Knitting Community: Human and Social Capital in the Transition to Entrepreneurship

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ABSTRACT

The process by which individuals become entrepreneurs is often described as a decisive moment of transition, yet it necessarily involves a series of smaller steps. This study examines how human capital and social capital are accumulated and deployed in the earliest stages of the entrepreneurial transition in the setting of "user entrepreneurship." Using the unique dataset from Ravelry—the Facebook of knitters—I study why and how some knitters become designers. I show that knitters who make the entrepreneurial transition are distinctive in that they have experience in fewer techniques and more product categories. I also show that this transition is facilitated by participation in offline social networks where knitters garner feedback and encouragement. Importantly, social and human capital appear to complement each other with social capital producing the greatest effect on the most skilled users. Broader theoretical implications on user innovation, the role of social capital, and entrepreneurship research are discussed.

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1. Introduction

How do individuals become entrepreneurs? The process by which individuals become entrepreneurs is often observed as a decisive moment of transition, yet it necessarily involves a series of smaller transitions from a stage when the individual is a mere consumer (or perhaps an employee) until launching a new business. Throughout the process, individuals interact with other individuals and organizations to develop and use their human and social capital and to make decisions, find resources, and realize opportunities (Carroll & Mosakowski, 1987; Hsu, Roberts, & Eesley, 2007; Murray, 2004; Shane & Khurana, 2003). The influence of human capital and social capital begins even before the "eureka" moments of entrepreneurial discovery, as their prior knowledge accumulated from educational and work experiences directs the opportunities to be discovered (Kirzner, 1997; Roberts, 1991; Shane, 2000). Given the cumulative nature of the transition to entrepreneurship, it is necessary to observe the beginning of the entrepreneurial process to answer why and how some individuals become entrepreneurs while others do not.

Past research on this question generally has focused on its later stages. For example, the Panel Study of Entrepreneurial Dynamics has been productively analyzed by various scholars (Greenberg, 2009; Reynolds, Carter, Gartner, & Greene, 2004; Ruef, 2010; Ruef, Aldrich, & Carter, 2003) for how the human and social capital of "nascent entrepreneurs"—those who are looking to found a firm but have not yet succeeded in doing so— facilitate their transitions to becoming (successful) entrepreneurs. There has recently been valuable research on how entrepreneurial pitches, venture capital funding, or participation in accelerators facilitate this transition (Burton, Sørensen, & Beckman, 2002; Fehder, 2016; Greenberg & Mollick, 2017), but such research provides limited insight about the process by which individuals become nascent entrepreneurs in the first place. Another productive approach is to track the career histories of the general population to find entrepreneurs who changed their employment statuses from employees to employers (Amit, Muller, & Cockburn, 1995; Carroll & Mosakowski, 1987; Giannetti & Simonov, 2009; Nanda & Sørensen, 2010; Roberts, 1991). But, changes in employment status may also occur at a later

stage of the entrepreneurial process, as an increasing number of nascent entrepreneurs divide their time between employment and leisure activities to reduce the risk of leaving their jobs completely (Lévesque & Schade, 2005). According to a nationally representative survey of US business founders, 58% of nascent entrepreneurs were working for someone else, while 27% of founders started their businesses as leisure activities or hobbies (Kim, Longest, & Lippmann, 2015).

With this context in mind, "user entrepreneurship" is an especially valuable context for observing and understanding key early stages in the entrepreneurship process. Grounded in the user innovation literature (von Hippel, 1988), recent studies of user entrepreneurship focus on individuals who become entrepreneurs based on their experience as frustrated users (Shah, Smith, & Reedy, 2012; Shah & Tripsas, 2007). Examples of frustrated users who become successful entrepreneurs are common. Nike was founded by a track-and-field coach who wanted to make a better running shoe for his students (Moore, 2006); Houzz was founded by a couple who could not find good resources when renovating their new house (Kurutz, 2012); and Spanx was founded by a salesperson who was required to wear dress pants at work but hated visible panty lines (O'Connor, 2012). Thus, by observing users and their experiences related to their entrepreneurial opportunities, we can better understand why some people create new ideas based on their user experiences, tinker with their ideas, and eventually commercialize them.

In particular, I examine how human capital and social capital are developed and deployed in the entrepreneurial transition of users. Previous literature on both entrepreneurship and user innovation suggests the importance of related knowledge and expertise in the generation of new ideas and entrepreneurial entry (Roberts, 1991; Shane, 2000; Kim, Aldrich, & Keister, 2006; Kacperczyk & Younkin, 2017; Franke & Shah, 2003; Lüthje, 2004; Oliveira, Zejnilovic, Canhão, & von Hippel, 2015; Shane, 2001). In addition to the role of human capital, recent studies have shown the positive effect of peers and social capital on entrepreneurial transitions (Aldrich & Zimmer, 1986; Eesley & Wang, 2017; Kacperczyk, 2013; Nanda & Sørensen, 2010; Stuart & Ding, 2006; Tartari, Perkmann, & Salter, 2014). The dominant mechanism shown in previous studies is that social capital provides access to information

and resources that enable discovery of entrepreneurial opportunities and business execution (Burton et al. 2002).

However, another stream of studies suggest a broader role for social capital in encouraging individuals, and that the effect cannot be reduced to the provision of resources or education. For example, Zuckerman & Sgourev (2006) documented that one of the roles of social capital in the "industry peer networks" common in the small business sector is not only to learn from each other but to augment motivation and raise aspiration levels. Recent studies on the geographic spillover of entrepreneurship also describe a similar social process by which local peers shape aspiration levels and increase the social attractiveness of entrepreneurship (Giannetti & Simonov 2009; Sorenson 2017; Sorenson & Audia 2000). This can be especially salient in the earlier stages of the entrepreneurial process when those who consider starting a business take the lowest-cost steps, such as getting feedback from their friends (Bennett & Chatterji, 2017).

One way to disentangle the mechanisms is by investigating for whom the social capital makes the biggest difference. When the main role of social capital is to provide resources, it helps individuals to compensate for their lack of human capital. Evidence from several studies resonates with the explanation, as the peer effect is shown to be greater for those who have lower levels of entrepreneurial resources (Eesley & Wang, 2017; Nanda & Sørensen, 2010; Stuart & Ding, 2006; Tartari et al., 2014). However, when the role of social capital is not to provide education but to reveal talented individuals and encourage them, the effect should be higher for those who already possess entrepreneurial human capital. In this study, I present both qualitative and quantitative evidence that social capital can complement human capital, as the mechanism of the social capital effect is peer feedback and encouragement.

My setting is an online marketplace for knit patterns, Ravelry.com, where minority of the knitting hobbyists (3-4%) transition to become designers who create and sell their original design patterns. Using data on 403,199 individual knitters' activities between 2007 and 2014, I first find that—compared to the majority of users who have not become designers—future designers have distinctive human capital in

terms of their depth of expertise and tendency toward experimentation. Although entrepreneurial human capital is necessary for the entrepreneurial transition, it is not sufficient. Specifically, I find that some knitters—"creative knitters"—have significant skills and demonstrate their abilities to create original designs but do not necessarily produce their designs to share with or sell to other knitters. Qualitative evidence shows that the motives and skills of creative knitters are almost identical to those of designers, and the only difference between them is the existence of social networks that triggered them to become designers. Based on this observation, the second part of the present study tests the effect of users' encounters with their peers on their transitions to become entrepreneurs. Specifically, I measure the effect of a knitter joining a local networking group whose members' primary purpose is motivating and supporting each other. With a closely matched sample of potential designers, the difference-in-difference analysis shows that joining such a local group increases the probability of entrepreneurial transition by 26 percent.

In addition, I find that this effect is particularly strong among creative knitters who already have developed innovative ideas and a higher potential to innovate. Qualitative evidence suggests that this is because creative knitters are the first to be encouraged and get positive feedback. About half of the designers interviewed mentioned that they had been creative knitters for years but it was not until they were encouraged by their fellow knitters and friends that they actually began to codify their designs so they could be sold to others. According to those designers, social capital helped them to "*get over their shyness and develop self-confidence in their designs*" and this is especially important for early entrepreneurial transitions of users who *"think the biggest personal challenge is believing in yourself–that what you are creating is something that is desired and valued by others."* The evidence support the positive interaction effect between human capital and social capital, as users who have better skills are more likely to be encouraged by their close peers.

The rest of the paper proceeds as follows. In the next section, I describe my research setting as well as the empirical advantage and generalizability of the setting. Section 3 presents my analysis of the

individual determinants of entrepreneurial transition based on the human capital perspective. In the next section, I present my qualitative evidence on creative knitters and designers that motivates the social capital perspective in the entrepreneurial transition. Section 5 presents my analysis of the effect of social capital on entrepreneurial transition, including the interaction effect between human capital and social capital. Section 6 concludes and discusses in detail the implications of the study for research in user innovation and entrepreneurship.

