers for role models [Saks 1994].</td>
<td></td>
</tr>
<tr>
<td>3 Prompt Online Social Support</td>
<td>● Encourage enabling feedback and mutually supportive communication [Saks 1994, 1995; Parker 1998].&lt;br&gt;● Facilitate (a) emotional, (b) instrumental, (c) informational, and (d) appraisal support based on individual needs [House 1983].</td>
<td>● Showcase examples of similar others that demonstrate that setback is normal, such as showing profiles of staff learnings or having pairs share learnings and failures together [Harburg et al. 2015].&lt;br&gt;● Teach organizational culture and better adjust to new settings through asking questions that prompt sharing of learnings and asking for help [Bierema 1996; Chao 2007].&lt;br&gt;● Utilize peers to help newcomers to feel less intimidated and work more effectively through connecting peers on mentorship systems [Ward 2008].&lt;br&gt;● Online profiles can help support identity and bonds-</td>
</tr>
<tr>
<td>4 Encourage Resilience and Normalizing Setback</td>
<td>● Self-regulation can help workers to anticipate possible stressors and develop coping mechanisms [Gist, Bavetta, and Stevens 1990].&lt;br&gt;● Provide accurate expectations and less role ambiguity [Fisher 1985]</td>
<td></td>
</tr>
<tr>
<td>(b) Facilitating Online Social Support &amp; Mentorship</td>
<td></td>
<td></td>
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<tr>
<td>5 Distribute coaching through mentorship</td>
<td>● Given the burdens placed on managers, mentorship relationships can facilitate psychosocial and career-related support for newcomers [Kram &amp; Isabella 1985].</td>
<td></td>
</tr>
<tr>
<td>6 Utilize peers to provide online social support</td>
<td>● Use peers for psychosocial support, emotional support, personal feedback, and career support [Bryant &amp; Terborg 2008; Kram &amp; Isabella 1985]</td>
<td></td>
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<tr>
<td>7 Increase trust and</td>
<td>● Trust has been shown to be a significant factor in the</td>
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bonds-based commitment online

- Effectiveness and depth of mentors pairs, particularly at a distance [Hughes 2004; Holland 2009]
  - Trust can be developed through: (a) familiarity, (b) shared experiences and goals; (c) reciprocal disclosure between pairs over time, (d) demonstration of non-exploitation [Dani et al. 2006].

8 Encourage online help-seeking

- Increase (1) awareness of needing help, (2) knowing whom to ask for help and identifying potential helpers, (3) knowing how to best ask for help, (4) deciding to ask for help, and (5) responding to help-seeking attempt [Nelson-Le Gall 1981].

9 Provide online help-giving guidance

- Train mentees on how to guide newcomers effectively [Ehrich et al. 2004; Garvey and Alfred 2000].
- Expose mentees to their own biases and encourage seeing beyond their own circumstances and needs [Caruso et al. 2006; Ross et al. 1977].

10 Connect intentionally

- Newcomers typically like to receive support from role models who share characteristics to themselves, particularly gender or ethnicity [Packard 1999], though there can be some advantages of diversified mentoring [Jossi 1997].

11 Make online social support easy to provide

- Make social support easy to provide by allowing quick access to increase likelihood of providing it [Kraut et al. 2012].
- E-mentorship, email, and video-based mentorship can be used to reduce isolation of newcomers and increase retention [Alliance 1995].

12 Make social support mutually beneficial, express gratitude

- Make mentorship pairings a mutually beneficial relationship [Clemson 1985].

(c) Facilitating Online Reflection

13 Externalize current state

- Make newcomer thinking and needs more visible to facilitate based commitment between supporters and students [Ren et al. 2012].
and help needs online support and help-giving [Bransford et al. 2000]. Relational learning can also help to boost growth and make sense of experiences [Bierema 1996].

14 Provided opportunity for knowledge sharing

- Relational learning can also help to boost growth and make sense of experiences [Bierema 1996].
- Ask questions that have users reflect on past actions to better understand the relationship between actions and associated outcomes [Kale & Singh 2007].
- Have users practice self-distancing online, or taking the time to reflect on negative experiences adaptively to distance from the situation and make meaning out of it [Kross & Ayduk 2011].

