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Conversations and idea generation: Evidence from a field experiment

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ABSTRACT

When do conversations lead people to generate better ideas? We conducted a field experiment at a startup bootcamp to evaluate the impact of informal conversations on the quality of product ideas generated by participants. Specifically, we examine how the personality of an innovator (openness to experience, capturing creativity) and the personalities of her randomly assigned conversational peers (extroversion, measuring willingness to share information) affects the innovator's ideas. We find that open innovators who spoke with extroverted peers generated significantly better ideas than others at the bootcamp. However, closed individuals produced mediocre ideas regardless with who they spoke, suggesting limited benefits of conversations for these people. More surprisingly, open individuals, who are believed to be inherently creative, produced worse ideas after they spoke with introverted peers, suggesting individual creativity's dependence on external information. Our study demonstrates the importance of considering the traits of both innovators and their conversational peers in predicting when conversations will lead to better ideas.

1. Introduction

Having a *great* rather than an *average* product can mean the difference between success and failure for any company (e.g., Kornish and Ulrich, 2014), but this is especially true for young firms whose survival depends on introducing innovative products to the market (e.g., Vogel, 2017; Shane, 2000). It is therefore essential that a company's product development teams have creative people who can help them generate high-quality ideas (e.g., Baum and Bird, 2010; Zhao and Seibert, 2006). At the same time, idea generation also requires access to new and varied information from potential users and other external parties (e.g., Walsh et al., 2016; Blank, 2013; Ries, 2011; March, 1991). Having an effective idea generation process means not only hiring the most creative people, but also having them talk with others who can provide valuable insights.

Yet, prior studies have viewed these two decisions—choosing the innovator and choosing who they converse with outside the team—as theoretically distinct. On one hand, psychologists have developed a substantial literature on individual differences in creative behavior and outcomes (see, Feist, 1998; McCrae and Costa, 1997; Barron and Harrington, 1981). In these studies, researchers link differences in personality to creativity (e.g., McCrae and Sutin, 2009; John et al., 2008; McCrae, 1987). On the other hand, research on innovation in the management literature highlights the importance of external information from social interactions, collaborators, and users (Laursen and Salter, 2006; Baldwin et al., 2006; Burt, 2004; Lilien et al., 2002). Further, individuals who converse and collaborate generate better ideas than lone inventors (Singh and Fleming, 2010; Wuchty et al., 2007; Burt, 2004). Given the inherent complementarity between these two decisions, we still know little about which innovators can best leverage external conversations, and who they should talk to.

With respect to choosing innovators, extensive research links the personality trait *openness to experience* to creative behavior and outcomes (Hammond et al., 2011; Silvia et al., 2009; Feist, 1998; McCrae, 1987). Open individuals appreciate different perspectives, are better at recombining concepts, and generate unconventional ideas—all of which makes them more creative (McCrae, 1987). However, open individuals sometimes also produce bad ideas if the organizational context is not conducive to their style of creativity (e.g., Bell, 2007; Baer and Oldham, 2006; Burke and Witt, 2002).

One key aspect of an innovator's context is who they talk to (Perry-Smith and Mannucci, 2015; Burt, 2004). Some conversations—with people who are willing to share their knowledge, experiences, and opinions—will be more fruitful for idea generation. Information from these conversations is important input to the creative process (Perry-Smith and Mannucci, 2015). Conversational peers who exhibit the personality trait *extroversion* are talkative, loud, and willing to share knowledge or disclose information about themselves (e.g., Cuperman

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and Ickes, 2009; Funder and Sneed, 1993). These behaviors, rather than their converse, will increase not just the amount of information shared, but also its novelty and idiosyncrasy. This information will provide the innovator greater grist for their product ideas (De Vries et al., 2006; Forret and Dougherty, 2001; McCrae and John, 1992).

Here we present the results of a field experiment designed to test the impact of informal conversations on the quality of an innovator's product ideas. We embedded our field experiment in a startup bootcamp for over 100 aspiring product entrepreneurs. Specifically, we test how an innovator's personality (openness to experience, capturing creativity) and a peer's personality (extroversion, measuring willingness to share information) jointly affect an innovator's ideas. Our intervention consists of randomly assigning individuals to three conversations about a specific product area ("the Indian Wedding Industry"), with each conversation lasting 14 min. We use the resulting random variation in the pairing of innovators and peers with different personalities to examine the impact of innovator–peer personality on the subsequent quality of the ideas subsequently generated.

Our study produces three broad findings. First, the ideas of 'closed' innovators do not improve or worsen based on their conversations. This finding implies an important scope condition on the value of external information for idea generation. Conversations matter primarily for people who have the ability and motivation to incorporate outside information. In contrast, the ideas of open individuals are affected by their conversations. This effect, however, is asymmetric. Open innovators paired with extroverted peers (Open-Extrovert pairs) produce the highest quality ideas. In this condition, both creative ability and the volume of novel information are at their highest. In contrast, Open-Introvert pairs develop lower quality ideas than even closed individuals. Though a person may have creative ability and motivation, a high volume of novel information is necessary for them to leverage their natural creative ability.

This study contributes to three research streams. First, our study sheds light on the interaction between personality and the social context as they jointly pertain to idea generation (e.g., Perry-Smith and Mannucci, 2015; Fleming et al., 2007; Burt, 2004). The effect of conversation on idea generation appears to be moderated by the personalities of both the sender and receiver of information. Second, our research also provides new insights for scholars of entrepreneurship and product development by showing the importance of conversations at the earliest stages of idea and product development (e.g., Girotra et al., 2010; Ward, 2004; Shane, 2000). Finally, our work links to research on brainstorming and the psychology of creativity (e.g., Kaufman and Sternberg, 2010; Paulus, 2000; Amabile et al., 2004; Amabile, 1983), highlighting the importance of personality differences in predicting who will generate the best ideas and which types of interactions will be most fruitful.

2. Theory and hypotheses

The success of organizations relies on new product ideas (e.g., Schulze and Hoegl, 2008; Shane, 2000). Good ideas are especially important for young entrepreneurial teams, who must take a nascent idea and develop it over the course of weeks, months, or years into a product (Ward, 2004). Indeed, all future steps in the entrepreneurial journey depend on an essential first step: *idea generation* (Perry-Smith, 2014). During this stage, innovators generate many ideas and then choose one or a few to implement. According to Perry-Smith and Mannucci (2015) individuals must have the "cognitive flexibility to recombine disparate knowledge into new associations" as well as "access to non-redundant knowledge" to develop good ideas. Good ideas are the product of individual capabilities *and* social interaction.

Two distinct research streams examine these facets of idea generation at the individual level. One literature, mostly in psychology, studies individual differences in creative capabilities (see for a review Kaufman and Sternberg, 2010). This work usually ignores the social interactions of creative people who are generating ideas. Another stream, in management, studies how social relationships shape information access and thus creativity (see for a review Perry-Smith and Mannucci, 2015). The latter stream has often ignored individual differences among both innovators and their conversational partners. Based on the results from this work, combining these perspectives should lead to new insights about when conversations will be most fruitful and for whom.

Below we develop a model of individual creativity and peer conversations. We build on research in psychology into the personality correlates of both creative behavior (e.g., Feist, 1998; McCrae and Costa, 1997) and information sharing (e.g., Funder and Sneed, 1993). We model innovators as varying in their openness to experience, a trait synonymous with "creative" personality (Kaufman et al., 2016; McCrae and Costa, 1997). We model conversational peers as varying in introversion and extroversion, traits linked to conversational patterns, information sharing, and the size and diversity of social networks (e.g., Landis, 2016; Cuperman and Ickes, 2009).