2. Setting

I examine the determinants of the entrepreneurial transitions of knitters. Generally, knitters make a knitting "project" (e.g., a sweater) by following a specific "pattern" designed by a professional designer. A standard knitting pattern consists of pictures of the finished project, information about necessary materials (e.g., yarn and needles), the gauge and sizing, as well as detailed step-by-step instructions. In the market for knit patterns, designers are producers and knitters are consumers who follow patterns to create their projects. Figure 1 shows how this market works. Traditionally, knitters accessed new design patterns from knitting magazines, pamphlets provided by local yarn stores, or pattern books. However, through digitization, it is now easier for knitters who are able to create original designs to share their design patterns through their personal blogs or online communities. Since Ravelry.com was launched in 2007 and grew to be the largest online community and marketplace for knitters, the entry barrier to becoming a designer has been lowered even further.

—Figure 1 goes about here—

By 2018, Ravelry—the so-called "Facebook of knitters" (Martin, 2012)—served over 7 million registered knitters throughout the world. According to a survey by The National Needle-Art Association, 86% of active knitters reported that they use Ravelry (TNNA, 2013). Ravelry became an important platform for knitters for several reasons. First, it provides an archival system for knitters who want to keep track of their projects. When recording their projects in digital libraries, the knitters include the

specific patterns they used in their projects, the characteristics of the yarns used, and the dates they started

and finished their projects. In this way, knitters can conveniently archive the history of their knitting

activities in great detail through Ravelry.com. Second, Ravelry connects knitters via various

communication features. It supports "groups" and "forums" where knitters with common interests get

together, share information, and support each other. Last but not least, Ravelry serves as a marketplace for

knit designers. Nascent designers can easily open designer accounts to run their design shops, and

Ravelry provides extensive resources for operating the shop from payment systems to sales analyses. In

2014, 11,500 individual designers—excluding yarn companies and publishers—sold at least one pattern,

and they recorded a cumulative total of 11.2 million USD in annual sales. As of 2018, over 20,000

designers were sharing over 700,000 different design patterns through Ravelry.

I use the dataset scraped from Ravelry in May 2017, and define entrepreneurial transitions of

users as knitters' transition to become designers who charge for their original patterns. According to the

definition below, it is the transition from knitters (a) to entrepreneurs (c). Table 1 provides a detailed

categorization of knitters in Ravelry and their descriptive statistics.

(a) Knitters (users): A knitter is defined as someone who is registered in Ravelry to look at and use

patterns, but does not create her own original patterns. In general, knitters follow a specific pattern of a

designer to create a project and clearly indicate the pattern used in the project. A small subset of knitters

are defined as creative knitters and described in detail below in the beginning of section 4.

(b) Designers (producers): A designer is who has a designer account and who produces designs to share

with or sell to others. Although Ravelry has made becoming a designer easier than ever, only a minority

of knitters became designers. As shown in Table 1, only 3.3% of knitters were designers with at least one

pattern in Ravelry. Among all designers, those who do not charge for their designs and share them for free

are defined as *sharing designers*, while those who have at least one pattern for sale are categorized as

entrepreneurs.

(c) Entrepreneurs: Once a knitter produces a knit pattern, she can either share it for free or sell it for a price.[2] A designer can also do both by selling some patterns while sharing others for free. Designers who have at least one pattern for sale are defined as entrepreneurs. As shown in Table 1, only 1.5% of knitters become entrepreneurs.

—Table 1 goes about here—

My data on knitters' entrepreneurial transition provides two important empirical advantages. First, by focusing on the field of knitting, I can access the entire risk set of user entrepreneurs in the field. Since knitting designers necessarily have experience in knitting before they can become designers, every designer begins her career as a knitter. Therefore, the pool of knitting users serves as an appropriate risk set of user entrepreneurs. Second, the data provides a rare opportunity to observe the usage behavior of future entrepreneurs at a fine-grained level. In general, a user's transition to becoming an entrepreneur is observable only after they make the transition, so their pre-transition activities are difficult to observe. Since my setting provides pre-transition activities in detail, I can test not only how future entrepreneurs are different from users who remain as users (i.e., their human capital), but also how their individual characteristics interact with the effect of social capital.

While the hobbyist niche of knitting may seem idiosyncratic, there are at least two important reasons to believe it has broad implications. First, the setting resembles many other cases of entrepreneurial transition in various online platforms such as Etsy (craft producers), Udemy (teaching-content producers), SumZero (analysts), Thumbtack (local services providers), YouTube (video channel owners), etc. As a wide variety of online platforms open opportunities for general users to become producers, the study can provide more general insight on who becomes a producer and what triggers the

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[2] Another way to become a paid designer is by submitting patterns to magazine or book publishers. Selling patterns to printed publications has been the major route to becoming a professional designer for decades until online marketplaces emerged. The print publication route is not considered in this study for two reasons. First, most designers who sell their patterns to print publications tend to be established designers. Therefore, they are excluded from the sample assembled to study the transition to becoming a designer. Second, many magazines now allow designers to sell their patterns via online marketplaces, and one can publish in print and sell online at the same time.

transition. Second, hobbyists *per se* play an important role in entrepreneurship generally. According to a nationally representative survey of US business founders, 27% of founders started their businesses as leisure activities or hobbies (Kim, Longest, and Lippmann, 2015). Furthermore, the boundary between one's hobby and one's work is becoming blurry, and an increasing number of nascent entrepreneurs split their time between employment and their leisure activities (Levesque and Schade, 2005). Therefore, understanding hobbyists' entrepreneurial entry is important to understanding who becomes an entrepreneur and what triggers the transition in general.

3. Entrepreneurial Human Capital

In this section, I investigate the characteristics of users who become entrepreneurs. Based on detailed observational data on users, I analyze how entrepreneurial human capital is accumulated and deployed in the early stage of the entrepreneurial transition. In particular, I first examine how users' accumulated experience affects their transitions to entrepreneurship. Prior studies on user innovation show that higher levels of users' expertise and specialized knowledge leads them to innovate (Franke & Shah, 2003; Lüthje, 2004; Oliveira et al., 2015), but research on entrepreneurship suggests that entrepreneurs tend to be generalists with diverse skill-sets (Lazear, 2004, 2005). To resolve these conflicting arguments, Kacperczyk & Younkin (2017) separated market expertise from technical expertise and showed heterogeneous effects on the entrepreneurial transition. Based on this line of research, I examine the effect of (a) users' general experience, (b) their market experience, and (c) their technical experience on the transitions. Second, I study the users' entrepreneurial human capital reflected in their usage behaviors. Specifically, I examine if future entrepreneurs are distinctive with respect to (a) whether they repeatedly use their favorite products or enjoy exploring new products, and (b) whether they follow the suggested way of using the product or experiment with their own way of using it.

3.1. Data and Methods

The sample includes Ravelry users with at least one project adequately linked to any pattern by the end of 2014. Then I narrowed the sample to users with identifiable profile pages and location information. Non-US knitters were excluded to control unobserved cultural differences in knitting activities and social behaviors. Furthermore, I excluded knitters who were not appropriate constituents of the risk set. Because my main focus is to predict the risk of a knitter's transition to an entrepreneur, I dropped established designers who were designing before joining Ravelry.[3]

For analysis, I employ discrete-time hazard rate models. The hazard rate with time and other covariates is as follows:

$$\ln\left(\frac{p_{it}}{1 - p_{it}}\right) = \alpha_t + \beta' X_{it}$$

where the hazard rate is $p_{it} = \Pr[T_i = t | T_i \geq t, X_{it}]$, T_i is the time at which knitter i becomes a designer, X_{it} is a vector of covariates, and α_t is a set of time variables. In practice, I estimate a logit of the transition where the sample consists of each quarter for every knitter. The model incorporates the time effect with the number of years the knitter has spent in Ravelry (8 indicator variables). Covariates are measured at each quarter, and 29 indicator variables of each quarter are included to control both the seasonal effect and the lifecycle effect of the website or of knitting in general. Once a knitter becomes a designer, her post-transition observations are omitted as they are no longer at risk of another transition. Knitters who did not make the transition were observed for the full period from when they joined Ravelry to the end of 2014. My final sample for this human capital analysis consists of 6,798,353 knitter-quarter observations for 403,168 individual knitters.

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[3] Established designers were detected in two ways. First, I excluded knitters whose patterns were listed by other Ravelry users before the designer joined Ravelry. Second, I excluded knitters who retrospectively filed their publication records with the oldest pattern published before 2005. I chose 2005 over 2007 because designers who self-reported that their first pattern was designed between 2005 and 2007 tended to be nascent designers whose careers were motivated more by the availability of online platforms than established designers who had been designing for traditional media.

