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SOCIO-COGNITIVE PERSPECTIVES IN BUSINESS VENTURING

Diego Zunino

SOCIO-COGNITIVE PERSPECTIVES IN BUSINESS VENTURING

PhD School in Economics and Management

PhD Series 22.2018

CBS  **COPENHAGEN BUSINESS SCHOOL**
HANDELSHØJSKOLEN

PhD Series 22-2018

Socio-Cognitive Perspectives in Business Venturing

Diego Zunino

Supervisors:

Prof. Mirjam van Praag

Prof. Keld Laursen

PhD School in Economics and Management

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“Not only that; let us exult, too, in our hardships, understanding that hardship develops perseverance, and perseverance develops a tested character, something that gives us hope”—St. Paul to the Romans, 5, 3-4

“Patience you must have, my young padawan”—Yoda, Episode V: The Empire Strikes Back

After six years of doctoral studies, I have learned much about strategy, entrepreneurship, and innovation, and even more about hardship, perseverance, and patience.

Many people had a lot of perseverance and patience with me; for example, those who helped me write and those who ultimately read my dissertation. First and foremost, I would like to thank my supervisors, Mirjam van Praag and Keld Laursen. I also would like to thank Vera Rocha and Randolph Sloof for the many and useful improvements suggested during the pre-defense meeting. Finally, I would like to thank Elena Novelli and Michael Dahl for having agreed to assess this dissertation. During the years of this long Ph.D. journey, I had the luck and privilege to work at three institutions that contributed to my academic development: Bocconi University, Boston University, and Copenhagen Business School.

Bocconi. At Bocconi, under the guidance of Stefano Breschi and Stefano Brusoni, I took the decision to pursue doctoral studies. I did an internship and wrote my thesis at the KITeS research center of Bocconi University thanks to Franco Malerba and Alfonso Gambardella, two invaluable mentors. Raffaella Piccarreta has been a constant source of encouragement throughout all my doctoral studies.

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coursework. I joined an exciting research program, and one of the projects is now part of this dissertation. Thanks to Fernando Suarez and Stine Grodal for the invaluable academic experience. Working together has taught me so much about strategy, technology, and categorization, but also about the latest tennis talent or the newest technology gadget. Outside Boston University, I am very grateful to Juan Alcacer for allowing me to take his class and always finding the time for mentoring me with insightful conversations.

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Copenhagen Business School. The last step of my doctoral path has been at Copenhagen Business School, at the Innovation and Organizational Economics Department. My primary supervisor Mirjam van Praag has taught me a lot during these years. Her guidance and support of any sort were beyond any expectation. Keld Laursen, my second supervisor, has been a source of inspiration. His honest feedback and wise guidance helped me consistently improve my research. I taught at CBS together with Lars Bo Jeppesen, and it was a real pleasure. I learned a lot about digitization, platforms, and Copenhagen's most authentic bodegas. I would also like to thank Vera Rocha, Orsola Garofalo, and Marcus Simeth for informally supervising me and solving issues on the spot at a very short notice. Outside the boundaries of my department, I would like to thank Magda Dobrajaska, Toke Reichstein, and Lars Frederiksen for their precious help during these years. Outside CBS, I had the opportunity to work with Gary Dushnitsky from London Business School.

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Back home. At a more personal level, I would like to thank those friends who have been there from my childhood in Albissola Marina. Thank you, Chiara, Alberto, Davide, Daniele, Fabrizio, and Andrea: you are my resilience network. The same goes for more recent but not less important friends whom I met in Milan: Riccardo, Guido, Nicolò, Flavio, Francesco, Amedeo, Nicola, and Daniele.

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All in all, I am immensely grateful for this experience. I tend to complain a lot about this process, but studying for a Ph.D. has been a true privilege. Thanks to everyone who made it possible in so many different ways and to the reader who had the perseverance to read up on this final line.

SUMMARY

Entrepreneurship is an increasingly relevant and popular object of scholarly investigation. In this dissertation, I borrow relevant socio-cognitive constructs from the field of strategy and employ them to four relevant steps of the venture creation process. The purpose of this dissertation is to refine our understanding about perceptions in entrepreneurship through four essays.

The first essay of the dissertation investigates entry into entrepreneurship. More specifically, I look at the relationship between institutional environment and predisposition to entrepreneurship as antecedents of entrepreneurial activity. The key insight is that, among other institutional factors, the perception of entrepreneurial activity positively moderates the role of innate predisposition to entrepreneurship.

The second essay looks at the problem of resource acquisition when entrepreneurs have experienced business failure in the past. The key insight is that past failure is an ambiguous rather than a negative signal of entrepreneurial skill. When entrepreneurs provide additional information about their entrepreneurial skill, investors do not penalize past failure.

The third essay addresses the problem of recruitment. The key insight is that startups can convey different types of information through their job advertisements and attract different types of early employees based on their level of human capital and risk propensity.

The fourth essay looks at the step of technology product launch. The key insight is that perception of familiarity and creativity of category labels has an influence on their adoption to represent the technology product category. More precisely, I find that for both familiarity and creativity, there is an inverted U-shaped relationship associated to category labels' adoption.

Through diverse theories and methodologies, the dissertation provides empirical support to the role perceptions play during the entrepreneurship process, and suggests rhetorical strategies entrepreneurs can exploit to gather resources and achieve competitive advantage.

RESUMÉ

Entreprenørskab er i stigende grad et relevant emne for videnskabelig undersøgelse. I denne afhandling lånes socio-kognitive begreber fra strategifeltet til anvendelse i fire relevante trin af ventureskabelsesprocessen. Formålet med afhandlingen er at forfine forståelsen af opfattelser i entreprenørskab gennem fire essays.

Det første af afhandlingens essays undersøger indtræden til entreprenørskab. Mere specifikt kigges der på forholdet mellem det institutionelle miljø og pre-disposition for entreprenørskab som fortilfælde for entreprenant aktivitet. Nøgleindsigten er, at opfattelsen af entreprenant aktivitet, blandt andre institutionelle faktorer, positivt modererer den rolle som medført pre-disposition for entreprenørskab spiller.

Det andet essay kigger på ressourceerhvervelsesproblemet, i tilfælde hvor entreprenører har konkurreret med i bagagen. Nøgleindsigten er, at fejl i fortiden ikke signalerer manglende entreprenant formåen, men skaber tvetydighed omkring denne formåen. Når entreprenøren giver ekstra information omkring deres entreprenante formåen, straffer investorer ikke tidligere konkurs.

Det tredje essay adresserer rekrutteringsproblemet. Nøgleindsigten er, at nystartede virksomheder kan befordre forskellige typer af information gennem deres jobopslag, og deraf tiltrække forskellige typer af tidlige medarbejdere baseret på niveauet af menneskelig kapital samt risiko tilbøjelig.

Det fjerde essay kigger på teknologisk produktlancering. Nøgleindsigten er, at opfattelse af familiaritet og kreativitet af kategorimærker har en influerende effekt på kategorimærkeadoptionen.

Mere præcist ses det, at der både for familiaritet og kreativitet er en invers U-formet relation associeret med kategorimærkeadoption.

Gennem diverse teorier og metoder frembringer afhandlingen empirisk evidens for hvilken rolle opfattelser spiller i den entreprenante proces og foreslår retoriske strategier, som entreprenører kan bruge til at tilgå ressourcer og opnå konkurrencemæssige fordele.

SOMMARIO

L'imprenditorialità è un soggetto di ricerca sempre più rilevante e diffuso. In questa tesi di dottorato, vengono applicati a quattro importanti fasi della creazione di un'impresa concetti mutuati dalle teorie socio-cognitive della strategia aziendale. Lo scopo di questa tesi è raffinare quanto conosciuto sul ruolo della percezione nell'imprenditorialità attraverso quattro saggi.

Il primo saggio della tesi studia la scelta imprenditoriale. Nello specifico, si focalizza l'attenzione alla relazione tra ambiente istituzionale e predisposizione all'imprenditorialità. La conclusione principale è che, tra gli altri fattori istituzionali, la percezione della carriera imprenditoriale modera positivamente il ruolo della predisposizione innata all'imprenditorialità.

Il secondo saggio della tesi studia il problema del finanziamento dell'impresa quando gli imprenditori hanno fallito in passato. La conclusione principale è che il fallimento non è un segnale di scarsa abilità imprenditoriale, piuttosto crea ambiguità intorno alla medesima abilità. Quando gli imprenditori riescono a fornire maggiori informazioni sulla loro abilità, gli investitori non penalizzano una passata esperienza di fallimento.

Il terzo saggio si rivolge al problema dell'assunzione di lavoratori. La conclusione principale è che le imprese giovani trasmettono differenti messaggi attraverso le loro offerte di lavoro ed attraggono diversi tipi di lavoratori a secondo del loro livello di capitale umano e della loro propensione al rischio.

Il quarto saggio guarda infine alla fase di lancio di un prodotto tecnologico. La conclusione principale è che la percezione di familiarità e creatività delle parole utilizzate per definire una categoria ha un'influenza sulla loro adozione per rappresentare la categoria di riferimento. Più precisamente, trovo una relazione ad U rovesciata tra sia familiarità sia creatività ed adozione.

Attraverso teorie e metodi differenti, la tesi di dottorato fornisce evidenza empirica al ruolo della percezione nel processo imprenditoriale e suggerisce strategie retoriche che gli imprenditori possono sfruttare per raccogliere risorse ed ottenere vantaggio competitivo.