Our theoretical framework consists of two parts. We first describe how personality traits independently affect creative capability and information sharing. Next, we explain how innovator–peer matches on these dimensions affect the quality of ideas.

2.0.1. Openness to experience and creativity

Psychological research has long studied the antecedents to creative behavior (Feist, 1998). Although several measures of personality relate to specific facets of creativity, there is consensus that *openness to experience*, a factor in the five-factor model of personality, is predictive of creativity in many settings (e.g., Beaty et al., 2016; Baas et al., 2013; Silvia et al., 2009; McCrae and Costa, 1997; McCrae, 1987). Relatedly, openness is also linked to entrepreneurial intentions and performance (for a review of this literature, see Zhao et al., 2010).

Two classes of mechanisms—intrapsychic and interpersonal—link openness to creativity (McCrae and Costa, 1997; McCrae, 1996). Intrapsychic mechanisms argue that open individuals (relative to individuals with closed personalities or other personality traits) have skills and dispositions that allow them to generate better ideas. Interpersonal mechanisms enable open individuals to readily acquire novel information from their environment.

Intrapsychic mechanisms: Several studies show that openness to experience is related to differences in creativity. In a classic study, McCrae (1987) highlights the importance of openness to the creative process. Open people possess the *ability* and *disposition* to engage in creative behavior. Their abilities make them skilled in unstructured creative tasks (Williams, 2004). They prefer ambiguity and complexity over certainty and simplicity (e.g., LePine et al., 2000). When generating ideas, open individuals deploy more representational resources, a state often called 'absorption' (e.g., Hammond et al., 2011; Oldham and Cummings, 1996). They also consider many perspectives and enjoy divergent thinking—e.g., exploring unrelated ideas and finding unconventional connections (George and Zhou, 2001; McCrae and Costa, 1980).

Open individuals also have a creative disposition. They seek out complex tasks and relish diverse perspectives, often preferring information that diverges from what they already know (McCrae, 1996). They also have a firm belief in their creative abilities (e.g., Karwowski et al., 2013) and are "unorthodox, free-thinking, and prone to flout convention" (McCrae and Costa, 1997).

Together, these abilities and dispositions map to what Perry-Smith and Mannucci (2015) describe as "cognitive flexibility" and the ability to "recombine disparate knowledge into new associations" required for creativity.

Interpersonal mechanisms: Open individuals also interact with others in distinct ways (Funder and Sneed, 1993). McCrae (1996) states that when conversing with others, open individuals both solicit in-congruent

information and are more prone to adapt to others' perspectives and opinions. Open individuals are also better at recalling information that is incongruent with their own experience, giving them a wider base of information for idea generation. Finally, they delve into abstract topics (e.g., Funder and Sneed, 1993) and prefer talking to new people and initiating new conversation threads (Cuperman and Ickes, 2009). While the interpersonal mechanisms are not sufficient contributors to creativity, they allow open individuals to seize opportunities to acquire novel information.

Conversely, those *closed to experience* eschew complexity and ambiguity and prefer conventional ideas (George and Zhou, 2001). They seek conversations that confirm their existing beliefs, and thus novel or dissonant information is ignored or dismissed. Being closed to experience impedes mechanisms driving creativity—i.e., recombining diverse information and experiences into new ideas. Closed individuals do not necessarily generate bad ideas, but ordinary ideas. Existing theory, therefore, predicts:

Hypothesis 1. Innovators with higher (lower) openness to experience will develop higher quality (lower quality) ideas.

2.1. Having the right conversations: extroverted peers

Generating good ideas depends on more than individual creativity. Prior work on invention and the role of social interactions in creative production provides useful analogies for understanding the impact of conversations on idea generation. For example, research on the social dimensions of innovation shows that lone inventors rarely produce breakthrough ideas (Singh and Fleming, 2010; Wuchty et al., 2007). Those who collaborate—and who, during the production process, converse with collaborators about their ideas—generate higher-quality inventions. In another analogous stream of research, scholars have found that having and using social ties affects idea generation. In this work, conversations—with coworkers, customers, acquaintances, and even strangers—constitute the specific interactions in a network that provide new information, perspectives, and opinions that can shape the quality of an idea (Burt, 2004; Perry-Smith and Mannucci, 2015). Finally, the practitioner literature on innovation and idea generation highlights the central role of talking to potential customers in shaping the quality of ideas generated by entrepreneurs (Blank, 2013; Brown et al., 2008). In this literature, conversations are an important underlying mechanism that explain why joint collaborative work or information seeking helps people generate better ideas.

Which conversational peers provide the greatest grist for idea generation? Conceptually, conversational peers should possess two characteristics. First, they must be *willing* to share their experiences and opinions. A lack of willingness to talk will limit informational *volume*. Second, the peer should have a *diverse* pool of personal and vicarious experiences to draw upon, which will increase information variety.

While research on the effect of peer personality and idea generation is limited, scholars have linked personality to conversational dynamics. Two personality traits, in particular, *extroversion* and *agreeableness*, appear to influence interactions strongly (Cuperman and Ickes, 2009; Funder and Sneed, 1993; John and Srivastava, 1999; Goldberg et al., 1998).

While agreeableness relates mostly to affect during conversation (e.g., warmth, laughter, and cheerfulness), extroversion is related to both affect and the diversity and volume of information shared (Funder and Sneed, 1993). Extroverts, therefore, may be fruitful conversational partners during early ideation.

Willingness to share information: Several studies suggest that extroverts exhibit distinct patterns of behavior during conversations. Funder and Sneed (1993) found that extroverts were talkative, loud, and enjoyed interactions. In contrast, introverts were reserved, inexpressive, and volunteered little personal information. In conversations with strangers, extroverts took the lead and were evaluated by their partners as saying "interesting" things. Cuperman and Ickes (2009) found similar patterns. Extroverts took the lead role in conversations, were not self-conscious, and believed that interactions were 'smooth, natural, and relaxed.' Beukeboom et al. (2013) found that extroverts described events and experiences in elaborate and interpretive terms. Extroverts were eager to share their knowledge with others (Matzler et al., 2008; John and Srivastava, 1999).

Higher informational volume, idiosyncratic personal details, and greater elaboration characterize the information that extroverts share.

Social interactions and information variety: In addition to sharing 'new' or 'interesting' information, extroverts also have diverse networks that give them access to novel information (e.g., Landis, 2016; Watson and Clark, 1997). Totterdell et al. (2008), Neubert and Taggar (2004) and Casciaro (1998) all find that extroverts have larger networks or are more central in their social networks. Extroverts' ability to build larger networks also increases their ability to build weak ties (Pollet et al., 2011), suggesting differences in access to heterogeneous information from their many contacts (Granovetter, 1973).

In contrast, introverts are less likely to engage in self-disclosure and do not share high volumes of information. They listen and reflect (Cain, 2013). In conversations, introverts appear reserved and keep both emotional and physical distance from their partners. This behavior sometimes appears as disinterest (Funder and Sneed, 1993).

Introverts are also comfortable with others leading the conversation (Cuperman and Ickes, 2009); they listen to their partner and do not seek to dominate the conversation. This tendency means they speak less and therefore offer their partners less information. Introverts are also less likely than extroverts to engage in "small talk" and "idle chatter" that lacks informational content.