The purpose of this analysis is to find leading indicators of the transition to entrepreneurship among the correct set of users. The analysis shows who is more or less likely to transition, but it does not make any causal claim as entrepreneurial human capital can be accumulated endogenously with the knitters' decisions to become entrepreneurs. Note also that the analysis does not include individual knitter fixed effects, thus focusing on between-individual variations to identify the determinants of entrepreneurial transitions. Further analyses with individual fixed effects are presented in Appendix A.

3.2. Variables

3.2.1. Dependent Variable: Entrepreneurial Transitions

The first transition I examine is the transition of a knitter (user) to become a designer (producer). For a knitter to become a designer, she opens a designer account—which is different from her user account—prepares the page of her store, and uploads her original patterns. I consider the moment she releases her first pattern to be her transition to become a designer. Table 2 shows descriptive statistics for the variables including transitioning to become designers.

—Table 2 goes about here—

The second transition I examine is the transition of a knitter (user) to become a designer who charges for her designs (entrepreneur). I consider the designers who have at least one pattern for sale during the observation period the entrepreneurs, and the first releases of for-sale patterns charging the price the transition to become an entrepreneur.

3.2.2. Independent Variables: Knitting Experiences

General level of experience. Knitters in Ravelry keep records of the knitting projects they are working on as well as the projects they have completed. The more projects a person lists means the more frequently she person has been knitting. Therefore, I use the number of projects as a proxy for the general level of knitting experience. By 2014, the average number of projects per knitter was 10.68. The distribution of the number of projects is highly skewed (median at 2, maximum at 1,583). Therefore, the

variable is included in the model as categorical variables with 9 sub categories (0, 1, 2, 3-4, 5-9, 10-19, 20-39, 40-99, 100+). The results remain consistent when the variable is included as a logged value of the number of projects.

Technical experience. Every pattern indicates specific knitting techniques that are required to finish the pattern's project. Ravelry has categorized 50 knitting techniques that are linked to the patterns, including 7 color-work techniques (e.g., Intarcia, mosaic, stripes), 27 construction techniques (e.g., one-piece, worked flat, worked in the round), and 16 fabric techniques (e.g., cables, lace, ribbed). To measure the level of technical experience, I use the number of different techniques the knitter has tried throughout her projects until time t when the variable is measured. On average, a knitter had tried 9.75 techniques by 2014 with a median of 6 and a maximum of 49.

Market experience. Based on the 26 pattern categories that Ravelry suggests (e.g., sweater, coat, dress, bag, hat, blanket, softies), I examine whether the likelihood of becoming a designer increases when the knitter experiences more diverse market segments of different product categories. The variable counts the number of different categories the knitter has made until time t when the variable is measured. By 2014, a knitter on average experienced 3.21 product categories, with a median of 2 and a maximum of 25.

Repeated applications. Although over 700,000 patterns are available in Ravelry, knitters often work on the same pattern they previously completed. For example, a knitter can create 10 projects that apply the same hat pattern but with different colors of yarns. In this case, I consider the 9 follow-on projects of the knitter after her first project of the specific hat pattern as "repeated projects." On average, 12% of projects are repeated projects. The variable is measured by the number of repeated projects divided by the number of all projects.

Disobedient applications. When a designer writes a pattern, she can suggest a specific kind of yarn that is best for making that pattern and knitters use their discretion about whether to follow the suggestion. A knitter is more likely to achieve the expected results when she follows the suggestion, as

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different yarns are made of different materials and have different thicknesses or softness. I use the proportion of projects using the same yarn as suggested by the designer as the knitter's tendency to obey the suggestion. By "the same yarn," I refer to the same product line of the same brand, but not necessarily the same colorways. For example, Belle 8-ply Superwash yarn of the brand name Red Riding Hood Yarns is one kind of yarn, regardless of whether its colorway is Cherry Blossom or Lavender. About 26.5% of projects are constructed with the same yarn as suggested by the designer.

3.2.3. Control Variables

First, I control *completeness of yarn information*. Since project information is self-reported and yarn specifications are not mandatory, all knitters do not indicate the kinds of yarns they employed in their knitting projects. Since the proportion of projects using suggested yarns significantly differs by the number of projects with yarn information, I additionally included the ratio of projects with yarn information as a control variable. The variable not only improves the validity of previous measures but also can be a proxy for the knitter's commitment to maintaining her Ravelry digital library. Second, whether the knitter joins the editors' group is also included in the model as a control. Knitters in Ravelry may volunteer to become editors who edit Ravelry patterns and yarn records. About 3.5% of knitters in my sample joined the editors' group by 2014, and they tended to have higher levels of experience in knitting. Since the primary job of editors is to edit pattern records in Ravelry, editors are also more exposed to new patterns and are, therefore, expected to show higher rates of transition to becoming designers. Third, as explained in the model section, the time effect with the number of years the knitter has spent in Ravelry (8 indicator variables), and 29 indicator variables for each quarter are included to control both the seasonal effect and the lifecycle effect of the website or of knitting in general.

3.3. Results

The results from the discrete-time hazard rate regressions are found in Table 3. Model 1 shows the effect of knitting experience variables on a knitter's transition to becoming a designer. Models 2

analyzes a knitter's transition to becoming an entrepreneur, a designer who sells her pattern. I interpret the effect of each of five knitting experience variables below, followed by generalized implications for entrepreneurial transitions at the end of this section.

—Table 3 goes about here—

First, the number of projects positively associates with the probability of entrepreneurial transitions. That is, a knitter is more likely to become a designer and an entrepreneur as she accumulates general experience in knitting by making more projects. Second, the number of different techniques a knitter has experienced has a negative coefficient, meaning that future designers tend to focus on honing a small set of knitting techniques. Third, in contrast with the diversity of techniques, the diversity of product categories has a positive association with the probability of entrepreneurial transition. That is, the more product categories a knitter explores, the more likely she is to become a designer (Model 1) and an entrepreneur (Model 2). The result implies that future designers tend to have generalized or diversified market knowledge, which resonates with prior studies suggesting that entrepreneurs tend to be generalists with balanced skill-sets (Lazear, 2004, 2005). Together with the aforementioned evidence on knowledge depth, it is more likely that specialists in technical experience but generalists in market experience make entrepreneurial transitions.

Fourth, the probability of entrepreneurial transition increases with the proportion of repeated applications. In other words, future designers tend to work on the same patterns repeatedly, while pure users (i.e., knitters who remain as users) tend to apply different patterns every time they knit. Fifth, Model 1 shows that the transition to becoming designers is more likely to happen when knitters do not obey other designers' suggestions and, instead, make projects using yarns of their own choosing. The results show that the less obedient the knitter is, the more likely she is to become a designer. However, unlike the previously mentioned four other characteristics that show consistent effects in Model 1 and Model 2, the disobedient application effect shows an opposite sign in Model 2. Disobedience leads knitters to create their own designs to share, while those who sell their patterns tend to show lower levels of disobedience.

These results offer valuable insights about which users become entrepreneurs and how they differ from users who remain users. It is possible that unobservable entrepreneurial characteristics of some users are reflected in both their knitting activities and entrepreneurial transitions. However, this possibility is largely excluded if the analysis controls for unobserved characteristics of individuals. Table A1 of Appendix A shows that the results are the same in a test with individual fixed effects. At the same time, while the analysis suggests what characteristics are associated with transitions to entrepreneurship, these associations are not necessarily causal: future designers might develop their human capital in ways that reduce the cost of transition. For example, by not following the suggestions of designers and choosing different yarns, the knitter can learn how to make modifications in the gauge or the sizing of the project. In this case, the results imply that improvement in entrepreneurial human capital increases the probability of entrepreneurial transition.

4. The Role of Social Capital: Qualitative Evidence

But why do some users become entrepreneurs while others with the same level of entrepreneurial capital do not? To make progress on this question, I first identify a subset of talented users who did not become entrepreneurs—"creative users"—as a comparison group of entrepreneurs who made the transition, and show that the two groups are equally skilled and creative. I then present qualitative evidence that users' social networks play an important role in facilitating the entrepreneurial transition.

Creative knitters are defined as those who indicate that they incorporated two or more patterns to create their projects rather than applying one pattern exactly. For example, if a knitter created an original hat project that included elements of sweater pattern X and another hat pattern Y, her project is not associated with any pattern but is categorized as a new project incorporating patterns X and Y. If a knitter has at least one creative project that incorporated other designs, she is considered to be a creative knitter. As shown in Table 1, creative knitters have higher levels of entrepreneurial human capital. Their levels of expertise and tendency to disobey are significantly higher than passive knitters who follow designers'

patterns exactly. The comparison suggests that entrepreneurial human capital is necessary for the entrepreneurial transition, but it is not sufficient for the transition. To investigate what drives users to make entrepreneurial transitions while others with entrepreneurial human capital remain creative knitters, I conducted an archival study on the designers and creative knitters in Ravelry.