15 Allow for reflection of negative and positive experiences, facilitate self-distancing

- Positive reflection can help create physical, intellectual, and psychological resources to combat setback and manage future threats [Fredrickson 2002]
- Reflecting on negative and stressful experiences to improve physical and mental health and coping [Pennebaker 1997; Wilson & Gilbert 2008].
- Have prompts that allow users to snooze and come back at a time when they are read [King et al 2006]

16 Provide follow-up contact and facilitate face-to-face help

- When connecting online, facilitate external communication between newcomers and supporters to initiate face-to-face meetings [Kraut et al. 2012]. Technology should not feel disruptive or intimidating [King et al 2006]
- Provide limited online reflection period to increase ease of use [Ensher et al. 2003]
- Increase feelings of safety online through asking follow-up and prompting mutual sharing online [Ensher et al. 2003]

17 Provide clear content expectations and coaching

- Adoption more likely to occur when there is a simple learning curve and ease in use with clear instructions [Longhurst & Sandage 2004]
- Make confidentiality, privacy, and boundary setting essential [Kerka 2002]

18 Ensure safety and promote comfort

- Make confidentiality, privacy, and boundary setting essential [Kerka 2002]

**Table 13. Revised Design Implications for Online Social Support Systems**: Design implications to improve usability of an online social support system for newcomers related to: (a) fostering self-efficacy, (b) providing online mentorship, and (c) facilitating online reflection to increase online social support.
6.3 General Limitations & Future Work

There were several large limitations of my dissertation that motivate future work. These include: (a) sample size and qualitative analysis, (b) work contexts, (c) participant variability, and (d) measuring external offline and online communication.

**Increasing Sample Size & Technical Adoption:** As discussed in the Limitations and Future Work section of Study Three, one limitation was the low sample size and technical adoption on *Pairachute*. Thus, my immediate next step is to redesign several system features of *Pairachute* (ex: revising reflection question to promote help-seeking, keeping notifications turned on for all users.) and adjusting the protocol (ex: public commitment at the start of the test and requiring users to set up pre and post interviews) to increase technical adoption and commitment on the tool. I then plan to continue to test the *Pairachute* system with a several different groups of newcomer and mentor pairs (ex: women in coding mentorship programs like Brave Initiatives, mentorship programs for newcomers in sports teams, newcomers in corporate work settings, etc.) to understand whether the trends I observed remain constant in a larger sample size and with a variety of user groups. I desire to focus first on redesigning *Pairachute* as it seems to have great potential to be highly beneficial to newcomers in need of social support, however down the road I hope to continue this work for a variety of group sizes and contexts.

**Work Contexts:** While there are benefits to studying a phenomenon across contexts because of our ability to compare results across domains and see what themes emerge, there are also limitations. Studying and comparing newcomers across three different contexts makes it at times difficult to compare the impact of the unique sociotechnical systems. My three studies discussed in this dissertation assessed newcomers in a three unique settings: (1) newcomers to
entrepreneurship participating in crowdfunding campaigns with online crowd support, (2) newcomers to design participating in project-based learning classrooms with online group support, and (3) newcomers to a company participating in innovative technical work with individual mentor support. While these three settings provided a unique comparison to study newcomers in three unique contexts, the diversity of these three groups may have also blurred the comparison across results. For example, financial incentives may have played a role given that mentors in Tech Co for Pairachute testing were being paid employees, while those on CheerOn and crowdfunding campaigns were strictly volunteers. In addition, professionalism at Tech Co may have played a role in willingness to be vulnerable on the tool, in comparison to less formal settings. Thus, future work could explore how participants in the same work setting respond to online social support from crowds, groups, and individuals to allow a more fair comparison.