However, an introvert's greater reflection, analytical tendencies, and thoughtfulness can lead to valuable insights for their partners (e.g., Cain, 2013; Grant et al., 2011). Götz and Götz (1979) and Feist (1999) suggest that introverts, rather than extroverts, are likely to be overrepresented among scientists and artists judged to be the most creative. Researchers theorize that this overrepresentation of introverts among the most creative is due to their heightened imagination, willingness to engage in individual play, and self-sufficiency. Roy (1996) also finds that introverts are more likely to exhibit higher levels of visual creativity than extroverts. Moreover, researchers who have studied creativity across innovators varying in age have found that introverts remain creative across their lifespan as compared to extroverts (Feist and Barron, 2003). As a consequence, the individual creativity of introverts might be useful for a conversational partner who is generating new ideas assuming introverts share enough information.

On balance, introverts and extroverts, because of their different behaviors, may be valuable at different phases of the innovation process. Idea generation benefits from others' perspectives, experiences, or opinions. Because extroverts are talkative, warm, connected, and willing to share knowledge, they will be more valuable during the early stages of ideation.

Hypothesis 2. Individuals who converse with more-extroverted peers will develop higher quality ideas.

2.2. Innovator–peer interactions and ideation

The theories outlined above link personality to individual-level behaviors. However, the mechanisms described also suggest the potential for complementarities in how some pairings perform versus others. Fig. 1 depicts a model crossing innovator and peer personalities and their predicted effect on idea quality.

Closed–extrovert interaction: Being closed to experience means an individual has a preference for conventional ideas, ones that do not stray from expectations (McCrae and John, 1992). Thus, although an extroverted conversational peer may be talkative, share personal experiences, and provide high volumes of new information, a closed

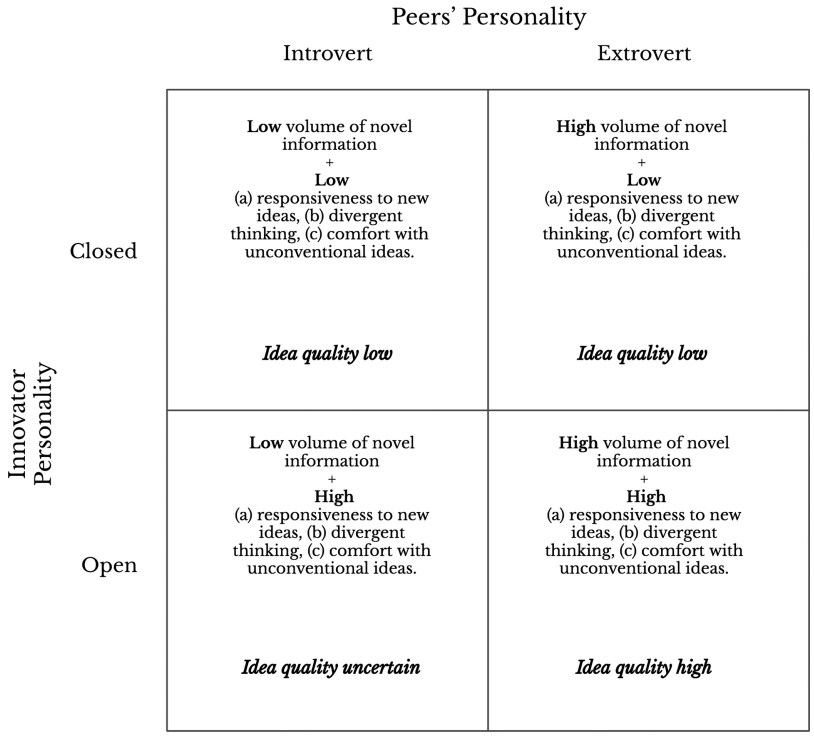

Fig. 1. Summary of theoretical arguments for the innovator–peer conversation interaction and its impact on idea quality.

person may not benefit. They may filter out dissonant information, especially if it does not conform to what they believe. They may be uncomfortable recombining information and may prefer the ordinary over the novel. Their ideas would remain conventional even after talking with an extroverted peer. Thus, closed innovators should not benefit as much as open ones from talking to extroverts.

Closed–introvert interaction: Being paired with an introverted peer may not greatly affect a closed individuals' idea quality. With introverts the volume of information may be lower; it may also lack variety, personal opinions, or detail. Nevertheless, the closed innovator would continue to develop his conventional ideas and would be just as unlikely to benefit from conversations with introverts as she would from conversations with extroverts.

Hypothesis 3. Closed innovators will not benefit from interacting with peers who are more introverted nor more extroverted.

Openness–extroversion interaction: In contrast, open individuals seek and appreciate interactions with people who have different perspectives. In conversations with extroverted peers, open innovators are receptive to the flow of idiosyncratic and personal information (McCrae and Sutin, 2009), which offers them a more abundant pool of facts, emotions, ideas, opinions, and perspectives to recombine into new ideas.

Open innovators will ask probing questions, guide the conversation in useful directions, and listen more intently (McCrae, 1987). Relatedly, extroverted peers will take the lead in the conversation, causing them to share more in response to the inquisitiveness of their open partner. Together, such behaviors should amplify the amount of information received from an extroverted peer. The open innovator's ideation capabilities will lead them to recombine information in unconventional ways. However, because their ideas derive from others' experiences, the resulting product concepts will be grounded. Thus, their product ideas will be both novel and of high quality (Karwowski et al., 2013).

Open–introversion interaction: When paired with introverts, on the other hand, open innovators pose a theoretical challenge. While introverted peers possess analytic depth, objectivity, and a willingness to listen, they will share less of their own experiences during a conversation. Further, whereas an extroverted peer assumes a dominant role, a more introverted peer prefers the opposite. In conversations with an introvert, an open innovator will exert considerable effort getting her partner to share a relatively small amount of information.

After such a conversation, there are two possible outcomes. On the one hand, an open innovator may still develop high-quality ideas because of her natural creativity. However, the ideas may have been even better had she been paired with an extrovert. In the openness–introversion pairing, the complementary relationship between creativity and new information is absent. Thus, the ideas are weaker, but are still better than the ones closed individuals produce.

An alternative possibility for the Openness-Introvert pair also exists. Recombining ideas is risky, and could result in inferior ideas as well (Ferguson and Carnabuci, 2017). Although an idea may be 'original,' it may also be low quality.

Without external information about others' experiences, an open innovator might compensate by increasing their idea's novelty or unconventionality. These ideas may become detached from actual user needs without the external constraints posed by the experiences of potential users. The open individual may generate divergent ideas without converging on the good ones (Schilpzand et al., 2011).

Just as open innovators may produce higher-quality ideas after talking to extroverts, they may produce worse ideas after talking to introverts. The extent of the discrepancy across these conditions is uncertain. On the one hand, open individuals' creative ability may limit the pitfalls of lower amounts of external information. On the other, their higher levels of divergent thinking and exploration may lead them towards unorthodox and unappealing ideas.

Hypothesis 4. More open innovators will generate better-rated ideas after talking to more extroverted peers.

3. Empirical setting and methods

3.1. Experimental design: an innovation competition

To rigorously test our predictions we embedded a field experiment

in an entrepreneurship bootcamp held in New Delhi, India, in July 2014.[1] This three-week program was designed to help aspiring entrepreneurs from across India to develop skills in idea generation, design thinking, prototype design, and business model development.