The main sources I used to study designers include the interview sections of Patternfish newsletters (N=50) and three interview-intensive blogs (35 interviews by Kimberly Golynskiy of Around the World in 80 Skeins, 11 interviews by Jean Clement of Desert Rose Fiber Art, and 8 interviews by Marie Segares of Underground Crafter). I chose these sources because (a) to my knowledge they provide the most extensive interviews—employing the same format—on multiple designers and (b) they ask how the interviewee became a designer. In answering that question, 70% of interviewed designers shared a story about what motivated their transition. To supplement the interviews, I also used information found in the Ravelry store accounts and personal blogs of the interviewed designers. Because four designers interviewed with more than one of the interviewers, the sample for this qualitative study includes 99 designers.

I also collected stories by creative knitters in the Ravelry discussion forums for "modifiers" who do not follow an exact pattern and modify it to their taste. By comparing stories by those who made the transition to designers with those who did not, the following patterns emerged: (a) both creative knitters and designers create new designs, and the reasons for creating new designs are very similar, (b) most designers were creative knitters who became designers when encouraged by people in their social networks, and (c) social feedback is the mechanism by which knitters' networking affects their transitions.

First, the motive to become a creative knitter seems very similar to that of becoming a designer. Many creative knitters mentioned that they had never really followed a pattern, and the reasons why they created their original projects were to satisfy their creative urges and to feel a sense of independence. Most designers also had been heavy modifiers of patterns. According to the interviews, 55% of designers

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in the sample specifically mentioned their tendency not to follow the patterns line by line, and only 9% of them mentioned their past experience as passive knitters. Many of them described their experience of designing as they "have been always designing since they [I] learned knitting." Both designers and creative knitters also mentioned their experience as frustrated users, as "I was having a hard time finding patterns that fit my style (a designer)," or "I never have a fitting sweater if I follow the pattern blindly (a creative knitter)."

Although both designers and creative knitters tend to be heavy modifiers from the outset and satisfy their specific needs and creative urges through generating projects from their original designs, only designers made the transition. One possible trigger can be a reduction in opportunity cost (Amit et al., 1995; Kacperczyk, 2012; Shah & Tripsas, 2007). For example, Shah & Tripsas (2007) suggest that one reason parent users create the majority of children's products companies is that the potential founders are on parental leave and face lower opportunity costs. This is also observed in the setting of entrepreneurial transition among knitters. Eight percent of designers explained that they started their ventures when they were in situations during which they focused on knitting (e.g., illness, unemployment, pregnancy, immigration, etc.). However, the opportunity cost of knitters in general has been significantly reduced by the introduction of Ravelry, as the platform provides every administrative and technical support service needed for potential designers. In fact, 4% of designers answered that their transitions to become designers were encouraged by the existence of Ravelry and other technical advances. On the other hand, 3% mentioned financial reasons, 7% transitioned naturally from relevant jobs such as fashion designing, and 13% mentioned a specific piece they needed to make or a specific customer (usually their child) they wanted to fit.

In addition to those answers, the most salient reason that was suggested by 35% of designers in the sample (i.e., 50% of designers who shared any story) was encounters with and encouragement from people they knew. As shown in the quotes below, most designers had been generating new design ideas

even before they began to codify and share their designs, and the critical moment of making their entrepreneurial transition came when they were encouraged by people they encountered.

> *"I had been designing things for myself for a couple of years and my knitting friends kept encouraging me to write up the patterns."*
>
> *"Someday, someone from my knitting group, Euskadi Knits, asked for the pattern of some improvised mittens... and I started to write down what I was doing... and I ended up as an amateur designer."*
>
> *"Only when people started asking for my chess pattern, did I decide to become a full-time designer. I don't know why the idea never occurred to me before, but I just knew I had to go for it!"*

Oftentimes, the encouragement comes from non-knitters, such as a spouse. One designer recalled, "*My husband is the one who got me to design in the first place. He watched me knit from other people's patterns, and remarked that I never could completely follow one as written. I'd change a neckline here, add pockets there, re-work the math to match the gauge I got….If it weren't for him I don't know how long it would have been before I took the next step into design. But he was there, encouraging me to try, and since 2007 I've been designing non-stop.*" The observation resonates with the literature on early stage of entrepreneurship that one of the first steps taken by individuals pursuing entrepreneurial opportunities is to speak to a friend about their business ideas and get feedback (Bennett & Chatterji, 2017). Note that the friends or family members in these cases are not necessarily experts in the field, yet future entrepreneurs seem to gain motivation from their feedback and encouragement.

Why do talented knitters begin producing original patterns only after they are encouraged by others? One knitter provided this answer: "*It wasn't until people were commenting on my sweaters and asking where the patterns came from that I decided to write them.*" because "*I had to get over my shyness and develop self-confidence in my designs.*" That is, potential designers often are not certain about the potential market reaction to their ideas or whether they are desirable and valuable to others. They can gain self-confidence by exposing themselves to like-minded community members and getting social feedback. This resonates with another study showing that craft workers show greater willingness to sell their work

to an audience who can appreciate it (Ranganathan, 2017). In this context, local community members serve as good audiences who can provide social feedback, mitigating the fear of negative audience reactions in the market and enhancing self-confidence. The mechanism is supported by another designer who writes:

> *"For many entrepreneurs, I think the biggest personal challenge is believing in yourself–that what you are creating is something that is desired and valued by others. Loving an idea and creating a marketable product (which is what the business of designing is all about) are not always the same thing. Taking a design from idea to finished pattern takes a lot of investment in energy, money and time, and there is no guarantee that your idea is a good one until the end of the process."*

This observation is consistent with prior studies that have indicated the importance of learning about one's self in making economic actions and improving job match (Jovanovic, 1979). In a more recent study on nascent entrepreneurs, Howell (2018) show that venture competitions are useful in most part for providing peer feedback.

This observation also supports the particular role of social capital in encouraging individuals to take economic opportunities (Putnam, 2000). For example, an individual is more likely to participate in stock market when they are more sociable, i.e., interacting with their neighbors or attending church (Hong, Kubik, & Stein, 2004). Also, owner-managers of young firms may achieve higher performances when they join local networks and have regular offline meetings with other members (Cai & Szeidl, 2017). And Zuckerman & Sgourev (2006) documented that the perceived benefit of peers in such relationships is not only to learn from each other but also to augment motivation and raise aspiration levels. Recent studies on the geographic spillover of entrepreneurship also describe a similar social processes by which local peers shape aspiration level and increase the social attractiveness of entrepreneurship (Giannetti & Simonov 2009; Sorenson 2017; Sorenson & Audia 2000).

5. The Effect of Peer Feedback on Entrepreneurial Transition

The previous section suggests that peer feedback spurs knitters to pursue entrepreneurial opportunities. This raises the question of whether it is possible to identify the effect of knitters'

encounters with fellow knitters on their entrepreneurial transitions. To that end, I now examine whether the development of social relationships with fellow knitters indeed increases the rate of transition to entrepreneurship.

5.1. Joining SnB Groups

The resurgence of knitting in the United States began with the *New York Times* best-selling book, *Stitch 'N Bitch,* (2003) by Debbie Stoller, a woman who founded a "SnB" group in New York City's East Village in 1999. Thousands of local SnB groups subsequently were created in the US. In general, SnB groups share these characteristics: (a) the meetings are free and open to everyone who wants to join, (b) the purposes of the meetings are primarily for social interaction, and (c) members are strictly local.

Among the groups listed in Ravelry, 3,000 are categorized as SnB groups and provide information about their meet-ups. In general, SnBs declare their location (e.g., the "South End," "Jamaica Plain"), meeting place (e.g., "Panera," "Starbucks"), and an optional characteristic such as religion, profession (e.g., nurses, graduate students, moms), drink preference (e.g., knitting over beer, wine, coffee), and meeting time (e.g., knit night, Sunday morning meet-up). This Ravelry group membership data[4] shows that 71,900 unique Ravelry users belong to at least one SnB group in the United States. On average, Raverlry users are associated with 1.61 local SnB groups. The median size of SnB groups at age one is 13 members, and full size distribution at the end of the group's first year is illustrated in Figure 2.

—Figure 2 goes about here—

5.2. Empirical Strategy

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[4] The membership data do not tell whether a specific knitter attended the meet-up, but as long as the main purpose of the Ravelry group is to organize and schedule the meet-ups and to communicate between group members, knitters have little or no incentive to join the group if they are not going to appear at the meet-ups. Even if they have never been present at an actual meeting, joining indicates their "intent to join the SnB" or their intent to socialize with other knitters.

I use observational data of knitters' SnB membership and consider a knitter's joining a group to be an exogenous shock to a knitter's potential encounters with fellow knitters. A challenge for this approach is that knitters may seek to join SnB groups because they seek to become entrepreneurs. A review of the qualitative data suggests that this is generally unlikely since this is rarely cited as a reason for joining SnB groups, which are framed primarily in social terms.