**Participant Variability:** This research is also limited in that it is trying to work across a variety of different participants and did not always take personal user differences and preferences into account. For example, research suggests that personality, age, and background can impact adoption to technology [Morris et al 2000]. Due to time and limitations in the data collection, I did not sufficiently examine how personality might impact the way participants responded to online social support and am interested in delving into this further for future research to better understand how sociotechnical systems can support different types of newcomers. Future work could explore the impact of online social support internationally and across a larger diversity of work contexts to assess if this research can extend to a variety of settings. For example, future work could explore the impact of online social support systems for workers in highly demanding
settings in need of social support such as young medical professionals who deal with intense work stress, military personnel working in high-stress conditions in diverse geographies. In addition, future work should explore how participants from a diverse array of ethnicities, socio-economic backgrounds, genders, and personality types respond to online social support. For example, I hypothesize that people of the same gender and background might feel more comfortable sharing together online, pending that they both feel their responses are strictly confidential. Future work should explore how online social support systems impact personalities and subgroups of people who are in need of increased online or offline social support. This is particularly important given than newcomers who are from minority groups, specifically based on gender or racial-ethnic identities, have been shown to have lower levels of self-efficacy [Meister et al 2014]. For example, despite comparable levels of ability at the start, women rated their self-confidence and abilities as lower than their male counterparts’ due to feelings of isolation, insecurity, intimidation, and questioning of their ability to continue at a task [Seymour & N. Hewitt 1997]. As a result, minority group members can feel threatened and experience a lack of identity which can be impacted when they feel a lack of inclusion, support, and identity safety [Murphy & Destin 2016]. This is particularly dangerous for organizations given the benefits of having women and minority group members on a team [Ng & Burke 2005]. Thus, further exploration into the role that online social support can have for minority groups would be valuable.

**Measuring External Online and Offline Communication:** Across all three studies, we were limited in the data we could collect regarding what online and offline communication was occurring externally from our systems (ex: e-mails, messages, or in person). While we asked
newcomers in all three studies were asked about their external communication in interviews and also examined their communication styles in multiple channels, we could not measure it precisely, limiting our understanding of how other forms of communication and external factors impacted newcomer social support and self-efficacy development. Thus, future work could explore different communication means while using tools and how newcomers were receiving social support alongside our interventions. Furthermore, we might test future systems that better monitor and track behavior of workers or that allow for daily journal logs from workers for the purposes of a more precise study and understanding all communication patterns.

In sum, future research in this area should explore how socio-technical systems can foster online and offline social support to those in need of social support. To do so, future work might involve: (a) larger sample sizes to allow for greater quantitative analysis, (b) increased understanding of how the research applies in a variety of work contexts, (c) increased understanding of how online social support impacts different personalities, and (d) measuring external forms of online and offline communication.

6.4 General Conclusion & Broader Impact

The studies presented in this dissertation build on one another to help us understand how sociotechnical systems can be designed to impact online and offline social support for newcomers. Study One found that online crowds can impact the self-efficacy of newcomers through showcasing role-models, providing social support, highlighting mastery, and helping normalize failure. However, newcomers did not always feel supported through the public platform and many desired more personalized support. Study Two of CheerOn found that an enterprise-messaging system can help support newcomers in their work by offering social
support throughout the learning process. However newcomers still had difficulty feeling sincerely supported due to the nonspecific nature of the feedback and the depersonalized aspects of social support provided. Thus, Study Three sought to make social support more personal by connecting newcomers with one individual mentor for paired online reflection on learning and progress on *Pairachute*. While Study Three found that paired reflection with mentors could prompt some online and offline social support and help mentors better understand newcomer needs, many users did not participate on the tool and mentors rarely gave online social support due to time and a desire to converse offline rather than online.

Comparing the findings of these three studies side by side, clear patterns emerge. For one, I find that across all studies, online social support from external supporters was inconsistent and difficult to facilitate without prompting. However, when it occurred it was often appraisal or informational support online, and sometimes prompted emotional or instrumental support offline. Secondly, I found across systems that asking for help and revealing vulnerability online was difficult for newcomers. However, online supporters from across all three platforms could sometimes see that newcomers needed social support from externalized progress online and stepped in to provide online and offline support. Finally, I learned that across studies, externalizing progress online helped newcomers see their own progress publicized to an online audience and also helped them to learn from the progress of others, increasing opportunities for building mastery and modeling in ways that are not possible offline.