The ages of the participants ranged from 18 to 36, with a mean age of just over 22 years. The gender distribution was 87 men and 25 women. Everyone had at least a college degree or was enrolled in college, with 60 of the participants enrolled in a college, master's, or Ph.D. program. Our program was regionally diverse, with 62 of the participants from the state of Delhi and the rest from across India. The class was composed primarily of engineering and computer science degree holders (78), followed by 18 business degree holders; the remaining 16 were from the arts and sciences. Eight people were enrolled in or had graduated from advanced degree programs.

Leading members of India's startup ecosystem, including successful entrepreneurs, designers, and venture capitalists provided instruction. The program was structured into three week-long modules. The first week, on which we base this study, focused on idea-generation. To incentivize participation and effort, the teams with the three highest-rated prototypes won cash prizes. The major prizes were team-based. The first prize was 20,000 INR, the second was 10,000 INR, and the third was 7500 INR. The prize allocation was based on the average rating received by a team's proposal during the peer review process. The second week focused on business models, and during the final week participants were free to work on a business concept of their choice in self-selected teams.

To test our prediction, we used the activities from the first week and data collected before the bootcamp. All participants completed surveys, chief among which was the 44-item Big Five Inventory (John and Srivastava, 1999), giving us pre-bootcamp (thus, pre-treatment) measures of extroversion, openness to experience, neuroticism, agreeableness, and conscientiousness. We discuss the construction of our independent variables using this inventory in the variables section below.

The first day (Monday) was dedicated to logistics, an introduction to the program, and a short icebreaker in a randomized group at the end of the day. We did not collect any data during this day, as it was not part of the experiment. The second day (Tuesday) began with individuals reporting to one of 40 tables, where they sat with their randomized icebreaker group and were asked to individually generate as many or as few ideas as they wished for innovative software products for the Indian wedding industry. The text of the prompt read:

> On November 27, 2011, over 60,000 weddings took place on this single day in New Delhi just because the day was auspicious. Every wedding hall in Delhi was booked for every shift, and families paid large premiums of at least one to two lakhs to book even the smallest halls. Even on less auspicious days, Indian weddings are big, fun, complex, loud, colorful, and most of all, expensive. Today, the size of the Indian wedding industry is estimated to be around 2.25 trillion Indian rupees or 38 billion US dollars. The industry is also diverse—it includes products and services such as marriage gardens, matchmaking, clothing, decorations, makeup, gifts, and jewelry. Startups in India have only scratched the surface of this industry. The most prominent example is Shaadi.com, which has revolutionized matchmaking and made many aunties across India obsolete. Your task for this week is to develop a product concept for a mobile and web application that will reinvent part of the wedding experience—either before, during, or after the wedding—in India. On to reinventing!

[1] The experimental nature of the bootcamp was reviewed by our university's Institutional Review Board. All participants signed two consent forms: an online form at the time of application and a paper-based form on the first day of the bootcamp.

We chose the Indian wedding industry as our prompt for three reasons. First, based on conversations with Indian entrepreneurs and venture capitalists, the wedding industry was noted as having a large market potential. Several venture capital firms are investing in software products for this market. Second, unlike finance or biotechnology, the "Indian wedding" was something that the vast majority of participants had experienced, but it represented an industry in which a subset of individuals would not have a systematic skill or knowledge advantage. Third, we chose this industry because it was complex, composed of problems ranging from finding mates, to buying wedding dresses, to post-marital counseling. Thus, the Indian wedding context could produce differentiation in the types and quality of ideas generated by the participants. For one hour, the participants entered their ideas into a software application as short paragraphs.

Individuals produced on average 6.6 ideas, each having a length of approximately 505 characters. We call these ideas "pre-treatment" ideas.

Conversational peer randomization. To test our hypotheses, we randomized each participant to a set of three conversations in the form of semi-structured "empathy interviews" with other participants at the bootcamp (e.g., Kelley and Kelley, 2013). Each conversation lasted 14 min. We assigned each pair to random and pre-assigned seats, with participants assigned (randomly) to an "A" and a "B" position.

The protocol of the interview was semi-structured. Participants were asked to learn about their conversational peers' experience with an Indian wedding. We began with person A interviewing and listening to person B's perspective for 4 min, followed by person B interviewing and listening to person A's perspective for the same amount of time. Next, person A was asked to "dig deeper" by asking person B more questions for three more minutes. Person B then repeated this process with person A.

During and after the conversation, participants could take notes about their conversation and record it in the sheet depicted in Fig. A2. After the first pairwise peer interaction, individuals were re-randomized to two more pairwise interactions following the same structure. After all three randomizations, individuals were instructed to return to a randomly assigned table and generate new ideas individually for one hour.

The participants generated an average of 4.5 new ideas, with the average idea having 476 characters. We call these "post-treatment" ideas.

Anonymous peer evaluations of individual ideas. The next morning, from 9:30 am to 11:00 am (Wednesday, day 3), all participants anonymously evaluated a random subset of both the pre- and post-treatment ideas of other participants. Our choice of double-blind anonymous peer evaluations arises from three considerations. First, peer evaluation is perhaps the most common evaluation method in many creative contexts. In academia, research articles are evaluated by anonymous peers, as are grants (Marsh et al., 2008). In organizations, many decisions about products and design choices are evaluated by peers. In education, peer evaluations are becoming increasingly common for classroom projects (Cooper and Sahami, 2013; Reily et al., 2009). Second, many prior studies of creativity have used peer ratings as measures of the creative output of teams and individuals (Amabile et al., 2005, 2004; Kornish and Ulrich, 2011). Third, peer evaluation, particularly in this context, may be more reliable than evaluations by experts, who may have neither the incentive, time, nor ability to evaluate an idea's worth (Kornish and Ulrich, 2014; Scott et al., 2016). Finally, research indicates that peer evaluations are more accurate when the evaluators are blinded to the identity of the subject. They are also harsher and more accurate when evaluating more than three items (Marsh et al., 2008; Boudreau et al., 2016). Thus, we asked individuals to rate approximately 50 ideas in three dimensions on a 5-point Likert scale from *strongly disagree* to *strongly agree*: whether the idea was novel, whether the product was something that the rater would buy, and whether the

idea had business potential.

Each idea received approximately 3.42 complete ratings. The average ratings were 2.45 for business value, 2.59 for buy likelihood, and 2.43 for novelty.

Evaluations from Indian consumers. To complement our anonymous peer evaluations, we also measure idea quality using another common metric of idea quality: consumer evaluations. Prior research on product development documents that online consumer evaluations predict future success, often with more accuracy than expert assessment (e.g., Kornish and Ulrich, 2014).

To ensure our raters were potential consumers we recruited 45 digitally savvy Indian consumers on Amazon's Mechanical Turk, a platform commonly used by firms to do early market research (e.g., Bentley et al., 2017). To ensure comparability with our peer evaluations, we had the Indian consumers rate the startup ideas on the same three dimensions and on the same 5-point scale. Each consumer evaluated 41 ideas on average, yielding 5.58 complete ratings per idea. The average ratings were 3.36 for business value, 3.12 for buy likelihood, and 3.27 for novelty. Beyond providing an additional metric of idea quality, the consumer evaluations serve as a partial replication of our analysis. We use exactly the same models, but estimated with the consumer evaluation data, to test whether our results are robust to different measures of idea quality.