Nevertheless, it is important to address this endogeneity analytically. To do so, I constitute a counter-factual control group of knitters who could have, but did not, join the group using extensive observed characteristics of knitters including the knitters' locations. Then I provide evidence that the difference in the probability of entrepreneurial transition between treated and control knitters appears only after the treated knitters joined a SnB group. The evidence is shown in Figure 3 and provides an ex-post empirical justification for the construction of the control group for the difference-in-difference analysis (Azoulay, Furman, Krieger, & Murray, 2015; Azoulay, Stuart, & Wang, 2014).

—Figure 3 goes about here—

Specifically, the control group is constructed using coarsened exact matching (Iacus, King, & Porro, 2011) with the knitter's location at the state level,[5] quarter when the knitter joined Ravelry, and knitting experience variables by the (counter-factual) time of group joining. They include the level of general experience, technical experience, market experience, repeated applications, disobedient applications, and whether the knitter joined the editors' group. The experience variables are measured by the time they (counter-factually) joined the group (previous quarter to the quarter they joined the group). Also, I excluded knitters who released their original patterns no later than the fourth quarter after they joined Ravelry. This condition necessarily excludes all knitters who released a pattern in 2007, the year

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[5] Knitters without location information are omitted here. Knitters from Puerto Rico are also excluded because no knitters from Puerto Rico in the sample became entrepreneurs during my observation period.

Ravelry was launched, and it allows me to observe at least three quarters of a knitter's activity before her entrepreneurial transition.

After matching on these variables, I dropped controls that do not minimize the sum of squared differences between treated and control groups by the number of projects. Then I randomly selected one observation per strata for 1:1 matching. The final sample for the difference-in-difference analysis consists of 14,145 knitters who joined at least one SnB group during the observation period, and 14,145 control knitters. The descriptive statistics of treated knitters and control knitters is described in Table 4.

—Table 4 goes about here—

To estimate the effect of knitter i joining her local group in time t, I use a linear probability model with individual fixed effects as below:

$$E[\text{TRANS}_{it}|X_{it}] = \beta_0 + \beta_1 SnB_{it} + f(AGE_{it}) + \delta_t + \gamma_i$$

where TRANS denotes whether the knitter made the entrepreneurial transition (i.e., became a designer who sells her original patterns), SnB is the indicator variable that takes 1 at the quarter she joins the local SnB group, f(AGE) indicates a function of the knitter's tenure at Ravelry, δ_t corresponds to a set of indicator variables for each quarter, and γ_i denotes the individual fixed effect.

5.3. Results: The Effect of Joining a Local Meeting

Table 5 shows the results of the difference-in-difference analysis. Model 1 suggests that when a knitter joins her local SnB group, her likelihood of becoming a designer increases by 0.64 percentage points. Since the likelihood of becoming a designer is as low as 2.4%, the effect can be interpreted as a 26% increase in the probability of transition. Models 2 and 3 test the effects of a knitter joining her local SnB group on the transition to entrepreneurship. Model 2 shows that when a knitter joins the group, her likelihood of becoming an entrepreneur (a designer who sells her patterns) increases by 0.23 percentage points, meaning a 25% increase in the probability of entrepreneurial transition. Joining the group also

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increases the probability of entrepreneurial transition after the knitter became a designer. Model 3 suggests that among a subset of knitters who became designers, joining a SnB group increases the probability to charge prices for their patterns by 13%.

—Table 5 goes about here—

5.4. Results: The Heterogeneous Effect of Joining a Local Meeting

To further examine the mechanism of the SnB effect, I turn to the interaction effect with human capital. First, I examine whether the effect of joining a local SnB group remains the same for creative knitters who already have designing experience and the necessary skills for transition. As shown in Table 6, the effect of joining a SnB group increases for creative knitters.

—Table 6 goes about here—

Second, based on the entrepreneurial human capital I previously described, I test whether the effect of joining a local group differs by the level of human capital the user acquired. To operationalize the level of human capital, I estimate the knitters' predicted probability at one quarter prior to their group membership. The predicted probability is estimated by logit regression including the number of projects made, proportion of repeating projects, number of different project categories explored, number of techniques experienced, voluntary editor status, degree of following yarn suggestions, completeness of yarn information, age in Ravelry, and quarter effect. Figure 4 shows that the higher the level of human capital, the larger the effect of joining local groups.

—Figure 4 goes about here—

The quantitative evidence agrees with the mechanism of social feedback and encouragement suggested in the qualitative evidence in two ways. First, the encouragement effect should be stronger for those who have high levels of skills. Offline in-person interaction allows people to observe each other's skills in detail, so unlike the education effect, the effect should be the most salient among those with the

highest level of entrepreneurial capital. Second, the effect of social encouragement should be stronger for those who already have generated ideas. In-person interaction allows people to observe not only the process of creating an original project but also a set of finished results. Therefore, the experiences as creative knitters will magnify the encouragement effect within the knitters' social groups.

6. Conclusion and Discussion

This study examines how human capital and social capital are developed and deployed in the entrepreneurial transition of users. Using a unique setting of knitting hobbyists where only a minority transition to designers while most remain as users of the designs, the study demonstrates that knitters who make entrepreneurial entries are distinctive in that they are specialist in techniques and generalist in market experience. But, many who have this entrepreneurial capital—creative knitters— do not become designers who produce patterns. A qualitative study suggests that the critical factor explaining why some creative knitters transition to designers is the feedback and encouragement they receive from fellow knitters and friends. With a carefully matched sample, difference-in-difference analysis verifies that the participation in an offline local networking group increases the likelihood of transition by 25%.

Furthermore, the results suggest that social capital effect is largest among those with entrepreneurial human capital, as social capital complements human capital in knitters' transition to designers. When the role of social capital is to provide access to information and resources, social capital allows actors to compensate for their lack of human capital. However, as suggested by the qualitative evidence, the role of social capital in my setting is not to educate but to reveal talented individuals, the effect should be higher for those who already possess entrepreneurial human capital. Therefore, the mechanism of peer feedback explains the major difference between my results and other studies on entrepreneurial transition regarding to whom the social capital is the most effective and the interaction between human capital and social capital.

This study contributes to the existing literature in three ways. First, the study provides the first empirical evidence on the question of which users become entrepreneurs with detailed observational data of users who are truly at risk of becoming entrepreneurs. Second, the study contributes to the literature on the role of social capital in innovation and entrepreneurship by suggesting an understudied mechanism of peer feedback and encouragement. Third, the study provides a novel perspective on the early entrepreneurial process by focusing on the role transition from consumers to producers among hobbyists. This process is becoming increasingly important as the number of online marketplaces and hybrid entrepreneurs increases.

6.1. Determinants of User Innovation

Since the canonical book by von Hippel (von Hippel, 1988), studies on user innovation have focused on the significance and prevalence of users' roles in innovation. The classical approach has been to identify "user" innovators among a set of innovators, show their prominence, and compare their characteristics with others types of innovators (e.g., profit-seeking firms) in the same field. Studies in this stream showed that 11-54% of firms in their sample were founded by users (Shah et al., 2012; von Hippel, de Jong, & Flowers, 2012; von Hippel, Ogawa, & De Jong, 2011), and the ratio increases to as high as 87% in juvenile industries (Shah and Tripsas, 2007). The studies also suggest several characteristics of user innovators that differ from other innovators. For example, Shah, Smith, and Reedy (2012) showed that user innovators possess fewer resources than other types of innovators, yet they are more likely to receive venture capital financing compared to other start-ups. In the same vein, a study of the healthcare industry also shows that products developed by users are rated higher than those developed by professionals (Goeldner, Kaufmann, Paton, and Herstatt, 2014).

Although the comparability or superiority of innovating users to innovating firms has received much attention, little is known about the needed comparison between innovating users and non-innovating users. Such a comparison is empirically challenging as it is difficult to define a set of users who are at risk of becoming user innovators. Since most user-based entrepreneurs can be observed only

after they become nascent entrepreneurs, it is difficult to compare them with those users who could have become entrepreneurs but remain users. Second, even if we were to identify the broad set of users who are at risk of becoming entrepreneurs, it would still be difficult to observe their consumption activities and measure their actions. Accordingly, recent studies depend on self-reported answers in surveys of general users (von Hippel et al. 2011, 2012) or the small set of users in a specific field (Franke & Shah 2003; Lüthje 2004; Oliveira et al. 2015).

Given these empirical challenges, the present study offers a rare opportunity to observe the full risk set of users and their activities. With longitudinal detailed observations on consumption experiences related to their entrepreneurial opportunity, the study shows how and why some users transition to become entrepreneurs in the context of knitting hobbyists. To my best knowledge, this is the first empirical study that examines the factors affecting user innovation with the large-scale dataset of the complete risk set of user innovators.