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CHAPTER 1. INTRODUCTION

Entrepreneurship is a topic that recently received attention among scholars. The term “entrepreneur*” on Web of Science appears in 468 articles in 1996, 1057 articles in 2006, and 5856 articles in 2016. The rise of entrepreneurship research has ignited debate whether entrepreneurship should be a separate field in the scholarly community (Shane and Venkatraman 2000) or a phenomenon that different academic disciplines (e.g., economics, sociology, and psychology) should tackle separately (Sorenson and Stuart 2008). Shane and Venkatraman (2000) argue that entrepreneurship is a complex phenomenon that requires a separate field of studies because of many behavioral and institutional contingencies. Sorenson and Stuart (2008) contend that entrepreneurship is a legitimate subject within the academic disciplines and that the costs of drawing boundaries between entrepreneurship and other fields outweigh its benefits. In this dissertation, I suggest that there is no need to establish a further field of study. I argue that existing academic disciplines are fit to host a complex phenomenon such as entrepreneurship. More precisely, I argue that the socio-cognitive lens adopted in the field of strategy can be useful to analyze the entrepreneurship phenomenon. Strategy and entrepreneurship studies share two main affinities.

First, the goals of strategy and entrepreneurship are inherently related. Strategy scholars try to explain the antecedents and the implications of firm heterogeneity: what drives entry into markets and what drives competitive advantage. Entrepreneurship research similarly strives to explain the antecedents and the implications of individual heterogeneity: both in terms of career choice, and in terms of their startups’ performance (van Praag 2003). The similarity is reflected in the categories of antecedents these study theorized and found.

For strategy, explanations range from macro patterns like industry structure (Porter 1979, McGahan and Porter 1997) and the stage of the technology (Suarez and Utterback 1995) to firm

level determinants like resources (Barney 1991, Henderson and Cockburn 1994, Ahuja and Katila 2004) and dynamic capabilities (Teece et al. 1997, Eisenhardt and Martin 2000).

For entrepreneurship, there are similar explanations. On the one hand, there are broad institutional factors (Gartner 1988) like geographic areas (Sorenson and Audia 2000, Stuart and Sorenson 2003) and organizations (Sorensen and Fassiotto 2011); on the other hand, there are micro-founded antecedents like traits (McLelland 1967, Zhao et al. 2010), human capital (Dunn and Holtz-Eakin 2000, Lazear 2005), and biological determinants (Nicolaou et al. 2008).

That is, both strategy and entrepreneurship are grounded in the explanation of heterogeneity, and thus they often try to explain how some explanations are contingent to moderating conditions.

Second, strategy has become a plural discipline that incorporates insights from different social sciences. The field results in a vast array of theoretical constructs and methodological approaches that complement each other. Strategy originated from industrial organization and economics (Schmalensee 1985, Ghemawat 2002), and it gradually incorporated perspectives from psychology (Ocasio 1997), sociology (Zuckerman 1999), and also from neuroscience (Laureiro Martinez et al. 2015). One good example is socio-cognitive theories that have expanded our understanding of strategy by examining how market stakeholders perceive firms' actions (Pfarrer et al. 2010) or technologies (Rindova and Petkova 2007).

To date, we do not know much about the role of perceptions and how they interact with individual characteristics in entrepreneurship. To address this gap, I borrow concepts from strategy and I investigate the process of venture creation through a socio-cognitive lens. The dissertation addresses this research question: "What are the socio-cognitive elements that affect the process of venture creation?" Table 1 below provides an overview of the dissertation. In each chapter, I will focus on one specific step of the entrepreneurial pattern: Chapter 2 analyzes the entry into entrepreneurship; Chapters 3 and 4 study resource acquisition of respectively financial and human

resources; Chapter 5 investigates the launch of a technology product. Each chapter is an independent study that relies on autonomous gaps, theories, data, and methodologies. However, all chapters utilize a socio-cognitive lens to investigate the role of perception in entrepreneurial phenomena.

In Chapter 2, I study how predisposition to entrepreneurship interacts with the institutional environment, defined as the “commonly held beliefs and understandings about “proper” organizational structures and practices” (Tolbert et al. 2011). In the Chapter 3, I study with Mirjam van Praag and Gary Dushnitsky how investors perceive and value entrepreneurs’ past business failure, and whether they can disentangle bad luck from lack of skills. In Chapter 4, I study how different potential joiners perceive a venture differently based on whether the information the venture conveys focuses more information about distinctiveness or membership. In Chapter 5, together with Stine Grodal and Fernando Suarez, I investigate how audiences’ perception of familiarity and creativity of category labels shapes their adoption to represent a technology product. In the following four sections, I will introduce and discuss each chapter of the dissertation. In the fifth section, I will discuss the limitations of each chapter and the intended contribution.

Table 1. Overview of the Dissertation Chapters

Chapter	Title	Question	Perception	Unit of Analysis	Data	Method
2	Favorable Institutional Environment and Predisposition to Entrepreneurship. Evidence from a Twins Study in Italy	Do institutions favorable to entrepreneurship compensate for individuals with less predisposition, or do these institutions enhance individuals with more predisposition?	Entrepreneurship as an attractive career	Entrepreneur	862 pairs of Italian twins	Regression-based twin study (DeFries and Fulker 1985, LaBuda et al. 1986)
3	Badge of Honor or Scarlet Letter? Unpacking Investors' Judgment of Entrepreneurs' Past Failure	How do investors, prominent resource providers, evaluate entrepreneurs who experienced past failure?	Failure as signal of entrepreneurial skill	Investor	246 British and European individuals with past investment experience and interest in crowdfunding investment	Framed field experiment (Harrison and List 2004)
4	Recruiting Talent for Early-stage Ventures: an Online Experiment on Startup Job Ads	Can startup use different types of information to attract different types of joiners?	Startup as an attractive workplace	Joiner	160 American individuals looking for new job opportunities	Framed field experiment (Harrison and List 2004)
5	Familiarity, Creativity, and the Adoption of Category Labels in Technology Industries	Why some category labels gain traction and others falter?	Familiarity and creativity of category labels' words	Category Label	390 category labels from 382 press releases of smartphones introduced in the US and UK between 2000 and 2010 and two experimental samples of 263 and 202 individuals recruited on Amazon Mechanical Turk	Negative binomial regression for archival analysis, ordered logit for experiments

Chapter 2. Favorable Institutional Environment and Predisposition to Entrepreneurship. Evidence from a Twins Study in Italy

Studies in institutional theory have examined how a favorable institutional environment helps increase the level of entrepreneurial activity (Saxenian 1996, Sorenson and Audia 2000). However, most of them have overlooked that there is heterogeneity across individuals. On parallel, studies from economics and psychology focused on how individual-level factors like human capital, traits, and biological features contribute to explain entrepreneurial activity (Nicolaou et al. 2008). These studies have neglected the institutional setting where these individual features take place (Thornton 1999).

This gap about the interaction between institutional and individual-level factors of entrepreneurship has been recently addressed: scholars looked at how different institutions supporting entrepreneurship affect individuals heterogeneously, based on their human capital endowments (Eesley 2016, Eberhart et al. 2017) or family background (Eesley and Wang 2017). In this chapter, I contribute to this conversation by testing how a favorable institutional environment for entrepreneurship affects individuals differently, based on their innate predisposition. The chapter presents two competing hypotheses about the direction of the interaction between institutional environment and predisposition. On the one hand, institutions can complement predisposition to entrepreneurial activity; on the other hand, institutions can substitute to lack of predisposition for entrepreneurial activity.

I exploit a unique dataset of 862 pairs of Italian twins to identify the effect of predisposition in the entrepreneurial choice, and I use sharp cross-sectional institutional differences in Italy to test whether there are institutional-specific effects. I find that individual predisposition to entrepreneurship has a positive effect when institutions are favorable to entrepreneurship.

Chapter 3. Badge of Honor or Scarlet Letter? Unpacking Investors' Judgment of Entrepreneurs' Past Failure

The increase of attractiveness of entrepreneurial activity, also through the fall in entry costs thanks to digitization (Greenstein et al. 2013), makes two phenomena particularly widespread: serial entrepreneurship and business failure (Kerr and Nanda 2009). In this chapter, we study how investors evaluate those serial entrepreneurs who experienced past business failure.

We address a specific gap in the resource acquisition literature that studied the informational value of entrepreneur's characteristics. This literature found relevant evidence about education (Zucker et al. 1998) and industry experience (Chatterji 2009), but overlooked entrepreneurial experience. Earlier studies focused on past success as positive signal of entrepreneurial skill for investors' decision (Gompers et al. 2010) and considered past failure a signal of poor entrepreneurial skill (Hochberg et al. 2014).

In this study we argue that past failure signals skill ambiguity rather than poor skill. We build on the key insight from socio-cognitive literature that negative information is less diagnostic than positive information (Pfarrer et al. 2010) and we incorporate luck in our theoretical framework (Liu and De Rond 2016).

We identify two key factors for business success: an endogenous factor—within the control of the entrepreneur—we label “skill,” and an exogenous factor—beyond the control of the entrepreneur—we label “luck.” We further argue that business success takes place when both factors are present, while business failure encompasses cases where it takes place due to lack of skill, “mistakes,” and/or due to bad luck—“misfortunes.” As a consequence of past failure as a noisier signal of skill, additional information should reduce the discount investors attach to failure. Alternatively, investors can have a bias against failure that does not change irrespectively from additional information about skill.