3.2. Variable construction

Dependent variables. The key dependent variables for our analysis derive from the anonymous peer evaluations (day 3) of the raw ideas generated by individuals on day 2 as well as the text of those ideas.

The first dependent variable is *Idea Quality*. It is the sum of the evaluations an idea receives from an anonymous evaluator on the dimensions of business value, buy likelihood, and novelty.[2]

To understand how our intervention affects the content of the ideas generated, we also construct two dependent variables using the raw text of the ideas themselves. The first variable, *idea development*, counts the number of *unique* words used by an innovator in describing her idea. Development, as measured by unique terms, has been used in a wide variety of prior studies and has been shown to correlate with success in fields ranging from poetry to the hard sciences (Simonton, 1990; Feist, 1997).

Our second content-based variable, *recombination*, measures the extent to which the words used by an innovator in the write-up of an idea connect different semantic domains. To generate our measure of recombination, we construct a semantic similarity network between the ideas generated using word overlaps as a measure of connectedness. Using this semantic network, we then calculate the betweenness centrality for each idea to measure how recombinative each idea likely is. Research on the success of products, articles, and patents finds that ideas that sit between different and distinct idea "domains" often represent novel recombinations with greater potential (Hargadon and Sutton, 1997; Uzzi et al., 2013). Full details on how we construct these text-based measures are in the Appendix.

Independent variables. To examine the relationship between an innovator's openness and peer extroversion on quality of the idea generated, we create three variables. First, *Openness (Self)* is the average of an individual's responses to the 10-item openness scale deployed before the bootcamp. This variable is normalized to have mean of 0 and SD of 1.

Second, *Extroversion (Peer)* measures the average extroversion score of an individual's three randomly assigned conversational peers. Extroversion is calculated using the average of the 8-item extroversion scale and is standardized at the individual level before being aggregated into our average peer measure.

Third, we create an interaction variable *Extroversion (Peer)* × *Openness (Self)* to test Hypothesis 3, that open individuals benefit especially from talking with extroverted partners.

Control variables. To assess the robustness of our results, we also control for a number of additional factors. To test that open innovators benefit from talking with extroverts, and not the other way around, we parallel the operations described above and construct *Extroversion (Self)*, *Openness (Peer)*, and *Extroversion (Self)* × *Openness (Peer)* variables. For completeness, we also generate *Openness (Self)* × *Openness (Peer)* and *Extroversion (Self)* × *Extroversion (Peer)* variables.

We also include three non-personality controls in our models that capture the abilities and talents of the participants. The first of these controls is a person's pre-treatment idea quality, the average of the evaluations of each person's pre-conversation ideas. This variable allows us to test whether there is any effect of being paired with someone who simply generates higher-quality ideas. The second control is a measure of each person's general ability and talent, based on their independently evaluated bootcamp admission score.[3] The admission score allows us to rule out the possibility that extroversion mainly captures differences in human capital. The third control is educational background; we construct a binary measure that indicates whether the participant has an engineering degree. Given the technological focus of the bootcamp, we can control for familiarity and experience developing web applications.

Table 1 presents summary statistics for our dependent, independent, and control variables. We also include the other three personality measures for completeness. As expected, the standard deviations are smaller for the averaged personality scores of each participant's three randomly assigned peers. Table A1 in Appendix provides bivariate correlations. We find little evidence that a person's personality traits are correlated with those of their randomized peers, providing evidence that our randomization was successful. Table A2 in Appendix tests for balance more formally by regressing an individual's personality measures on the *Extroversion (Peer)* variable. We find no evidence for imbalance.

Modeling strategy. To test our individual-level hypotheses, we used ordered logistic regression models to regress all evaluations e of idea d by individual i on the openness of the innovator, the randomized conversational peers' average level of extroversion, and the interaction.

Since peers were randomly assigned and the assignment does not appear imbalanced, our estimate of *Extroversion (Peer)* can be interpreted as a causal peer effect. We use ordered logistic regression since our dependent variable takes on integer values between 3 and 15. Since we have multiple evaluations and multiple ideas for individuals i, we included fixed effects at the evaluator level and corrected our standard errors by clustering them at the individual level. The evaluator fixed effects increase our power by removing between-evaluator differences. The clustering reduces our power by accounting for the fact that the ideas generated by the 108 brainstorming participants are not independent.[4]

[2] While most ideas received evaluations on all dimensions, some received evaluations on only one. For the construction of *Idea Quality*, we coded the score as missing if it did not receive evaluations on all three dimensions. We find no systematic relationship between the variable of interest and the likelihood that a project evaluation was missing.

[3] Each participant's bootcamp application was rated by four independent admissions evaluators. The evaluations were on a 1 to 5 scale and based on grades in college; the prestige of their college; the quality of their application essay; their skills in business topics such as finance, marketing, and sales; and their technical skills, such as interaction design and programming.

[4] While the larger study had 112 participants, four participants were absent or unable to connect to the wireless Internet during the brainstorming exercise. These four participants do not appear to differ from the larger population of participants in terms of personality or ability.

Table 1
Summary statistics at the individual participant level.

	Count	Mean	SD	Min	Max
Average Idea Quality (Self)	108	7.696	1.245	5.000	12.000
Extroversion Raw Score (Self)	112	3.502	0.545	1.875	4.750
Openness Raw Score (Self)	112	3.896	0.405	2.700	4.700
Conscientious Raw Score (Self)	112	3.627	0.535	2.444	4.889
Agreeableness Raw Score (Self)	112	3.755	0.495	2.444	4.778
Neuroticism Raw Score (Self)	112	2.492	0.618	1.125	3.875
Extroversion (Self)	108	−0.025	1.005	−2.988	2.291
Openness (Self)	108	0.018	1.010	−2.953	1.986
Conscientious (Self)	108	0.011	0.988	−2.211	2.359
Agreeableness (Self)	108	−0.008	0.998	−2.646	2.066
Neuroticism (Self)	108	0.018	1.005	−2.212	2.237
Admission Score (Self)	108	−0.009	1.016	−2.284	1.777
Engineer (Self)	108	0.713	0.454	0.000	1.000
Pre-treatment Idea Quality (Self)	107	2.544	0.327	1.759	4.022
Extroversion (Peers)	108	0.002	0.569	−1.841	1.603
Openness (Peers)	108	0.031	0.596	−1.142	1.492
Conscientious (Peers)	108	0.004	0.613	−1.380	1.866
Agreeableness (Peers)	108	0.020	0.603	−1.524	1.589
Neuroticism (Peers)	108	−0.037	0.574	−1.808	1.159
Admission Score (Peers)	108	0.005	0.574	−1.269	1.342
Engineer (Peers)	108	0.686	0.270	0.000	1.000
Pre-treatment Idea Quality (Peers)	112	2.536	0.178	2.114	3.096
Observations	112				

4. Results

We first test whether open innovators develop better-rated ideas (Hypothesis 1). In Table 2 we regress each evaluation of idea quality on the focal innovator's openness score. Column 1 presents estimates of the innovator's openness on the aggregate post-treatment *Idea Quality* measure. The coefficient is negative, −0.077, but the standard error and *p*-value imply that the estimate is not statistically significant (SE = −0.065, $p > 0.1$). This suggests that individuals who are high in openness do not necessarily generate better ideas and may, on average, generate worse ideas.