6.2. Role of Social Capital in Innovation and Entrepreneurship

Great artists, inventors, and entrepreneurs emerge from local communities (Fleming & Marx 2006; Saxenian 1996). The advantage of creative individuals being positioned in such communities has been explained in large part by the informational benefit of social capital. That is, social capital opens opportunities for actors to aggregate and recombine information from different actors within and across communities (Ahuja, 2000; Burt, 2004). This stream of studies supports one dominant mechanism of how social capital benefits innovation and entrepreneurship: social capital facilitates information flow, and the inflow of new information enables the generation of new ideas, which in turn leads to the development of new goods and services.

However, the literature has tended to conflate the process of idea generation with the process of idea realization and commercialization. Put differently, being well-positioned in the flow of information may stimulate idea-generation, but it may not shift inventors to become entrepreneurs. Especially in the

case of user innovation where the user's personal benefit is a direct incentive for innovation, users have little incentive to market their new products or services as long as they are available to the user, herself. (Von Hippel, 2005). A recent survey on innovating users also supports that only 16% of users who invented a new product end up sharing their product with the public (von Hippel et al., 2012). Therefore, prior literature suggests the role of social capital in innovation and entrepreneurship yet does not fully explain (a) whether the effect of social capital extends to the idea execution stage after idea generation, and (b) if it does, how and for whom it becomes beneficial. In this context, my findings that social networks encourage entrepreneurial transition provide a valuable theoretical insight. First, users significantly benefit from social capital even after they have generated new ideas, as shown in the case of creative knitters who already have experience creating new designs. Second, the effect directs a new mechanism of how social capital benefits innovation and entrepreneurship: encouraging and providing peer feedback. This mechanism of peer feedback explains the major difference between my results and other studies on entrepreneurial transition regarding for whom social capital is most effective as well as the interaction between human capital and social capital. When the role of social capital is to provide access to information and resources, its effect is greater for those who have lower levels of entrepreneurial resources. However, since the role of social capital is not to educate but to reveal talented individuals, the effect is shown to be higher for those who already possess entrepreneurial human capital. Therefore, my results suggest that social capital complements human capital in knitters' transition to designers.

6.3. Entrepreneurial Process as Role Transition from Users to Producers

Previous studies on the entrepreneurial process have focused on the transition from employment to self-employment (Carroll & Mosakowski, 1987; Giannetti & Simonov, 2009; Lazear, 2005). However, the entrepreneurial process cannot be reduced to a transition in employment status as a growing number of new entrepreneurs do not make a sharp change in their employment statuses. For example, if you make furniture or jewelry, you can easily open a shop and sell on Etsy—an online marketplace for crafts with

two million active shop owners by 2016. If you have a specific product idea but lack the resources needed to produce it, Maker's Row can connect you with a manufacturing partner from among 1,400 US factories. If you want to launch a service business such as catering or plumbing, Thumbtack is connecting 250,000 small business professionals to local users. Online marketplaces and supporting services have lowered entry barriers and opportunity costs by a large measure for those with an idea and the intent to sell.

The increased opportunities caused by the rise of online marketplaces are also reflected in the changing nature of work and employment. Recent studies show that over 30% of American workers participate in the independent workforce (Oyer, 2016), and the number of workers engaged in alternative work arrangements (i.e., temporary help agency workers, on-call workers, contract workers, and independent contractors or freelancers) greatly increased (Katz & Krueger, 2016). The latest studies in entrepreneurship also suggest the rise of solopreneurs (Gopalkrishnan, 2015; Stam & van de Vrande, 2017) who are self-employed without employees. Alternatively, entrepreneurs can have multiple jobs, straddle between regular employment and self-employment, or allocate their time between work and leisure activities that develop into their new ventures (Folta, Delmar, & Wennberg, 2010; Lévesque & Schade, 2005).

Therefore, opening a new business does not necessarily require such high entry barriers as hiring people, exiting previous employment, committing full-time to the new venture, or building a platform to introduce new products. Given this change in the nature of business opportunities, we should take a broader approach when studying the entrepreneurial process of launching a new business. Specifically, the focus of the transitioning process has shifted from the change in an individual's employment status to the change in an individual's role from user to producer. To examine this change, therefore, we need to take a closer look at the specific activities of individual hobbyists as they develop their leisure activities into productive economic concerns. In this context, this study contributes to our understanding of the entrepreneurial process by focusing on the transition of a user into a producer.

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Table 1. Descriptive Comparison between Passive Knitters, Creative Knitters, Designers, and Entrepreneurs

	Knitters (Users)		Designers (Producers)	
	Passive Knitters	Creative Knitters	Sharing Designers	Entre preneurs
Definition				
Have at least one knitting project	✓	✓	✓	✓
Create a project with original design		✓	✓	✓
Codify their original designs and release as patterns			✓	✓
Have at least one pattern for sale				✓
Size of population	376,582	13,456	6,926	6,204
(Proportion among all users)	(93.4%)	(3.3%)	(1.7%)	(1.5%)
Knitting experience				
Number of projects	8.296	51.672	48.596	51.712
	(19.556)	(62.749)	(60.613)	(65.180)
Number of different knitting techniques applied	8.553	22.0104	21.382	20.824
	(8.278)	(11.527)	(11.213)	(12.363)
Number of different product categories explored	2.787	8.131	8.495	7.975
	(3.034)	(5.072)	(5.097)	(5.359)
Proportion of repeated applications	0.042	0.115	0.113	0.119
	(0.106)	(0.125)	(0.127)	(0.143)
Proportion of disobedient applications	0.215	0.658	0.602	0.541
	(0.378)	(0.352)	(0.378)	(0.405)
Age at Ravelry	4.122	4.465	5.319	5.405
	(1.979)	(2.143)	(1.741)	(1.747)

Note: All groups are mutually exclusive. Passive knitters are neither creative knitters nor designers. Creative knitters include those who have at least one creative project that incorporates other patterns, but who do not produce a pattern until the end of observation period, 2014Q4. Creative knitters who transitioned to become designers were included as designers, and designers who released a pattern for sale were included as entrepreneurs. Established designers who began designing before or right after joining Ravelry are excluded. All knitting experience variables are measured at the end of observation period, 2014Q4, and the standard deviation is in parentheses.

Table 2. Descriptive Statistics, Full Sample

	Mean	S.D.	Min.	Max.
Time-varying (6,798,353 knitter-quarter observations)				
Transition to Designer	0.0019	0.0439	0	1
Transition to Entrepreneur	0.0007	0.0255	0	1
Number of Projects	7.307	17.820	0	1,583
Number of different knitting techniques applied	7.798	8.390	0	49
Number of different product categories explored	2.522	3.064	0	26
Proportion of repeated projects	0.039	0.103	0	1
Proportion of disobedient applications	0.213	0.379	0	1
Completeness of yarn information	0.100	0.186	0	1
Ever joined the Ravelry editors' group	0.006	0.075	0	1
Calendar quarter	2012Q2	7.118	2007Q3	2014Q4
Years using Ravelry	2.563	1.804	0	7
One observation per knitter, 403,168 knitters (last observation of each knitter)				
Designers	0.033	0.178	0	1
Entrepreneurs	0.015	0.123	0	1
Quarter joined Ravelry	2010Q4	7.866	2007Q2	2014Q4

Table 3. Discrete-time Hazard Model of Entrepreneurial Transitions

		[1]	[2]
Dependent Variable		Knitters' Transitions to Designers	Knitters' Transitions to Entrepreneurs
Number of knitting projects (baseline category is 0 project)	1 project	0.057	-0.162*
		(0.045)	(0.067)
	2 - 3 projects	0.725***	0.333***
		(0.049)	(0.078)
	4 - 10 projects	1.511***	1.035***
		(0.054)	(0.090)
	11 - 30 projects	2.158***	1.711***
		(0.070)	(0.119)
	31 - 100 projects	2.630***	2.288***
		(0.092)	(0.159)
	100+ projects	2.998***	2.868***
		(0.124)	(0.214)
Number of different knitting techniques applied		-0.026***	-0.021***
		(0.003)	(0.005)
Number of different product categories explored		0.089***	0.036***
		(0.005)	(0.009)
Proportion of repeated applications		0.363***	0.471***
		(0.077)	(0.130)
Proportion of disobedient applications		0.131***	-0.112*
		(0.030)	(0.054)
Constant		-6.262***	-7.611***
		(0.125)	(0.336)
Pseudo R squared		0.089	0.046
N individuals		403,168	393,278
N observations		6,798,353	6,752,517

Note: Robust standard errors are in parentheses, clustered around each knitter. Twenty-nine indicator variables for each quarter and 8 indicator variables for the knitter's tenure (by year) at Ravelry are included in the model. Other controls not shown in the table include the editor status of knitters and completeness of yarn information. Established designers who published a pattern before Ravelry became available are excluded. *$p<0.05$, **$p<0.01$, ***$p<0.001$

Table 4. Post-Matching Descriptive Statistics for Knitters who Joined SnB Groups and their Controls