We test our hypotheses through an online experiment on 246 potential equity crowdfunding investors. Each participant evaluates an innovative venture where we manipulate the outcome of the founder's past entrepreneurial experience. The results support the hypothesis that investors do

not discount past failure when it occurs due to a misfortune and the founder provides additional information about skill, suggesting that the nature of failure discount is due to ambiguity and it can be removed.

Chapter 4. Recruiting Talent for Early-stage Ventures: an Online Experiment on Startup Job Ads

The strategy literature identified human capital as an important source of competitive advantage (Castanias and Helfat 1991). Human capital's role is even more salient for startups, and the associated hiring process is a crucial task (Williamson et al. 2002). Compared to established firms, startups face more difficulties in hiring due to lack of reputation and cognitive legitimacy. Because startups are resource constrained, they often rely on rhetorical tools to convey information (Lounsbury and Glynn 2001). These strategic tools are overlooked in the recent literature that devoted attention to startups' early human capital, labeled as "joiners" (Roach and Sauermann 2015). In particular, studies of the matching process between joiners and startups seem to assume perfect information between the two parties, thus neglecting startups' agency to convey specific information.

In this chapter, I release this assumption and theorize and test how startups can use different types of information to attract different types of joiners. I draw from resource acquisition (Kirsch et al. 2009) and socio-cognitive literatures (Rindova et al. 2005, Granqvist et al. 2013) for my categorization: on the one hand, startups can convey distinctiveness through substantive messages, suggesting higher quality; on the other hand, startups can convey industry membership through ceremonial messages, suggesting higher cognitive legitimacy.

I further theorize that these messages have different effects on joiners based on two key characteristics: human capital and risk propensity. I argue that substantive messages are more effective on individuals with higher levels of human capital (Vanacker and Forbes 2016), but lower

levels of risk propensity. On the contrary, ceremonial messages are more effective on individuals with lower levels of human capital (Mollick and Nanda 2015), but higher levels of risk propensity.

I test these predictions through an online experiment on 160 American participants who are looking for new employment opportunities. Each respondent reads a job ad with manipulated information about their potential employer. I find mixed support to my hypotheses. Substantive messages attract more joiners, but they are not effective on individuals with high human capital and they are more effective on individuals with high levels of risk propensity. Ceremonial messages do not attract more joiners on average, they are more effective on individuals with low human capital and they attract individuals with high levels of risk propensity.

Chapter 5. Familiarity, Creativity, and the Adoption of Category Labels in Technology Industries

When startups enter a market in the early stages of an industry, stakeholders hold multiple and simultaneous understandings of the industry's technology products. This socio-cognitive dimension is relevant to convey meaning and solve uncertainty around a new technology product (Zuckerman 1999, Rindova and Petkova 2007, Navis and Glynn 2010, Grodal et al. 2015, Smith and Chae 2016).

Entrepreneurs and other stakeholders experiment with a wide variety of cognitive partitions in the early stage of an industry, and use different category labels to invoke these partitions (Bowker and Star 2000, Pontikes 2012). Category label's adoption is important due to its potential implications for demand (Verhaal et al. 2015, Kahl and Grodal 2016). However, we know little about why some labels gain traction and others do not (Kennedy and Fiss 2013).

We identify two important antecedents of category labels' adoption from studies of the socio-cognitive literature of technology: familiarity (Hargadon and Douglas 2001) and creativity (Rindova and Petkova 2007). Familiar labels use words that are common in the English language, while creative labels recombine words that seldom appear together in the English language.

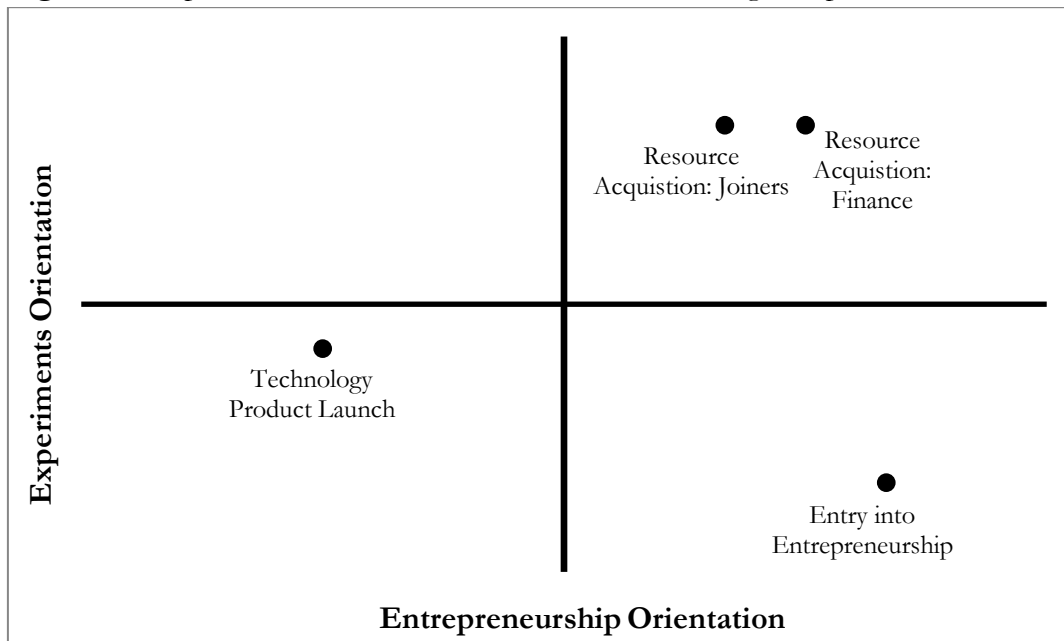
Drawing from the theory of semantic networks (Quillian 1969), we distinguish specific theoretical mechanisms that relate familiarity and creativity to category labels' adoption. Increasingly familiar labels are easier to comprehend but they are at risk of being processed unconsciously. Increasingly creative labels arouse curiosity but they have increasing cost of resulting dissonant and thus being ignored. These mechanisms allow us to theorize an inverted U-shaped relationship between each construct and adoption.

We test our predictions based on a mixed methodology approach (Fonti et al. 2017). We run an archival analysis on a sample of 390 category labels from 382 press releases from the smartphone industry over 10 years. We also design two online experiments to confirm our analysis in a setting where levels of familiarity and creativity are randomly assigned. Our results are consistent across methodologies and confirm that familiarity and creativity are two distinct important antecedents of category labels' adoption.

Limitations and Intended Contribution

This section is devoted to give an overview to the methodological approach, the theoretical angle, and the boundary conditions of each chapter of the dissertation. In Figure 1, I report the four chapters of the dissertation along two dimensions. On the horizontal axis, I report the degree of embeddedness of the four studies into entrepreneurship. On the vertical axis, I report the methodological mix of the studies from completely observational to completely experimental.

Figure 1. Chapters' location on Theoretical and Methodological Space



The chapter about predisposition and institutions is the most rooted into entrepreneurship research. It aims to investigate a fundamental question related to entrepreneurship: the initiation of entrepreneurial activity. The unit of analysis is the individual “at risk” of choosing entrepreneurship. The methodology is a regression-based twin study to identify the effect of predisposition (DeFries and Fulker 1985, LaBuda et al. 1986, Smith and Hatemi 2013). One important boundary condition of the chapter is the operationalization of entrepreneurship as self-employment. Even if it is the most basic form of entrepreneurship (Blanchflower and Oswald 1998), self-employment fails to capture salient aspects of high growth entrepreneurship (Henrekson and Sanandaji 2014). In the chapter, I argue that self-employment represents a lower bound in the study of the phenomenon: if the environment is more favorable to entrepreneurship, it should have even larger effects for high growth entrepreneurship.

The chapter about failure perception is less rooted in entrepreneurship because it speaks to resource acquisition literature while studying an important aspect of the entrepreneurial process. The unit of analysis is the individual investor. The methodology is a “framed field experiment” (Harrison and List 2004), where investors simulate an investment decision. The setting of equity

crowdfunding for the experiment has advantages in terms of representativeness, but it also represents a boundary condition because startups are at a very early stage and the average amount invested is small. It may be possible that investors may have a bias when ventures' past failure involve a large set of stakeholders or investors commit larger amounts.

The chapter about joiners and type of information addresses another step of resource acquisition and intends to complement the literature about startups' early human capital (Ouimet and Zarutskie 2014, Roach and Sauermann 2015, Burton et al. 2017, Kim 2018). The unit of analysis is the joiner. The methodology is a "framed field experiment" where joiners simulate the decision to apply and accept an offer from a startup. The main boundary condition of this study is that the study addresses potential hires beyond the network of the founder (Williamson et al. 2002), whose characteristics and contribution may differ systematically.

The chapter about category labels' adoption hinges on the process of launch of a technology product but it is not limited to entrepreneurship only. The unit of analysis is the category label. The methodology is mixed. We first run an observational study on a dataset of category labels from press releases, and we complemented it with two experiments. The first experimental study randomizes familiarity and creativity to make sure that unobserved heterogeneity and measurement error are not sources of bias; the second experimental study adds a randomization in the type of technology to make sure that the process we observed in the first experimental study is the result of a more general cognitive process. As important boundary condition, our results cannot be easily generalized to all technology products, for example stigmatized ones (Piazza and Perretti 2015). In the case of a stigmatized technology product, producers may choose deliberately to use category labels to disguise rather than help stakeholders to make sense of the product (Vergne 2012).