Column 2 in Table 2 tests the main effect of conversing with more extroverted peers (Hypothesis 2). The coefficient on Extroversion (Peers) is 0.305, nearly four times the magnitude of the Openness (Self) estimate, and is statistically significant ($p < 0.05$).

This coefficient indicates that when individuals have conversations with extroverted peers, they generate better-rated ideas. By exponentiating the coefficient, we find that the log odds for the peer extroversion variable is 1.36. Individuals who have extroverted peers, by one standard deviation higher than the population average, are about 36% more likely to receive a one-point higher rating than individuals who converse with a peer at the mean level of extroversion. A one-point increase is non-trivial, as it moves an idea up a decile in the idea quality distribution.

Column 3 includes the interaction term testing the predictions in Fig. 1. In Column 3 we include a variable for individuals' level of openness, the average peer extroversion, and an interaction of this

Table 2
Do conversations with extroverted peers increase an open individual's idea quality?

	(1) Idea Quality	(2) Idea Quality	(3) Idea Quality	(4) Idea Quality	(5) Idea Quality	(6) Idea Quality
Openness (Self)	−0.077		−0.092	−0.074	−0.111*	−0.121*
	(0.065)		(0.060)	(0.060)	(0.056)	(0.057)
Extroversion (Peers)		0.305*	0.323**	0.428**	0.371**	0.513**
		(0.123)	(0.109)	(0.117)	(0.104)	(0.116)
Openness (Self) × Extroversion (Peers)			0.300*	0.342*	0.328*	0.365*
			(0.142)	(0.153)	(0.141)	(0.158)
Extroversion (Self)				−0.103		−0.081
				(0.066)		(0.069)
Openness (Peers)				−0.220*		−0.311**
				(0.106)		(0.113)
Openness (Self) × Openness (Peers)				0.023		0.063
				(0.137)		(0.121)
Extroversion (Self) × Openness (Peers)				−0.138		−0.144
				(0.149)		(0.134)
Extroversion (Self) × Extroversion (Peers)				−0.177		−0.301†
				(0.158)		(0.176)
Pre-treatment Idea Quality (Self)					0.456†	0.499*
					(0.247)	(0.233)
Pre-treatment Idea Quality (Peers)					0.314	0.490
					(0.378)	(0.378)
Admission Score (Self)					0.013	0.088
					(0.059)	(0.066)
Admission Score (Peers)					0.199†	0.277**
					(0.107)	(0.106)
Engineer (Self)					−0.158	−0.062
					(0.152)	(0.154)
Engineer (Peers)					−0.045	−0.074
					(0.283)	(0.270)
Observations	1150	1150	1150	1150	1141	1141

Standard errors in parentheses. Ordered Logistic Regression with evaluator fixed effects. All tests are two tailed. Standard errors clustered at the individual innovator level.

* $p < 0.05$.
** $p < 0.01$.
† $p < 0.10$.

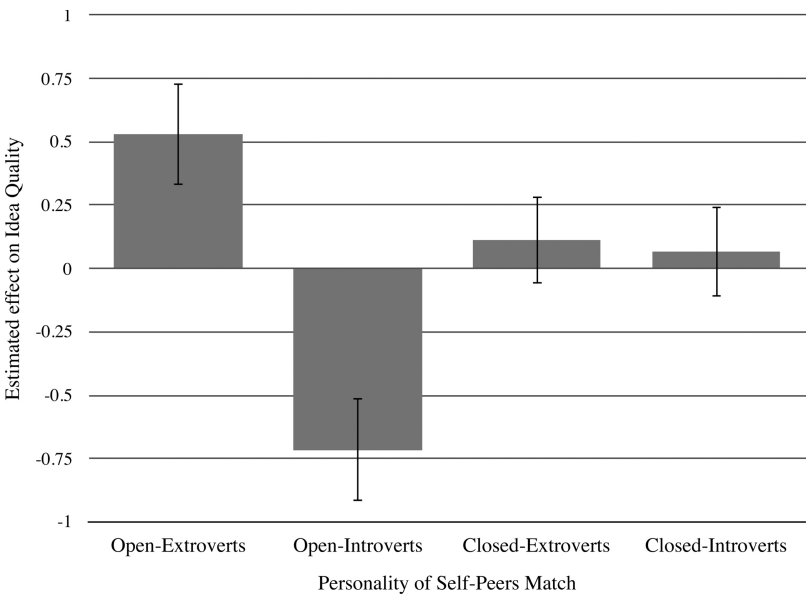

Fig. 2. Estimated effects on idea quality for self-peers matches displayed in Fig. 1. Open (closed) indicates an individual one standard deviation above (below) the mean; extroverts (Introverts) one standard deviation above (below) the mean. Whiskers display standard errors for each estimate. The effects for Open-Extrovert and Open-Introvert are both significant at the 1% level.

variable with their peers' average extroversion.[5] The coefficients on the main effects of Openness (Self) and Extroversion (Peers) remain relatively unchanged. The coefficient on the interaction term is similar in size and significance to the Extroversion (Peers) variable. The estimate is 0.300, and the standard error of (0.142) and p-value ($p < 0.05$) indicate that the effect is different from zero. The coefficient indicates that individuals who are one standard deviation higher in openness get twice the benefit when they talk with extroverts. Furthermore, since the main effect of Openness (Self) is a fourth the size of the interaction effect, we find that open individuals do generate better ideas, *but only after they have had conversations with extroverts.*

Fig. 2 plots the estimated effects on idea quality for matches between Open-Extroverts, Open-Introverts, Closed-Extroverts, and Closed-Introverts. The chart plots and tests the joint effect of Openness (Self), Extroversion (Peers), and their interaction. The chart reveals that open innovators benefit from talking to extroverts but will generate worse ideas when paired with introverts; closed innovators are unaffected by the extroversion of their peers.

In Column 1, we see that an open innovator paired with extroverts generates higher quality ideas, 0.53 ($p < 0.01$) points higher than an innovator at the mean level of openness matched with partners at the mean level of extroversion. The effect is substantial, implying that the innovator is 70% more likely to generate an idea that is one decile greater in the quality distribution. In Column 2, we see that an open innovator paired with introverts generates *worse* ideas, -0.72 ($p < 0.01$) lower. Closed individuals experience little change in the nature and quality of their ideas; partnering with extroverts has an estimated effect of.11 and partnering with introverts 0.07, both insignificant.

Returning to Table 2, Column 4 extends our models by including the full set of self-peer interactions between extroversion and openness. This model allows us to check the robustness of our results in the face of alternative self-peer personality interactions.

Including the additional interactions increases the magnitude of the coefficients on Extroversion (Peers) and its interaction with Openness (Self). Furthermore, having peers high in openness does not appear to help an innovator generate better ideas.

Column 5 includes our three non-personality ability measures to further assess robustness. The first control is pre-treatment idea quality, the average of the evaluations of each person's pre-conversation ideas.[6] The second control is our measure of each person's estimated generalized ability, as measured by his or her admission score. The third control is our dummy for whether the individual has or is pursuing an engineering degree. Including these controls at the self and peer levels does not change our primary results.

Our results do not appear to be driven by the peer's pre-treatment idea quality, talent, or educational background. Column 6 tests the robustness of our results by including all the variables in both Columns 4 and 5. Our results hold even in this relatively demanding specification.

Finally, these findings also hold when using evaluations from Indian consumers who did not attend the bootcamp; see Appendix Table A16, which replicates Table 2, but using our external measure of idea quality.