	Treated (N=14,145)				Control (N=14,145)			
	Mean	(SD)	Min	Max	Mean	(SD)	Min	Max
Quarter joined (195=2008Q4)	195.7	5.092	189	213	195.7	5.092	189	213
Editor status (1 if they became voluntary editor)	0.001	0.027	0	1	0.001	0.027	0	1
Number of projects	5.462	12.998	0	237	5.339	12.810	0	232
Number of different knitting techniques applied	6.616	8.477	0	44	6.554	8.383	0	21
Number of different product categories explored	2.080	2.926	0	22	2.059	2.882	0	0.667
Proportion of repeated applications	0.019	0.061	0	0.667	0.019	0.061	0	41
Proportion of disobedient applications	0.215	0.387	0	1	0.215	0.387	0	1
Completeness of yarn information	0.087	0.180	0	1	0.087	0.180	0	1
Creative knitters	0.030	0.170	0	1	0.030	0.169	0	1

Note: The control group is constructed using coarsened exact matching with the knitter's location at the state level, quarter when the knitter joined Ravelry, and knitting experience variables by the (counter-factual) time of group joining. They include the level of general experience, technical experience, market experience, repeated applications, disobedient applications, and whether the knitter joined the editors' group. The variables are measured by the time they (counter-factually) joined the group (previous quarter to the quarter they joined the group). After matching on these variables, I dropped controls that do not minimize the sum of squared differences between treated and control groups by the number of projects. Then I randomly selected one observation per strata for 1:1 matching.

Table 5. Effects of Joining Local Groups on Entrepreneurial Transitions

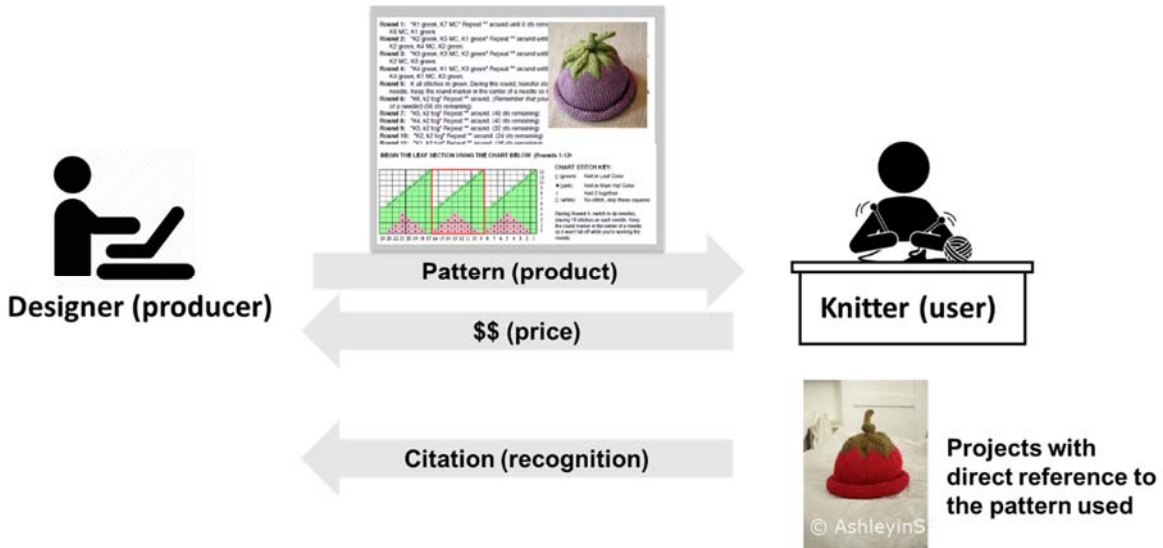|	[1] Transitions from Users to Designers	[2] Transitions from Users to Entrepreneurs	[3] Transitions from Designers to Entrepreneurs
Joined SnB Group Ever	0.0064***	0.0023***	0.0507***
	(0.0003)	(0.0017)	(0.0058)
Transition Rate	0.0242	0.0093	0.3833
Pseudo R Squared	0.0024	0.0009	0.0298
N individuals	28,290	28,290	784
N observations	678,749	678,749	11,320

Note: Transition rates indicate the proportion of knitters who became designers [1] or entrepreneurs [2] by the end of 2014. Unit of analysis is knitter-quarter, and dependent variable is whether the knitter made the transition. Estimates are from linear probability model with individual knitter fixed effect. Robust standard errors are in parentheses, clustered around each knitter. Twenty-nine indicator variables for each quarter and 8 indicator variables for the knitter's tenure (by year) at Ravelry are included in the model. Established designers who published a pattern before Ravelry became available are excluded. Both control group and treated group are non-designers at the time they joined the group. *p<0.10, **p<0.05, ***p<0.01

Table 6. Interaction between the SnB Group Effect and Creative Knitters

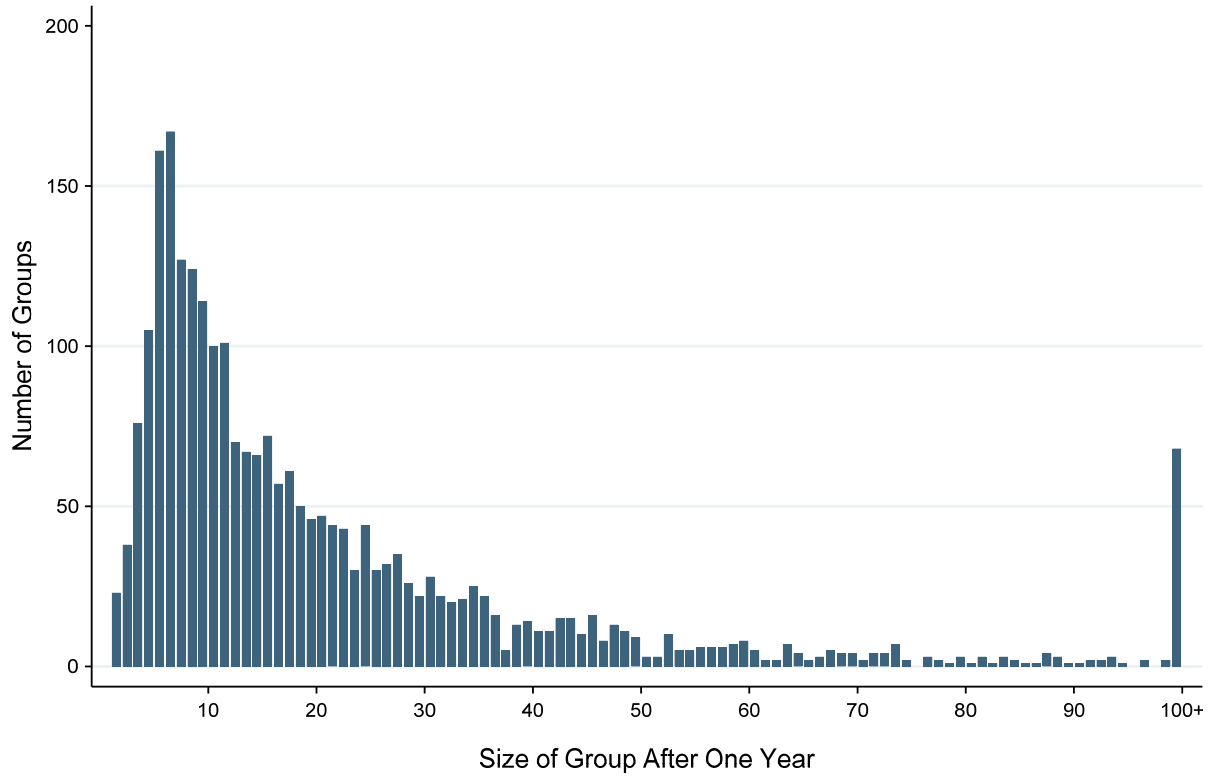|	[1] All Knitters	[2] Creative knitters	[3] Non-creative knitters
Joined SnB Group Ever	0.0023***	0.0031***	0.0023***
	(0.0002)	(0.0012)	(0.0002)
Transition Rate	0.0118	0.0167	0.0117
Pseudo R Squared	0.0009	0.0026	0.0009
N individuals	28,290	836	27,454
N observations	678,749	19,170	659,579

Note: Transition rates indicate the proportion of knitters who became designers by the end of 2014. Unit of analysis is knitter-quarter, and dependent variable is whether the knitter transitioned to become an entrepreneur. Estimates are from linear probability model with individual knitter fixed effects. Robust standard errors are in parentheses, clustered around each knitter. Twenty-nine indicator variables for each quarter and 8 indicator variables for the knitter's tenure (by year) at Ravelry are included in the model. Established designers who published a pattern before Ravelry became available are excluded. Both control group and treated group are non-designers at the time they joined the group. *p<0.10, **p<0.05, ***p<0.01