Altogether, this dissertation contributes to a larger understanding of how technology can be utilized to support people at work. My findings across all three studies suggest that technology can enable us to accomplish tasks that we, as humans, often struggle to do. For
example, technology can remind us to check in with people, provide examples of role models, show us the progress we have made when we forget, and draw on a larger community of virtual people to cheer us on when we feel alone or frustrated. However, there are some tasks technology alone cannot replace and that could be more effectively facilitated by human-human interaction. Expressing vulnerability online proved difficult. Some conversations are best done offline. In addition, participants across my studies often desired in-person contact and meetings to get help. Newcomers and supporters across all three studies were busy and overwhelmed, and technology often added to their cognitive load. Utilizing technology for the features that it can help us with, and using it to encourage necessary offline human interactions, is where the Human Computer Interaction dynamic needs continued attention.

This research helps us find ways to better utilize technology to provide online social support for newcomers, impacting their self-efficacy, retention, and performance. Corporations and managers can benefit from this research as it can potentially help to increase length and depth of employee engagement, decreasing costs associated with high turnover [Kats 1980]. In addition, this research adds to our understanding regarding how technology can facilitate greater self-efficacy and motivation in newcomers and identification of the most powerful cross setting elements for the support of newcomers. Furthermore, it allows us to better understand how crowds, groups, and individuals can be motivated to provide online social support for newcomers at work. These findings have implications not only for the way we use technology to support newcomers – but also for the ways in which we can support workers of all kinds. Increasing the number of newcomers who stay engaged in complex work helps solve some of society's greatest global challenges.
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APPENDIX A: DISSERTATION CONTRIBUTIONS. The literature review and three studies presented in this research build our understanding of how online systems can prompt social support, as well as the limitations of online systems for supporting workers.

<table>
<thead>
<tr>
<th>Contribution</th>
<th>Methods</th>
<th>Participants</th>
<th>Relevant Data Used</th>
</tr>
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<tr>
<td>Extensive Interdisciplinary Literature Review assessing related work on the development of self-efficacy in newcomers and facilitating online and offline social support through reflection.</td>
<td>Interdisciplinary literature review to develop key insights based on themes across disciplines [Fitzpatrick &amp; Elligsen 2013; Froehlich et al. 2010]</td>
<td>215 articles read and assessed from HCI, psychology, learning sciences, and organizational behavior</td>
<td>Notes and common themes compiled in spreadsheet from articles read</td>
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<td>Understanding of the impact of online social support from online crowds via Crowdfunding on the development of self-efficacy in newcomers through (1) showcasing mastery, (2) providing role models, (3) providing online social support, and (4) promoting resilience.</td>
<td>In-depth semi-structured interviews with newcomers to entrepreneurial work [Panovich et al. 2012; Hui et al. 2014; Drever 1995]</td>
<td>53 Entrepreneurs participating on Crowdfunding sites</td>
<td>Transcripts of interviews with newcomers</td>
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<td>Design &amp; Evaluation of CheerOn system and its impact on facilitating online social support for newcomers in PBL classrooms from groups of supporters through prompting online social support and showcasing progress online.</td>
<td>Observational needfinding case study [Sake 1995] and semi-structured interviews [Panovich et al. 2012; Hui et al. 2014; Drever 1995] with newcomers in a project-based learning setting and their assigned supporters Design-Based Research process for developing CheerOn [Easterday et al. 2017; Easterday et al. 2016]</td>
<td>Needfinding – 15 participants (newcomer students) Field Testing – 12 students (3 PBL teams)</td>
<td>Transcripts from interviews with newcomers and supporters Observational notes from watching students in the classroom Log data from CheerOn tool use</td>
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<td>Design &amp; Evaluation of Pairachute system and its impact on facilitating online social support for newcomers in corporate settings from individual mentors through prompting and showcasing reflections on progress and learning between pairs online.</td>
<td>In-depth semi-structured interviews [Panovich et al. 2012; Hui et al. 2014; Drever 1995] with newcomers, mentors, and HR staff in a corporate setting Design-Based Research process for developing Pairachute involving prototype testing and interviews, followed by user testing in the field with interviews, surveys, and log data collection [Easterday et al. 2017; Easterday et al. 2016]</td>
<td>Needfinding – 30 participants (mentors, HR staff, and newcomers) Lab Testing – 15 newcomers in a lab setting Field Testing – 100 newcomers and mentors in a corporate setting</td>
<td>Transcripts from pre and post interviews with newcomers and mentors Log data from Pairachute tool use Pre and post survey from newcomers and mentors</td>
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