While each chapter sets an autonomous contribution, I believe that the dissertation has also a value as a whole. This dissertation shows how socio-cognitive theories from strategy are a proper lens to study the entrepreneurial process. I contribute to provide empirical evidence to the impact

of perceptions at different levels of analysis: throughout the four chapters, I show how macro-level perceptions have are effective and interact at the individual level. These results also inform entrepreneurs about the role of different rhetorical strategies such as accounts, narratives, and category labels play in gathering resources and to achieve competitive advantage.

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CHAPTER 2. FAVORABLE INSTITUTIONAL ENVIRONMENT AND PREDISPOSITION TO ENTREPRENEURSHIP. EVIDENCE FROM A TWINS STUDY IN ITALY

Abstract

It has long been known that institutional environments contribute to explaining differences in terms of self-employment and entrepreneurship. Studies at the intersection between institutions and entrepreneurship looked at disproportional effects of institutional variation on individual characteristics, and little is known about the interaction between institutions and entrepreneurial predisposition. We exploit sharp institutional variations in Italy and a unique dataset of twins to address the research gap. We operationalize favorable institutions with Milan's industrial identity, and operationalize predisposition using differences between identical and fraternal twins. We find that individuals with predisposition enter self-employment when the institutional environment is favorable, while predisposition does not play a role under less favorable institutional environments. Our study contributes to the conversation about the role of institutions for self-employment, highlighting how predisposition to self-employment does not take place in vacuum and how favorable institutions moderate the relationship.

INTRODUCTION

Institutions, defined as “commonly held beliefs and understandings about “proper” organizational structures and practices” (Tolbert et al. 2011), are an important antecedent of entrepreneurial activity. This interest is not only theoretical, but it has also relevant policy implications. Every year governments, regions, and organizations invest resources to create an “entrepreneurial” environment.

The literature on institutional theory studied how differences between regions’ institutions explain differences in entrepreneurial and innovative outcomes (Saxenian 1996; Laursen et al. 2012), This literature focused mainly on the organizational dimension, and has overlooked differences at the micro level, especially with respect to individuals (with notable exceptions, e.g., of Eesley 2016).

In parallel, entrepreneurship research devoted more attention towards understanding who is the entrepreneur by looking at individual features, such as human capital endowments (Dunn and Holtz-Eakin 2000), behavioral traits (McLelland 1967, Zhao et al. 2010), and biological determinants (Nicolaou et al. 2008, Van der Loos et al. 2013, Shane and Nicolaou 2015).

Respectively, both the institutional and the entrepreneurship present some relevant gaps. Institutional theory focused mainly on othe organizational dimension and has overlooked differences at the individual level (with the notable exception of, e.g., Eesley 2016). Entrepreneurship literature devoted research efforts to understand the interaction between predisposition and family background (Lindquist et al. 2015), but neglected the institutional differences.

In this paper, we address this dual gap in the institutional theory and entrepreneurship literatures with the following research question: “Do institutions favorable to entrepreneurship compensate for individuals with less predisposition, or do these institutions enhance individuals with more predisposition?”

We exploit a unique twin dataset from Italy to answer our research question. Twin data allows us to clearly identify the predisposition factors, by comparing identical twins (who share 100% of their genes) and fraternal twins (who share on average 50% of their genes). Sharp institutional variation within country allows us compare individuals in favorable and unfavorable environments. We use Milan as a favorable environment, a city abundant in resources and opportunities, and where entrepreneurship is considered an attractive career. We use Rome as a less favorable environment, a city where doing business is more difficult

and where alternative careers in politics and bureaucracy are equally or more attractive. Our findings show that individuals with more predisposition enter self-employment when the institutional environment is favorable to entrepreneurship, while individuals with more predisposition do not enter self-employment differently from individuals with less predisposition in less favorable environments.

The study contributes to the literature in three ways. First, it joins a conversation that brings together institutional theory and entrepreneurship (e.g., Eesley 2016), which the past literature found at the extremes (Thornton 2009). We found that favorable institutions do not act homogeneously, but their influence is nuanced according to different levels of predisposition. Second, the study contributes to the literature on predisposition to entrepreneurship. We show an interaction between the two constructs and that predisposition to entrepreneurship is a complement to institutional environment, as predicted by the literature (Nicolaou and Shane 2009). Finally, our results contribute to the idea that predisposition is closer to a general talent that can be employed according to the most rewarding career path (Baumol 1990) rather than the existence of an “entrepreneurship gene” (Nicolaou et al. 2008, Van der Loos et al. 2013). All in all, by stressing the importance of institutions as catalyzers of talent, our results provide a basis to the effort of policymakers to create institutions that are favorable to entrepreneurship.

THEORETICAL DEVELOPMENT

Institutions and Predisposition to Entrepreneurship

Sociology-based studies of entrepreneurship traditionally looked at the context where the entrepreneurship takes place and somehow overlooked and sometimes downplayed the individual component (Gartner 1988, Thornton 1999). For example, organizational ecologists showed how institutional variation alters the rates of individuals entering entrepreneurship in a certain geographical area (Dobbin and Dowd 1997, Carroll and Khessina 2005). Institutional variation has been shown to matter not only within a certain region but also between regions. In the comparative study of technology hubs in the United States, Saxenian (1996) explains how Silicon Valley in California overtook Route 128 around Boston as the leading hub for entrepreneurship and innovation because of institutional differences. An entrepreneur who worked in the Route 128 district and later moved to the Silicon Valley says (Saxenian 1996, p. 36): “When I started Convergent, I got commitments for \$ 2.5 million in 20 minutes from three people over lunch who saw me write the business

plan on the back of a napkin. [...] In Boston, you can't do that. It's much more formal. People in New England would rather invest in a tennis court than high technology.”

Follow-up research provided quantitative evidence of institutions as important antecedents of entrepreneurial activity. For example, institutions explain the persistence of entrepreneurial activity in regions whose resources are no longer attractive (Sorenson and Audia 2000, Stuart and Sorenson 2003), and lack of favorable institutions explains the absence of entrepreneurial activity where resources are present (Sine and Lee 2009). Laursen et al. (2012) build on previous work exploiting sharp heterogeneity in Italy's institutions (Putnam et al. 1994) to show that differences in localized social capital are associated to differences in firms' innovative output.

On parallel, traditional entrepreneurship literature investigated the individual level with more attention. Studies more grounded in economics focused on economic and human capital as relevant antecedents of entrepreneurial activity (Blanchflower and Oswald 1998, Dunn and Holtz-Eakin 2000). Studies grounded in psychology looked at the behavioral traits of the entrepreneur (McClelland 1967, Zhao et al. 2010), which became of interest of behavioral economics too (Koudstaal et al. 2015). The underlying idea is that entrepreneurs possess particular traits that make them different from non-entrepreneurs. Opportunity recognition (Shane and Venkataraman 2000) and risk aversion (Kihlstrom and Laffont 1979, van Praag and Cramer 2001) are among the most well-known and well-studied traits.

More recent research started to look at individual innate predisposition as relevant antecedent of entrepreneurial activity (White et al. 2007, Nicolaou et al. 2008, Lindquist et al. 2015). Studies about predisposition to entrepreneurship found that there is not a particular gene determining it¹, rather there are associated traits such as extraversion, opportunity recognition, openness to experience, and sensation seeking (Nicolaou et al. 2008b, Nicolaou et al. 2009, Nicolaou and Shane 2009, Shane et al. 2010, Shane and Nicolaou 2015).

Overall, these studies overlook the role of the institutions where predisposition realizes. In the literature there are only two attempts (Zhang et al. 2009, Nicolaou and Shane 2010). Due to well-known

¹ Overall, a cross country study by van der Loos et al. (2013) found that rather than one single mechanism, “hundreds or thousands of variants that individually have a small effect [...] together explain a substantial proportion of the heritability” (van der Loos et al. 2013, p. 12).

gender gap in entrepreneurship (see, for review, Jennings and Brush 2013), the authors operationalize being male as a favorable institutional environment and being female as a less favorable one. Gender differences in predisposition produce inconclusive results. Zhang et al. (2009) find that predisposition substitutes for lack of institutional environment in a twin study based on Swedish data. Nicolaou and Shane (2010) find evidence of predisposition both in favorable and unfavorable environments in a sample of US twins. Different degrees of gender equality between countries can be a candidate motivation for the different results these studies obtained.

A new stream of literature investigated how favorable institutions to entrepreneurship have differential effects at the individual level, such as among individuals with different levels of human capital (Eesley 2016, Eberhart et al. 2017). For example, Eesley (2016) studied how institutional variation in China, namely the implementation of two policies aimed at making entrepreneurship more desirable and accessible, shaped participation to self-employment. In particular, he theorized and found that these two policies had differential effects on individuals with different human capital endowments. Eberhart et al. (2017) investigated the effect of a policy reform that decreased the bankruptcy regulation in Japan, and found that a more favorable institutional environment favored entrepreneurial activity by individuals with elite education, thus with higher levels of human capital.

These studies have in common the operationalization of human capital through education, either as part of an index or as elite education. However, while there is an effect of education on entrepreneurial performance, the impact of formal education on entrepreneurial activity is rather unclear (van der Sluis et al. 2008). Another important feature at the individual level is predisposition to entrepreneurship. A recent study on the different effect of mentoring looked at parental entrepreneurship (Eesley and Wang 2017). The authors found that mentoring is a substitute to parent entrepreneurship, but family background may be among the confounders of innate predisposition (Linguist et al. 2015). Thus, little is known about the interaction between innate predisposition and favorable institutional environment in the choice to enter entrepreneurship.