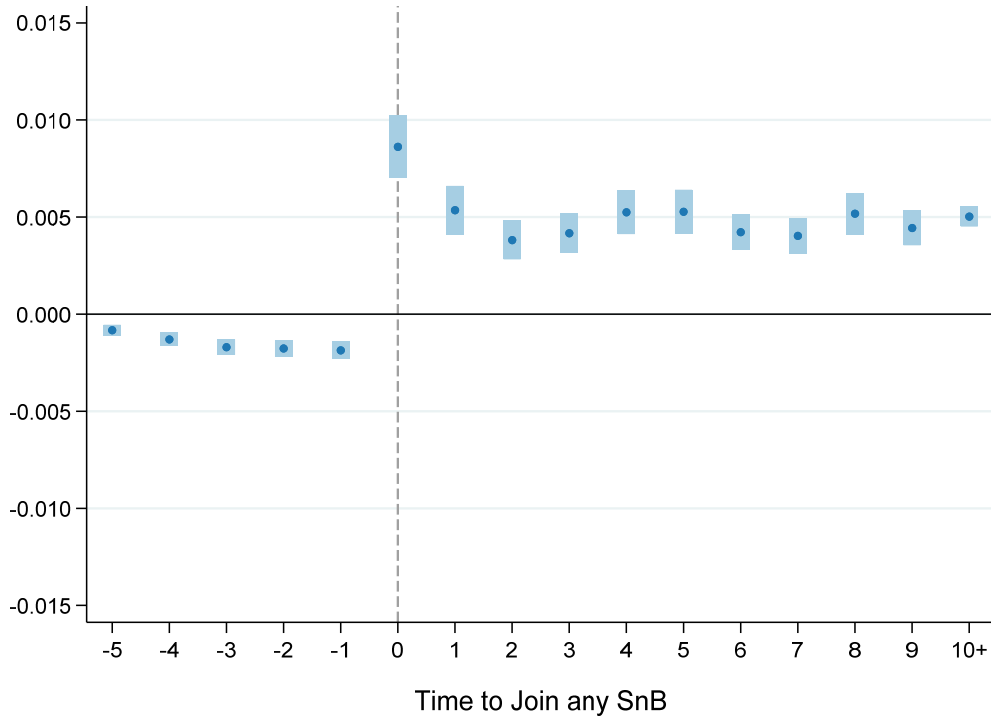Figure 1. Market for Knit Patterns

Note: In an online marketplace for knit patterns, designers (producers) sell patterns to knitters, and knitters (users) buy the patterns to create their projects. Sometimes designers share patterns for free, but they still earn recognition by fellow knitters who use and cite their patterns. The number of projects citing the pattern can indicate the popularity of the pattern, just as the number of citations indicates the impact of a scientific paper.
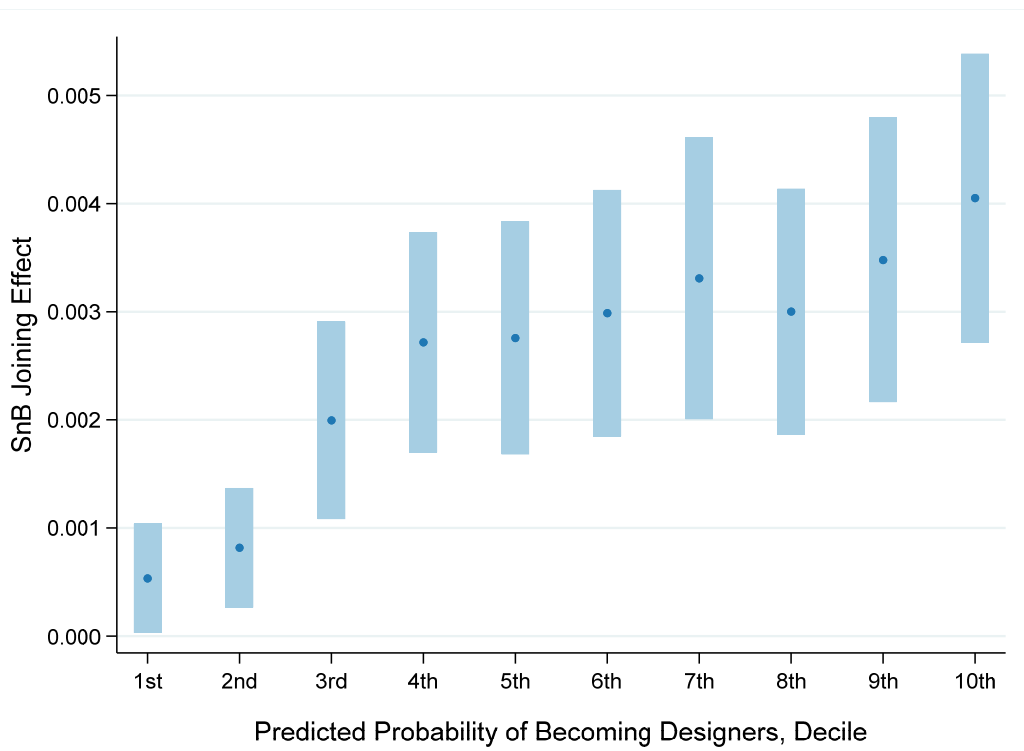
Figure 2. Size Distribution of SnB Groups

Note: SnB group size is measured at the end of 12 months after the group was founded. The median size of groups at age one is 13, and the mean size at age one is 23.22. Groups with less than 4 members by December 2014—the end of the observation period—are manually checked and omitted unless they provide clear records of actual meetings and interactions.

Figure 3. Dynamics of the SnB Joining Effect on Entrepreneurial Transitions

Note. The blue dots in the above plot correspond to coefficient estimates from a linear probability model with individual fixed effects (the coefficient of Table 2, column [1]) in which the probability of knitters to become designers is regressed onto quarter effects, knitters' tenure in the community effects, as well as 17 interaction terms between treatment status and the number of quarters until they first joined a local SnB group. The baseline of the interaction effect is 6 or more quarters before the treatment. The 95% confidence intervals around these estimates are shaded in light blue.

Figure 4. Interaction between the SnB Group Effect and Human Capital

Note. The blue dots in the above plot correspond to coefficient estimates from a linear probability model with individual fixed effects in which the probability of knitters to become entrepreneurs is regressed onto quarter effects, knitters' tenure in the community effects, as well as 10 interaction terms between treatment status and indicator variables for each decile of the predicted probability of a knitter's transition to an entrepreneur. The predicted probability is estimated at one quarter prior to joining a group, and by logit regression onto the number of projects made, proportion of repeated projects, number of different project categories explored, number of techniques experienced, voluntary editor status, degree of following yarn suggestions, completeness of yarn information, age in Ravelry, and quarter effect. The 95% confidence intervals around these estimates are shaded in light blue.

Appendix A. Full Risk-set Analysis with Individual Fixed Effects

Table 2 shows the results of a discrete-time hazard model without individual fixed effects. For an

additional test controlling unobserved individual characteristics, I also tested the effect of knitting

experience variables with individual fixed effects. However, logit estimation is not applicable because

conditional maximum likelihood estimation requires variation in the dependent variable, while my sample

includes the full set of knitters who have not made the entrepreneurial transition until the end of the

observations. As an alternative approach, I chose a linear probability model to examine whether the

variables tested in the discrete-time hazard model show consistent effect on the transition when

controlling unobserved characteristics of individuals. The results are presented in Table A1.

[Table A1] Linear Probability Model with Individual Fixed Effects

Dependent Variable		[1] Knitters' Transitions to Designers	[2] Knitters' Transitions to Entrepreneurs
Number of knitting projects (baseline category is 0 project)	1 project	0.002***	0.001***
		(0.000)	(0.000)
	2 - 3 projects	0.003***	0.001***
		(0.000)	(0.000)
	4 - 10 projects	0.005***	0.002***
		(0.000)	(0.000)
	11 - 30 projects	0.008***	0.002***
		(0.000)	(0.000)
	31 - 100 projects	0.012***	0.002***
		(0.001)	(0.000)
	100+ projects	0.015***	0.001
		(0.001)	(0.001)
Number of different knitting techniques applied		-0.000***	0.000
		(0.000)	(0.000)
Number of different product categories explored		0.002***	-0.000*
		(0.000)	(0.000)
Proportion of repeated applications		0.007***	-0.001*
		(0.001)	(0.000)
Proportion of disobedient applications		0.000	0.000
		(0.000)	(0.000)
Constant		-0.020***	0.000
		(0.001)	(0.000)
Pseudo R squared		0.0023	0.0001
N individuals		403,168	393,278
N observations		6,800,390	6,754,630

Note: Robust standard errors are in parentheses, clustered around each knitter. Twenty-nine indicator variables for each quarter and 8 indicator variables for the knitter's tenure (by year) at Ravelry are included in the model. Established designers who published a pattern before Ravelry became available are excluded. *p<0.05, **p<0.01, ***p<0.001