4.0.1. Analyzing the idea text

We further test our arguments by examining the text content of the ideas generated by participants. Specifically, we test whether our treatment effects shape how developed and recombinative an idea is and whether these changes mediate the effects on idea quality. Table 3 presents results from this analysis, providing a further check on our hypothesized pathway.

In Column 1 of Table 3 we test whether our treatment affects an idea's development score. We regress the score (the log of the number of unique terms) on Openness (Self), Extroversion (Peers), the interaction, and the average development score of the innovator's pre-treatment ideas.[7]

Similar to our idea quality models Table 2, we find that the coefficients on Extroversion (Peers) and its interaction with Openness (Self) are positive and similar in magnitude. A one SD increase in Extroversion (Peers) increases the number of unique terms in the idea by 0.38

[5] Openness (Peers) and Extroversion (Peers) have a correlation of 0.4, the largest correlation between our independent variables. We find no evidence that this correlation or any other correlation between our independent variables led to instability due to multicollinearity in any of the models in Table 2.

[6] We have complete observations for all 108 participants, except for one individual who participated in only the post-treatment idea generation session. In Column 9 we drop this person's 9 idea evaluation from the analysis.

[7] Three ideas, which each received 5 evaluations, used only very common words, and so after parsing the text ended up having zero terms. For these terms, the recombination score could not be calculated, since betweenness cannot be calculated for isolates in the semantic network. We drop these 15 observations from our analysis.

Table 3
Do conversations with extroverted peers change the content of an individual's ideas?

cline2-4	Dependent variable		
	Idea development (1)	Idea recombination (2)	Standardized idea quality (3)
Openness (self)	−0.114	−0.104†	−0.050
	(0.084)	(0.059)	(0.069)
Extroversion (peers)	0.379*	0.245*	0.271*
	(0.160)	(0.118)	(0.114)
Openness (self) × extroversion (peers)	0.340†	0.240†	0.230
	(0.205)	(0.138)	(0.148)
Pre-treatment development (self)	0.304*		
	(0.129)		
Pre-treatment recombination (self)		0.066	
		(0.087)	
Idea development			0.360**
			(0.072)
Idea recombination			0.098
			(0.073)
Indirect treatment effect (development)			0.259*
			(0.103)
Indirect Treatment Effect (Recombination)			0.047
			(0.037)
Indirect treatment effect (Dev. and Rec.)			0.306*
			(0.112)
Total effect			0.806**
			(0.217)
Observations	1135	1135	1135

Note: Ordinary least squares with evaluator fixed effects. Standard errors clustered at the individual innovator level.
* $p < 0.05$.
** $p < 0.01$.
† $p < 0.1$.

standard deviations ($SE = 0.160$, $p < 0.05$), and the effect appears larger for those higher in Openness, increasing the number of unique terms used by an additional 0.34 standard deviations ($SE = 0.205$, $p < 0.1$). Column 2 tests the effects on recombination and finds similar results with a one SD increase in Extroversion (Peers) leading to an increase in an idea's recombination score of 0.245 standard deviations ($SE = 0.118$, $p < 0.05$), and with the effect increasing by another 0.24 for innovators high in openness ($SE = 0.138$, $p < 0.1$). We find evidence that speaking with extroverts, especially among those high in openness, leads to more developed and recombinative ideas.

In Column 3 we examine whether higher recombination and development scores lead to better evaluations. We find that ideas with higher development scores are indeed better ideas. A one SD increase in an idea's development score leads to improvement in idea quality by 0.314 points ($SE = 0.076$, $p < 0.01$). We also find a significant effect for recombination, with a one standard deviation increase improving idea quality by 0.195 points ($SE = 0.096$, $p < 0.05$).

At the bottom of Column 3 we report the results of our formal mediation analysis (Baron and Kenny, 1986). Our mediation analysis tests if the effect of Extroversion (Peers) and Openness (Self) *X* Extroversion (Peers) is mediated by recombination and development.

Using a multiple-mediation model we show that it is, though primarily through idea development. The total effect of Extroversion (Peers) and Openness (Self) *X* Extroversion (Peers) on Idea Quality is 0.806 ($SE = 0.243$, $p < 0.01$). Of this effect, we estimate that 0.31 (about 38%) is mediated by development and recombination ($SE = 0.112$, $p < 0.05$). Examining each measure separately, we find that roughly 85% of the mediated effect appears to flow through development, and about 15% of the quality effect may come from recombination, although the indirect effect through recombination is not statistically significant. The models in Table 3 provide further evidence for our causal pathway: talking with extroverts, especially for innovators high in openness, leads to developed and recombinative ideas, which are of higher quality.

4.1. Robustness checks and alternative mechanisms

Our online Appendix provides a further suite of robustness checks, which we briefly describe below.

Alternative model estimates to test for non-linearity in interactions: Appendix Table A6 replicates Table 2 using ordinary least squares instead of ordered logistic regression to confirm that the interaction effect between Openness (Self) and Extroversion (Peers) is not an artefact of the non-linear specification (e.g., Ai and Norton, 2003). We find evidence for the interaction effect in the linear specification, and in further robustness checks we find that plots of our interaction terms are consistent over the range of the data.

The effect of other peer and innovator traits: Appendix Table A8 tests the importance of experience at weddings. The table tests if our results are sensitive to the inclusion of innovator age (perhaps older participants have attended more weddings) and gender (potentially women are more familiar with the wedding industry). None of these experience-with-wedding proxies meaningfully change our results. In Appendix Table A8 we also find little evidence that openness merely reflects an innovator's ability as measured by his or her admission score.

Alternative personality mechanisms: In Appendix Table A7 we test whether what matters is not the extroversion of an innovator's peers but rather their neuroticism, conscientiousness, agreeableness, or self-monitoring. We find these measures to be largely insignificant, even when interacted with the innovator's openness. Furthermore, they do not meaningfully change the coefficients on our openness and extroversion measures. Appendix Table A9 has perhaps the most demanding specification and reports the results from the fully parameterized regression that includes all 25 ego-alter pairwise personality interactions. In this regression, extroversion (peers) remains significant, although the interaction with Openness (Self) loses statistical significance but remains positive and is not statistically different from the specifications where significance at conventional levels is achieved. What matters most, however, is the joint effects. The pattern reported in Fig. 2 holds; open individuals do better (worse) when they converse with extroverts (introverts) ($p < 0.01$); for closed individuals, we find no statistically different outcomes when they talk to extroverts or introverts.

Alternative dependent variables: Moving beyond alternative personality explanations, in Appendix Table A10 we show that peer extroversion and the rest of our measures have little impact on the number of ideas generated, with the exception that open individuals appear to generate slightly more ideas ($p < 0.1$). This is not surprising as prior research suggests that quality of ideas, rather than quantity, distinguishes open from closed individuals.

Peer order and mix effects: Appendix Table A11 examines whether idea generation is improved not by talking solely with extroverts, but by talking with a mix of extroverts and introverts or by talking first to extroverts and then to introverts. We test for the value of talking to a mix of peers by including the standard deviation of extroversion; we test for potential order or sequence effects by separately including in our regression model the peer extroversion of an innovator's first, second, and third conversation partners. We find little evidence for either. Appendix Table A12 tests whether the effects on idea quality affect the underlying dimensions of novelty, business, and buy ratings. We find our effects hold across these dimensions.