Hypotheses Development

We argue that institutions do not play in isolation. At the individual level, behavioral traits associated to

entrepreneurship may be more or less receptive to a favorable institutional environment. Institutions are not limited to rules and norms, but also extend to socio-cognitive aspects that discipline understanding and expectations about reality (Scott 2008). Sine and Lee (2009) show how social movement organizations set more favorable institutions and shape the perception of opportunities. As a consequence, wind farms resulted more appealing in California where the institutional environment is favorable and the endowment of natural resources is modest. On the contrary, entrepreneurial activity around wind farms languished in Texas, where institutions were not supportive and natural resources are more abundant. Over time, favorable institutions contribute to shape the identity of the entrepreneur as a desirable career outcome compared to alternative careers such as bureaucracy, politics, or military (Baumol 1990, Murphy et al. 1991, Brandl and Bullinger 2009). The study of the intersection between institutions and predisposition to entrepreneurship is far from being established, and the earlier literature and findings motivate two equally plausible theories.

One candidate theory is that institutional environment and predisposition are complements. When the institutional environment favors entrepreneurship, there are more opportunities and easier access to resources. The survival and growth of a new venture is more likely, which increases expected profits and makes entrepreneurship more attractive compared to other career options (Eesley 2016). The impact of greater probability of survival benefits individuals with predisposition to entrepreneurship, with higher degrees of opportunity recognition (Nicolaou and Shane 2009; Shane and Nicolaou 2015). As a result, people with predisposition would find easier to follow their preferred career path when the institutional environment is supportive of entrepreneurship.

When institutions are not favorable to entrepreneurship, the career path of the entrepreneur is not rewarding. The process of entry and growth is harder because access to resources is steeper and failure is highly stigmatized. When it is hard to gather resources, likelihood of failure is higher and prospects of growth are dismal. When failure takes place, the individual is exposed to discounts both in monetary and social terms (Sutton and Callahan 1987, Eberhart et al. 2017). This makes entrepreneurship a less attractive career path both socially and economically. Traits associated to predisposition to entrepreneurship can be also associated to alternative career options that are more rewarding both socially and economically in an

institutional environment that is less favorable. According to this theory, the predisposition to entrepreneurship is talent that can be allocated according to the different expected rewards that are associated to the institutional environment (Murphy et al. 1991). This theorizing would be consistent with earlier studies about the different prominence of entrepreneurial activity across history and regions (Baumol 1990, Murphy et al. 1991, Brandl and Bullinger 2009). Accordingly, we hypothesize the following:

Hypothesis 1a. *Complementarity.* Individuals with higher degree of predisposition are more likely to enter self-employment when the institutional environment is more favorable to entrepreneurship.

Another candidate theory may argue that institutional environment and predisposition are substitutes. When the institutional environment is less supportive, predisposition plays a larger role in impacting the decision to become an entrepreneur (Zhang et al. 2009). In unfavorable environment, entry and growth are harder, and the probability of success is very steep. The economic and social costs of failure work in a similar direction: at an extreme, if the cost of failure is infinite (e.g., punished by death), entrepreneurship becomes an extremely risky endeavor. Individuals with more predisposition to entrepreneurship have higher levels of risk propensity, thus they would more likely to choose entrepreneurship as a riskier career path.

On the contrary, a favorable institutional environment may substitute for the lack of predisposition. When entrepreneurship is socially rewarding, people with less predisposition may find entrepreneurial activity a suitable career, irrespective from the outcome. When the cost of experimenting entrepreneurship is low, also individuals with low risk propensity may find entrepreneurial activity an attractive option. Earlier studies showed that an increase in the munificence of the environment in terms of access to resources and opportunities led to higher levels of entrepreneurial activity but also higher failure rates, suggesting that more people with less predisposition entered entrepreneurship (van Praag and van Ophem 1995, Kerr and Nanda 2009). This theory is consistent to a view that the traits associated to predisposition, like risk propensity, are more specific to entrepreneurship only. Thus, we posit the following competing hypothesis:

Hypothesis 1b *Substitutability.* Individuals with lower degree of predisposition are more likely to enter self-employment when the institutional environment is more favorable to entrepreneurship.

DATA AND VARIABLES

Setting

We investigate our research question through a twin study based in Italy. Our setting has two main advantages when it comes to institutional variation: rich internal variation and limited mobility. First, compared to other countries, Italy presents sharper regional heterogeneity due to different historical allocations of social capital² (Heliwell and Putnam 1995, Tabellini 2010). The past literature traditionally exploited the rich within-country institutional variation (Banfield 1958, Putnam 1993, Guiso et al. 2004, Laursen et al. 2012).

Second, mobility and thus selection into an environment can confound the results. While information about movers is not available in the dataset due to privacy concerns, the setting of Italy alleviates the problem. The country presents lower levels of mobility compared to other countries due to inefficiency in the interregional job-matching process and high mobility costs (Faini et al. 1997, Brunello et al. 2001). This phenomenon is more salient for entrepreneurs, whereas locals are able to reap more resources from their contacts vis-à-vis non-locals (Michelacci and Silva 2007).

Data

The data for this twin study come from the Italian Twin Registry (ITR), managed by the Rome-based Italian “Istituto Superiore di Sanità”. The ITR started in 2001 (Stazi et al. 2002), and its mission is to provide a scientific tool to identify the genetic, environmental, and lifestyle factors that influence the well-being of individuals. By the end of 2011, 24,800 pairs of twins were enrolled in a nonrandom way³. The registry was able to identify the type of twins through questions about their physical appearance (Fagnani et al. 2006) and DNA testing (Brescianini et al. 2013) with an accuracy rate above 90% (Fagnani et al. 2014).

² One may object that institutional variation reduced over time due to convergence policies. Historically, this has not been the case in Italy. The regional differences between North and South, after some periods of convergence, diverged again after the 1970s (Heliwell and Putnam 1995).

³ Twins were enrolled through five channels. The first channel is the analysis of the municipalities and following contact of the pair by the registry. The second channel is the enrollment at the moment of the birth. The third channel is voluntary enrollment at the registry’s website. The fourth channel is voluntary enrollment during TwinDay, a particular day dedicated to twins. The last channel is through twin meetings organized by third parties. The relative majority of the pairs come from Rome, where the registry is based. This highlights the selection through voluntary enrollment. The second largest group is from the province of Milan and the third largest group is from the province of Turin. Overall, at the larger regional level, Northern and Central Italy are overrepresented in the sample. In a robustness specification in Table A3 the Appendix, we replicate the results using probability weights for population per province, with qualitatively similar results.

We select a sample of twins who were born between 1946 and 1976: the number of twins in our sample drops to 2928. The small number of twins available is due to the young age of the registry as it has been established in 2001. By 2013, the updated twin registry counted 63% of twins born after 1982 (Fanagnini et al. 2014). Because the data is cross sectional, younger individuals would have entered the ITR as students, thus out of the labor force. Similarly, we excluded elderly pairs who could have entered the registry already as pensioners⁴. We exclude fraternal twins of different sex, 22% of our sample. These pairs of twins differ systematically from pairs of identical twins as there are no cases of identical twins of different sex. We further excluded individuals who have been consistently out of the labor force: there are cases of individuals who report their status as pensioner, student, homemaker, or recipient of invalidity welfare check both as main and actual job. We also removed cases that were not reliable either due to inconsistent answers or due to problems in the transcription, for example those who reported they started working before they were born. Since our analysis is at the pair level, we removed the siblings of the individuals out of the labor force and those providing inconsistent answers. Finally, we also removed individuals for whom it was not possible to clearly assign self-employment status. For example, someone reporting the profession of “architect” in Italy could either be an employee or self-employed. Similarly to individuals out of the labor force and those providing inconsistent answers, we removed the siblings of twins with unclear self-employment status. Table 1 shows how the final sample of 1724 twins (862 pairs) we selected from the total database: they are from 47 provinces⁵ and are between 35 and 65 years old in 2011.

Table 1. Twin data extraction and cleaning.

Sample	N	%
Born between 1946 and 1976	2928	100%
<i>Pairs of DZ twins of different sex</i>	-634	-22%
<i>Out of labor force</i>	-89	-3%
<i>Inconsistent data</i>	-16	-1%
<i>Siblings of individuals out of labor force and with inconsistent answers</i>	-73	-2%
<i>Self-employment status unclear</i>	-231	-8%
<i>Siblings of twins with unclear self-employment status</i>	-161	-5%
Final sample	1724	59%

⁴ The survey asked for both the individual’s actual job and main job of their life. Because of a past Italian pension reform allowing to retire as early as 35, it may be the case that some people just provided “retired” as their only profession in life.

⁵ There are about 110 provinces in Italy, and their size is analogous to counties in the United States.

Variables

Dependent Variable

Entrepreneurship. We operationalize entrepreneurship with an indicator variable for self-employment. While we are aware of the differences between the definitions of self-employed and entrepreneur (Sørensen and Fassiotta 2011, Henrekson and Sanandaji, 2014), we are also realistic that it would be very hard to obtain a sample of high-growth entrepreneurs who are also twins. We argue that self-employment is a proper operationalization for two reasons. First, self-employment can be considered the simplest kind of entrepreneurship (Blanchflower and Oswald 1998). Second, it offers an opportunity for more conservative estimates, because the level of favorable environment required for self-employment is comparatively lower than for high-growth entrepreneurship.

Explanatory Variables

Institutional Environment. We operationalize favorable institutional environment with industrial identity. The metropolitan area of Milan is a well-known example of a strong industrial identity and it is considered a munificent institutional environment for entrepreneurship (Dubini 1989). Historically, Milan succeeded to become one of world's fashion hubs because of the institutional environment that helped provide resources and managerial capabilities (Merlo and Polese 2006). The presence of related industry clusters (textile and retail) contributes to a more generalized industrial identity, which in turn delivers more access to resources (Romanelli and Khessina 2005). Over time, Milan progressively transformed from a manufacturing city to being also specialized in services and finance (Foot 2001, Glaeser 2011). As a result, Milan's per capita productivity was 54% higher than the national average in 2008 (Glaeser 2011). All in all, we claim that the metropolitan area of Milan represents a favorable institutional environment due to higher access to resources and opportunities.

As a control, we use the metropolitan area of Rome. We compare Milan to Rome because they are the two largest metropolitan areas and have comparable forms of self-employment. Other provinces have a larger size beyond the area of their main city, they are more likely to include rural entrepreneurship, which has different characteristics (Meccheri and Pelloni 2006). In addition, twins from the metropolitan areas of Milan and Rome make almost half of the sample's observations.

Predisposition We exploit differences between identical and fraternal twins to operationalize predisposition and the effect of common environment. Identical twins are those who develop from one egg that forms two embryos (they are also known as monozygotic) and they share almost 100% of their genetic endowment. Fraternal twins are those who develop from two eggs, each fertilized by different sperm cells (they are also known as dizygotic) and they share on average 50% of their genetic endowment. We operationalize the higher share of genetic endowment with an indicator variable that takes the value of one if the twins are identical, and zero if they are fraternal. To estimate the effect of predisposition, we use an interaction between the indicator variable for the type of twin and an indicator variable that takes the value of one if the other twin in the pair is entrepreneur. The resulting main effect of the co-twin entrepreneur tests the relevance of family background.

In order to identify the effect of predisposition and common environment, we rely on the equal environment assumption. This common assumption among twin studies states that there are not any unobservable differences in the way families raise identical and fraternal twins⁶ (Scarr and Carter-Saltzman 1979). In support of this assumption, our descriptive statistics show no difference between identical and fraternal pairs of twins. A large meta-study of twin studies across different domains ranging from medicine to sociology compared the results of studies using twins raised together with the results of studies twins raised apart to test the validity of the equal environment assumption. The author found that the equal environment assumption largely holds, and that the bias is modest when the assumption is violated (Felson 2014).

Control Variables

Due to data limitations, we can control for some socio-demographic characteristics only. To control for age and experience, we create 5-year cohort dummies. In order to control for the level of education, we use two indicator variables: an indicator variable that takes the value of one if the individual's highest degree is high school diploma, and an indicator variable that takes the value of one if the individual's highest degree is at the college level or higher. Education dummies capture both human capital and ability (Eesley 2016). We

⁶ Previous literature reports that identical twins are closer to each other than fraternal twins: identical twins raised apart are more similar than fraternal twins raised together. In case of parental misunderstanding of their children's type, it is the actual rather than perceived type which predicts similarities (Scarr and Carter-Saltzman 1979).

also control for gender of the pair. When we do not focus on Milan and Rome only, we also control for geographical location by adding a full set of indicator variables for the province of residence.

METHODOLOGY

The Ideal Experiment

The ideal experiment would assess the heterogeneous effect of an institutional environment favorable to entrepreneurship on the probability of becoming an entrepreneur across individuals with different levels of predisposition to entrepreneurship. The ideal experiment would randomly and independently assign people with different levels of entrepreneurship predisposition to places with different levels institutional environments, where mobility is not allowed. Then, one should then wait long enough to observe career outcomes. The simple difference between the shares of entrepreneurs with higher levels predisposition across different environments would identify our research question. Needless to say, this experiment would be impossible but we can try to approximate the ideal experiment.

Twins represent a naturally occurring source of random genetic assignment. Identical twins share 100% of their genetic endowment, while fraternal twins share on average 50% of their genetic endowment. We can assume that the distribution of identical and fraternal twins is as good as random⁷. We further assume that the populations of twins and non-twins are not systematically different.

Model

Twin studies in the extant literature relied on ACE models through structural equation modeling (Nicolaou et al. 2008). Structural equation models are the standard in behavioral genetics, but their diffusion in social sciences suffers from problems related to the execution and the interpretation. An alternative methodology to structural equation models is regression based methodology (DeFries and Fulker 1985), which exploits the framework similarity between twins and a natural experiment. The model takes the following form:

$$S_1 = \alpha + b_1 S_2 + b_2 G + b_3 (GS_2) + e$$

S_1 is the outcome variable for twin 1—an indicator variable for self-employment status. S_2 is the outcome variable for twin 2 and captures similarities between the two twins; after controlling for its interaction with

⁷ Although it is common knowledge that assisted reproduction leads with a higher probability to (fraternal as well as identical) twins, we are aware that assisted reproduction increases the ratio of MZ/DZ (Schachter et al. 2001), but we assume it is a fringe phenomenon in our study. In fact, assisted reproduction births in Italy are the lowest in Europe and they account for as little as 1.4% of total births (Kocourkova et al. 2014)

relatedness, it provides the greater probability due to family background. G is the degree of relatedness—an indicator variable for identical twins, and the interaction between S_2 and G isolates the effect of the predisposition. Replication studies showed the equivalence of this method to ACE models (Smith and Hatemi 2013).

Our regression analysis uses one random twin only per pair to avoid simultaneity issues (in Table A1 of the Appendix, we replicated the results for the other twin). The advantage of regression models is the incorporation of other controls and easier to test and interpret differences between subsamples. Because the dependent variable is an indicator variable, we use the Linear Probability Model (LPM). We prefer LPM to maximum likelihood methods like Logit because coefficients are more intuitive to interpret – especially its interactions⁸.

The gene-environment interaction can be analyzed comparing subsample and testing difference in the coefficients due to genetics (LaBuda et al. 1986). Thus, we perform the regression on two subsamples for favorable and unfavorable institutional environments. We can compare the difference between the coefficients and observe for which group the effect is larger. Since triple interactions may be cumbersome to interpret, we believe that split samples are a more parsimonious methodology to test our hypotheses⁹.

Balance issues

In this paragraph, we highlight some potential sources of bias from imbalance and their potential solutions. For some reason, identical twins might have observable factors that correlate with entrepreneurship. We mitigate this concern by showing that identical and fraternal couples show little or no difference in the observables through a t-test in Panel a of Table 2. There is no statistically significant difference among observables between groups.

We also test the balance between twins living in Milan and Rome. We would not like to have systematic differences between the two groups when we test the differences in institutional environment. We report the mean differences in Pane b of Table 2 and observe no systematic differences.

⁸ We predicted self-employment probability using LPM and found that the predicted values range from 0 to 0.65, thus alleviating the concerns of using linear models for binary outcomes, which may lead to predicted values either negative or greater than one. For completeness, we report the main analysis using the Logit specification in Table A2 of the Appendix.

⁹ In Table A4 of the Appendix, we use an alternative specification where we include indicator variables for different combinations of G and S_2 .

Table 2. T-test table

<i>Pane a.</i> Differences across fraternal (DZ) and identical (MZ) twins			
Variable	DZ	MZ	Difference
Entrepreneur	0.112	0.139	-0.027
Identical twin	0.362	0.351	0.011
Age	48.493	47.823	0.670
College degree and higher	0.281	0.272	0.009
High School degree	0.467	0.504	-0.037
<i>N</i>	608	1116	
<i>Pane b.</i> Differences across Milan and Rome twins			
Variable	Milan	Rome	Difference
Entrepreneur	0.141	0.102	0.040**
Identical twin	0.645	0.652	-0.008
Age	48.531	48.319	0.211
College degree and higher	0.305	0.283	-0.023
High School degree	0.512	0.472	-0.040
<i>N</i>	262	570	

RESULTS

Descriptive Statistics

Table 3 summarizes the observables. In the sample, 13% of the individuals have been or were entrepreneurs at the time of inclusion in the registry. This figure is lower than 20%-25%, the average rate of self-employment in Italy, due to the exclusion of individuals with uncertain self-employment status and we think it represents a lower bound figure. The sample includes more identical than fraternal twins (65% versus 35%) because we selected fraternal twins of the same sex only. Men are around 35.5% of the sample, which is not far away from the 41% of males of comparable cohorts in the entire ITR in 2013 (Fagnani et al., 2014); the average age is around 48 years old; 49% of the individuals studied up to high school, while 27% of them obtained a college degree or higher.

Pairwise correlation informs us that there is not any strong significant correlation of zygosity with

the other observables – in line with its random distribution. In addition, male individuals are less likely to have obtained a higher education degree, while they are more likely to be entrepreneurs, as expected.

Table 3. Descriptive Statistics

	Mean	S.D.	(1)	(2)	(3)	(4)	(5)	(6)
(1) Entrepreneur	0.129	0.336	1					
(2) Identical twin	0.647	0.478	0.039	1				
(3) Male	0.355	0.479	0.155**	-0.011	1			
(4) High School	0.491	0.500	0.009	0.035	0.019	1		
(5) College	0.275	0.447	-0.013	-0.010	-0.069*	-0.604**	1	
(6) Age	48.06	9.071	-0.066*	-0.035	0.043	-0.039	-0.176**	1
N	1720							

Notes: + $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Preliminary Analysis: The Effect of Predisposition

Before looking at the interaction, we first establish whether there is an effect of predisposition in our twin sample. Table 4 shows the results for the estimation of an effect of predisposition on the likelihood of ever being self-employed. Model 1 estimates the genetic effect without any control, Model 2 adds socio-demographic controls for age cohort, gender and education indicator variables, finally Model 3 adds indicator variables for province of residence. We estimate the results selecting one of the twins of each pair randomly: twin 1 (Models 1.1 to 3.1) and twin 2 (Models 1.2 to 3.2).