Evaluation bias: Appendix Table 14 includes controls for whether the idea evaluator knows, is friends with, or provides advice to the participant who generated the idea. While the evaluations did not include

any information about who generated the idea, perhaps people were able to determine who generated the idea and favored their friends. Controlling for evaluator–innovator relationship status does not affect our findings. In conjunction with the fact that our models hold when using evaluations from Indian consumers, we find little evidence that our peer-based measure would systematically bias our findings.

Path dependence on team-level outcomes: We further checked the robustness of our results by testing whether our individual-level findings could be replicated 3 days later on the performance of the 40 randomly teams to which the participants were assigned. Appendix Table 15 presents a brief description of this robustness test and our findings. In summary, we find path dependence in the team-level outcomes. Teams populated with participants higher in openness to experience and who conversed with extroverted peers during the individual pairwise conversations that constitute the main experiment produced final projects that were rated higher in the double-blind peer evaluation as well as in independent ratings by Indian consumers. This preliminary finding suggests that these early conversations may be consequential for team as well as individual performance.

5. Discussion

In this paper we contribute to a growing literature on the social dimensions of idea generation. This stream of research, though diverse, suggests that social interaction—often mediated through informal social ties (Burt, 2004; Perry-Smith and Mannucci, 2015), collaborations (Singh and Fleming, 2010), and conversations with potential customers (Blank, 2013)—is an important factor that affects the quality of new business ideas or inventions. Our approach, inspired by this work, argues that the specific conversations that individuals have with peers play an important role in idea generation. Specifically, we argue that a complementarity exists between the traits of conversational peers and focal idea generators in developing high-quality ideas. Our research examines how the personality of an innovator (openness to experience, capturing creativity) and the personality of her randomly assigned conversational peers (extroversion, measuring willingness to share information) affects the quality of the innovator's ideas.

Our study introduces scope conditions on both the social dimensions of idea generation as well as models of creativity based on individual differences. First, we find that the ideas generated by 'closed' innovators are unaffected by their conversational peers, suggesting limits to when social interaction will benefit idea generation. The value of social interaction appears bounded by individual differences in the ability and motivation to incorporate outside information. Conversely, the ideas of open individuals are responsive to social interaction, but this response to peer extroversion and introversion appears asymmetric. Open innovators paired with extroverted peers produce the highest-quality ideas. In comparison, Open-Introvert pairs develop substantially lower-quality ideas. This finding suggests that even among individuals with more creative ability and motivation, external interactions can lead them to produce bad ideas.

Regarding magnitude, while the estimated effect of talking with an extrovert will not turn the lowest-quality ideas into the best ones, they can shift ideas at the margins of "good" to "very good" or "very good" to "great." As the coefficients on Extroversion (Peers) suggests in Table 2, a one standard deviation increase in peer extroversion is equivalent to moving an idea from the 80th percentile of quality to the top decile. As the interaction effect *Openness (Self)* × *Extroversion (Peers)* also suggests, the effects are especially large for innovators high in openness, with ideas potentially moving up three deciles in the quality distribution when they switch from conversing with a introverted to an extroverted partner. Our magnitudes are comparable to related work on idea generation (Girotra et al., 2010) and are quite robust to many alternative specifications: including models that use the text of the ideas generated, external evaluations from Indian consumers, and substantial controls for alternative personality mechanisms as well as other background characteristics of both peers and focal individuals. We also find preliminary evidence that the results of individual-level conversations affect team-level outcomes, though more research is needed to understand how our findings interact with team processes such as social anxiousness (Camacho and Paulus, 1995) and other mechanisms at the group level (Sutton and Hargadon, 1996; Paulus, 2000).

This study speaks to three research streams. First, our research provides new insights for scholars of entrepreneurship and new product development by showing the importance of conversations at the earliest stages of business idea generation (e.g., Ward, 2004; Shane, 2000). Second, a diverse body of research has examined the role of collaboration and social interaction in invention (Fleming et al., 2007) and idea generation in organizations (e.g., Perry-Smith and Mannucci, 2015; Burt, 2004). Our results use this prior work as analogy to provide a closer look at conversations—which often make up the basic social interactions that drive such collaborative or network effects. The effects of conversations appear to be moderated by the personalities of both the senders and receivers of information. Finally, our work links research on brainstorming and the psychology of creativity (e.g., Kaufman and Sternberg, 2010; Paulus, 2000; Amabile et al., 2004; Amabile, 1983; Taylor et al., 1958). Our findings highlight the importance of personality differences in predicting which types of interactions will be more generative for new ideas during early stages of the brainstorming and creative process (Litchfield, 2008), and for what problems (e.g., Kavadias and Sommer, 2009).

How should entrepreneurs, innovators and managers view our results? The simplest takeaway is that if developing creative ideas matters for your team, then closed people are unlikely to help. However, being open to experience is not enough. Innovative teams must strive to get external information from individuals who provide both a higher volume of information as well as share more personal information. Getting this balance right—between the internal composition of the team and the sources of external knowledge—is critical not just for the initial ideas generated, but also for team performance in the longer term. Future research should examine this process for product development teams in established firms, but also at various stages of the idea journey (Perry-Smith and Mannucci, 2015).

Our study also contributes to the literature from a methodological perspective. In this article, we used data from a field setting (an entrepreneurship bootcamp) that is a growing source for new startups worldwide (Cohen, 2013; Dutt et al., 2016). We were able to randomize social interactions well as measure detailed data on ideation and individual characteristics. While the bootcamp we studied is just one example of a larger phenomenon, we believe startup incubators and bootcamps offer a fruitful research site to study important social mechanisms and outcomes—e.g., the creation of new products and firms.

That said, it is worth noting several limitations of the bootcamp setting and, more generally, of the present study. We focused on a specific interaction—short conversations early in the idea generation stage—and specific personality traits that prior research has identified as relevant to creativity and information sharing. A more general account of the value of external conversations should no doubt consider conversations at other stages (e.g., idea refinement and feedback on a developed product) and the individual differences in both the seekers and providers of that advice.

Second, our idea generation exercise focused on the Indian wedding industry, and many of our conversational peers are also potential end users (e.g., Von Hippel, 1978). However, in the course of idea generation, innovators may also converse with other external parties, including producers of complementary technologies, venture capitalists, early adopters, colleagues, and even competitors. While we believe that the basic psychological mechanisms outlined in this paper should hold, we expect that the effect of conversations in more specialized domains will be moderated by the domain knowledge of the peer (Poetz and Schreier, 2012).

Third, we conducted our study in the context of new product ideas for startups (Scott et al., 2016). While there are commonalities between product development teams in startups and in established firms, there are also differences. Innovators in established organizations face different constraints, including those imposed by existing product lines, organizational boundaries, and bureaucracy (e.g., Dougherty and Hardy, 1996). These constraints may limit how novel the ultimate product ends up being, independent of the idea generation process.

Finally, we also see these limitations as possibilities for future research. While our study focuses on how individual differences and peer conversations affect entrepreneurial idea generation, future work should explore how the complementarity between an innovator and her conversation partner operate within established enterprises, in conversations with consumers, or when developing technical and specialized ideas. We hope our study provides a template for future researchers by demonstrating how a peer randomization design can be used to simultaneously shed light on the individual and social dimensions that affect creativity, entrepreneurial ideas, and inventiveness.

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Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at https://doi.org/10.1016/j.respol.2019.103811.

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