The coefficient of being identical twins by itself is not significant and its size is close to zero. This is reassuring, as there is no reason to assume that being identical twins leads into entrepreneurship (or vice versa). The size and the significance of the coefficient are consistent across all the models. This zero coefficient lends support to the validity of the data for our approach.

The interaction (GS_2) between identical twins (G) and family background residual (S_2) identifies the effect of predisposition. On average, it is 19.6% more likely for a twin to be self-employed when the other twin is self-employed too *and* they are identical twins – i.e., they share 100% of their genes. The coefficients

are statistically significant at the 1% level across all twins and models.

The coefficient of the family background residual is positive and significant. It is 39% more likely that the twin is self-employed when the co-twin is self-employed too. Interestingly, the coefficients for predisposition and for family background have the same magnitude and ratio of comparable studies of nature and nurture, namely 20% and 40% (Lindquist et al. 2015).

We run a series of tests to look at the robustness of results. In Model 2 we control for potential drivers of the entrepreneurial choice such as sex, age, and education. The size and the significance of the coefficients of interest do not change. Net of individual and family characteristics, self-employment is from 4% to 7.5% more likely for male pairs due to institutional factors. Education plays apparently no role: compared to middle school education, coefficients for high school and college education are small and not significant. Again, this result is consistent with the entrepreneurship literature that finds no relationship between education and selection into self-employment (Van der Sluis et al. 2008). To control for age, we added 5-years cohort fixed effects and none of the coefficient was significantly different from zero (coefficients not reported in the table). In Model 3 we added indicator variables for province of residence to control for geography. The size of the coefficients diminishes not sizably and the results do not change qualitatively.

We also addressed some other concerns related to sample selection. One could argue that the selection of the random twin of the pair could potentially drive the results. To this extent, we ran the three models for both groups of twins and we report the results in models 1.2 to 3.2¹⁰. Descriptively, the only difference for twin 2 lies in the significance and the size of the variable for gender. The size of the coefficient is twice as large for twin 1 but the difference between coefficients is not statistically significant ($\chi^2_{(1)}=1.14$; $p = 0.29$). Finally, we tested the significance of the difference between the genetic effects and there is no statistical significance across the three specifications: without controls ($\chi^2_{(1)}=0.01$, $p=0.91$), controlling for socio-demographic variables ($\chi^2_{(1)}=0.01$, $p=0.93$), and controlling for province of residence ($\chi^2_{(1)}=0.01$, $p=0.94$).

¹⁰ We continue this exercise for the rest of our analysis. However, because our results do not change systematically and there are not statistically significance differences, we report the results in the Appendix (Table A1).

To conclude, we seem to have found evidence for predisposition to play a role, ranging from 16.95% to 19.6%, which is consistent across models and twins, in support of the extant literature (Nicolaou et al. 2008).

Table 4. Estimation of the effect of predisposition.

	(1.1)	(2.1)	(3.1)	(1.2)	(2.2)	(3.2)
	Twin 1			Twin 2		
	Baseline	Controls	Province	Baseline	Controls	Province
Predisposition (GS ₂)	0.196** (0.067)	0.189** (0.067)	0.180* (0.070)	0.180** (0.060)	0.177** (0.060)	0.169** (0.061)
Family Background (S ₂)	0.392*** (0.055)	0.382*** (0.055)	0.390*** (0.058)	0.353*** (0.050)	0.344*** (0.050)	0.338*** (0.050)
Identical twin pair (G)	-0.007 (0.023)	-0.006 (0.023)	-0.009 (0.0230)	-0.011 (0.022)	-0.012 (0.022)	-0.018 (0.022)
Male		0.075*** (0.021)	0.073*** (0.022)		0.036+ (0.021)	0.039+ (0.021)
High school degree		-0.026 (0.026)	-0.026 (0.027)		0.031 (0.025)	0.028 (0.026)
College Degree		0.003 (0.029)	0.002 (0.030)		0.004 (0.028)	0.009 (0.029)
Cohort FE	N	Y	Y	N	Y	Y
Province FE	N	N	Y	N	N	Y
Adjusted R ²	0.260	0.272	0.301	0.260	0.270	0.324
N	862	862	861	862	862	859
Wald Test	χ^2	<i>p-value</i>				
GS ₂ (1.1)= GS ₂ (1.2)	0.01	0.91				
GS ₂ (2.1)= GS ₂ (2.2)	0.01	0.93				
GS ₂ (3.1)= GS ₂ (3.2)	0.01	0.94				

Notes: Robust standard errors in parentheses. Dependent variable is: “individual *i* is entrepreneur”. Cohort FE are a full set of 5 birth-year indicator variables. Province FE are a set of indicators variables per province of residence. Significance levels: + $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

The Interaction with Institutional Environment

In this section we answer our research question by looking at the interaction between institutional environment and predisposition in determining self-employment. In Table 5, we report the differences in size and significance of the effect of predisposition across two different institutional environments according to their industrial identity. Residence in the metropolitan area of Milan approximates the favorable institutional environment and the metropolitan area of Rome approximates a less favorable institutional environment. Model 1 is the baseline model and model 2 controls for socio-demographic characteristics (we cannot control for province of residence as it is our source of variation).

When the institutional environment supports entrepreneurship, predisposition plays a larger role compared to the estimate in the national sample. For twins living in Milan, the effect of predisposition is more than three times larger than the national estimate. The coefficient for predisposition (GS_2) is significant at the 5% level and economically significant. If a twin is in an identical pair and their sibling is self-employed, it is 70% more likely that they become self-employed in a favorable institutional environment. For twins living in Rome – a more unfavorable environment – the effect of predisposition is smaller, around 6%, and insignificant. These results seem in line with the theory that predisposition and institutional environment are complements, in support of Hypothesis 1a.

We also find interesting results for what concerns the role of family background: the coefficient S_2 is small, negative, and insignificant in Milan, while it is large, positive, and significant in Rome. It seems that family background and the institutional environment are substitutes. When institutions support entrepreneurship, family background has little influence over the entrepreneurial decision, while it matters when the institutions are not particularly favorable.

To corroborate our results, we control for individual characteristics with no substantial variation in the size and significance of the coefficients. In order to validate our hypotheses, we use a Wald test to test significant difference of coefficients across models. The chi-squared statistic is significant for both predisposition and environment for the specification with and without controls. Overall, the results from Table 5 show evidence that individuals with predisposition to entrepreneurship favor more from a favorable institutional environment, lending support to Hypothesis 1a.

Table 5. Industrial Identity as Institutional Environment

	(1.Mi)	(1.Rm)	(2.Mi)	(2.Rm)
	Baseline		Controls	
	Milan	Rome	Milan	Rome
Predisposition (GS ₂)	0.678* (0.324)	0.063 (0.100)	0.688* (0.334)	0.074 (0.100)
Family Background (S ₂)	-0.065 (0.311)	0.371*** (0.080)	-0.119 (0.319)	0.355*** (0.081)
Identical twin pair (G)	0.036 (0.059)	-0.003 (0.034)	0.024 (0.059)	-0.004 (0.035)
Male			0.096 (0.063)	0.055 (0.034)
High school degree			0.073 (0.077)	-0.025 (0.040)
College Degree			0.046 (0.085)	0.008 (0.044)
Cohort FE	No	No	Yes	Yes
<i>Adjusted R</i> ²	0.294	0.209	0.231	0.294
<i>N</i>	130	283	130	283
<i>Wald Test</i>	χ^2	<i>p-value</i>	χ^2	<i>p-value</i>
GS ₂ (Mi)= GS ₂ (Rm)	7.55	0.006	6.99	0.008
S ₂ (Mi)= S ₂ (Rm)	8.59	0.003	7.88	0.005

Notes: Robust standard errors in parentheses. Dependent variable is: “individual *i* is entrepreneur” Cohort FE are a full set of 5 birth-year indicator variables. Significance levels: + $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Additional Analysis

Addressing Mobility Concerns: Subsample Analysis

One possible limitation of our operationalization of institutional environment is unobserved mobility: due to privacy, it was not possible to have information about the place of birth of the twins, and we cannot control whether twins in our sample selected into the environment. Despite evidence of prevalence of local entrepreneurs in Italy (Michelacci and Silva 2007), individuals with predisposition to self-employment can move to institutional environments that are more favorable. In the main analysis, we selected a sample of twins *both* living in the same province to alleviate selection issues. In a further attempt to mitigate these concerns, we ran a subsample analysis on individuals without college education. The intuition is that individuals without higher education may have lower propensity for mobility (Faini et al. 1997). We report the results of this subsample analysis in Table 6. Model 1 is the baseline analysis, while Model 2 adds controls

as in the analysis of interaction in Table 5. The results do not change in the sign and significance for predisposition, and the size is slightly larger than in the full sample. The same trend holds for S_2 , the sign and the significance are consistent, but the size is slightly larger. These results suggest that the interaction between institutional environment and predisposition is not driven by mobility, providing additional support to Hypothesis 1a.

Table 6. Industrial Identity as Institutional Environment: Subsample without College Degree

	(1.Mi)	(1.Rm)	(2.Mi)	(2.Rm)
	Baseline		Controls	
	Milan	Rome	Milan	Rome
Predisposition (GS_2)	0.740*** (0.151)	-0.074 (0.106)	0.774*** (0.154)	-0.072 (0.201)
Family Background (S_2)	-0.061 (0.042)	0.539*** (0.085)	-0.149 (0.093)	0.546*** (0.160)
Identical twin pair (G)	0.037 (0.059)	0.018 (0.038)	0.028 (0.052)	0.021 (0.269)
Male			0.117 (0.081)	-0.014 (0.039)
High school degree			0.085 (0.072)	-0.020 (0.038)
Cohort FE	No	No	Yes	Yes
<i>Adjusted-R</i> ²	0.311	0.314	0.231	0.294
<i>N</i>	94	201	130	283
<i>Wald Test</i>	χ^2	<i>p-value</i>	χ^2	<i>p-value</i>
GS_2 (Mi) = GS_2 (Rm)	9.97	0.002	11.13	0.001
S_2 (Mi) = S_2 (Rm)	12.18	0.001	14.18	0.000

Notes: Robust standard errors in parentheses. Dependent variable is: “individual i is entrepreneur.” Cohort FE are a full set of 5 birth-year indicator variables. Significance levels: + $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Alternative Operationalization of Institutional Environment: Gender

In this section, we conduct an additional robustness check to address the concern about mobility and to be consistent with previous studies of gene-environment interaction (Zhang et al. 2009, Shane and Nicolaou 2010). Conversely from province of residence, selection into gender is hard and very costly. Sociology literature defines gender as an institution (Martin 2004) and past literature shows how socio-cognitive aspects related to gender drive this gap. For example, stereotypes about women hinder entrepreneurial activity (Thebaud 2010, Gupta et al. 2014), and the discount women receive when try to secure funding is not driven by rational factors (Alesina et al. 2013). However, using gender as proxy of institutional environment is at risk of biased estimates due to unobserved heterogeneity of biologically-

determined characteristics like testosterone (White et al. 2007, Nicolaou et al. 2017). Earlier literature showed that despite biologically-determined characteristics, part of gender differences has to be attributed to institutional environment¹¹ (Guiso and Rustichini 2011). For this reason, we perform this analysis as a robustness check, mindful that while we alleviate selection concerns, there might be bias coming from unobserved heterogeneity.

Before proceeding with the analysis, we control for balance between male and female individuals in our sample. Table 7, Pane a reports the differences in means: women are systematically younger and more educated. In order to have females more “male-like” we perform coarsened exact matching on the observables (Iacus et al. 2011) to reduce the imbalance. We report the results of the matching exercise in Pane b, where we show that the matching exercise leads to no significant differences between the male and the female subsamples.

In Table 8, we rerun the analysis comparing predisposition between male and female twins. Models 1 and 2 are the baseline analysis without controls, Models 3 and 4 include a set of province indicator variables as controls. Models 1 and 3 are on the entire sample, Models 2 and 4 are on the matched sample. The results are overall consistent with the previous analysis, suggesting that predisposition matters for male individuals, who enjoy a favorable institutional environment, but it does not for females, who suffer from an unfavorable institutional environment. The results suggest also that the proxy for family background and institutional environment are substitutes. Overall, using gender as a proxy of institutional environment brings additional support to Hypothesis 1a.

¹¹ Other evidence of institution-based gender differences come from experimental economics. Earlier studies highlight a consistent difference in risk-taking propensity between men and women (Croson and Gneezy 2009). However, related behaviors like competition seems to be moderated by the society where individuals live. Experimental studies found no differences in competitive behavior in a matriarchal society (Gneezy et al. 2009), or in a society with gender equality (Dreber et al. 2011).

Table 7. Balance issues in alternative explanatory variable, before and after CEM matching.

Pane a. Differences across male and female twins – entire sample			
Variable	Female	Male	Difference
Entrepreneur	0.091	0.199	0.109**
Identical twin	0.651	0.641	-0.011
Age	47.773	48.578	0.805+
College degree and higher	0.298	0.234	-0.064**
High School degree	0.484	0.503	0.020
N	1112	612	
Pane b. Differences across male and female twins – matched sample			
Variable	Female	Male	Difference
Entrepreneur	0.091	0.189	0.098**
Identical twin	0.670	0.670	0.000
Age	48.615	48.543	-0.071
College degree and higher	0.281	0.236	-0.045
High School degree	0.483	0.488	0.005
N	452	452	

Notes: Matching procedure is coarsened exact matching (Iacus et al. 2011) with 1:1 assignment based on type of twin, age, college degree, high school degree, and province of residence. The matching variable is “male”. Significance levels. + $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 8. Gender as Institutional Environment.

	(1.m)	(1.f)	(2.m)	(2.f)	(3.m)	(3.f)	(4.m)	(4.f)
	Baseline				Controls			
	Entire sample		Matched Sample		Entire Sample		Matched Sample	
	Male	Female	Male	Female	Male	Female	Male	Female
Predisposition (GS ₂)	0.407*** (0.114)	-0.016 (0.081)	0.443** (0.172)	-0.243 (0.137)	0.429*** (0.121)	-0.049 (0.083)	0.429* (0.174)	-0.181 (0.208)
Family Background (S ₂)	0.253** (0.097)	0.490*** (0.066)	0.199 (0.152)	0.714*** (0.171)	0.217* (0.101)	0.542*** (0.070)	0.204 (0.149)	0.668*** (0.119)
Identical twin pair (G)	-0.051 (0.045)	0.018 (0.024)	-0.056 (0.053)	0.067 (0.020)	-0.053 (0.047)	0.016 (0.025)	-0.066 (0.054)	0.052*** (0.020)
<i>Adjusted-R</i> ²	0.292	0.219	0.237	0.222	0.348	0.279	0.295	0.269
N	306	556	226	226	306	555	226	226
<i>Wald Test</i>	χ^2	<i>p-value</i>	χ^2	<i>p-value</i>	χ^2	<i>p-value</i>	χ^2	<i>p-value</i>
GS ₂ (male)=GS ₂ (female)	3.95	0.05	5.99	0.01	5.23	0.02	5.05	0.02
S ₂ (male)= S ₂ (female)	1.75	0.18	5.06	0.02	3.65	0.06	4.52	0.03

Notes: Robust standard errors in parentheses. Estimation results for twin 1. Dependent variable is: “individual i is entrepreneur” Genetic Effect is the interaction between “Other twin entrepreneur” and “Identical twin pair”. Controls are a set of indicators variables per province of residence. Significance levels: + $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Alternative Unit of Analysis: Twin Pairs

In this section, we provide a further robustness check for Hypothesis 1a of our study. In fact, given our specification, one may argue that simultaneity problems may still be present even after choosing one random

twin. In order to alleviate this concern, we estimate the model at the pair level. There, our outcome variable of interest becomes an indicator variable that takes the value of one if both twins are entrepreneurs and zero otherwise. In this case, our proxy of the genetic effect becomes the simple indicator variable for identical twins. As a control, we include an indicator variable for both twins doing the same job. We report the results in Table 9. Model 1 is a pooled estimation, while Models 2 and 3 are split respectively between province of residence (Milan vs. Rome) and gender groups.

In the pooled sample, it is 3.5% more frequent to observe pairs of twins entrepreneurs if they share 100% of their genes. However, when we split the sample according to the environment, the results change according to our previous evidence. The effect for men is larger: it is 10.2% more likely to observe pairs of identical twins that are entrepreneurs, while for women there is no significant difference. The same results hold with the difference in provinces: it is more likely to observe identical twins being both entrepreneurs in Milan, while it is not the case in Rome. The differences in the coefficients are statistically significant, in further support of hypothesis 1a.

Table 9. Robustness check. Alternative unit of analysis: pair level.

	(1)	(3.Mi)	(3.Rm)	(2.m)	(2.f)
	Pooled	Alternative environment Milan	Rome	Environment as gender Males Only	Females Only
Identical twins pair (G)	0.035* (0.017)	0.123* (0.048)	0.002 (0.029)	0.102** (0.038)	-0.001 (0.019)
Twins do the same job	0.044** (0.017)	0.065 (0.050)	0.048 (0.029)	0.072+ (0.039)	0.036+ (0.020)
<i>Adjusted-R</i> ²	0.010	0.102	0.018	0.034	0.006
<i>N</i>	862	127	278	306	556
<i>Wald Test</i> <i>G(fav)=G(unfav)</i>		χ^2 7.02	<i>p-value</i> 0.008**	χ^2 7.18	<i>p-value</i> 0.007**

Notes. Robust Standard error in parenthesis. Unit of analysis is pair level. Outcome variable is “both the twins are entrepreneurs”. Models 2.Mi and 2.Rm control for “male pair”. Significance levels: + $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.00$

DISCUSSION AND CONCLUSION

The paper addresses the question about how favorable institutions towards entrepreneurship affect individuals' entry into self-employment differently according to their predisposition. We contribute to a growing literature that looks at the differential effects of institutions on individuals (e.g., Eesley 2016) by studying how predisposition matters under different institutional settings. Drawing from the literature, we formulate and test two competing hypotheses: either institutions favorable to entrepreneurship benefit disproportionately individuals with predisposition, or they compensate for predisposition, allowing less endowed individuals to enter entrepreneurship. Support for one of the two theories can shed light about the predisposition to entrepreneurship: if predisposition is complementary to institutions, the bundle of traits associated to entrepreneurship can be conceptualized as general talent that can be employed in different careers; if predisposition is substitute to institutions, the bundle of traits are specific to entrepreneurship.

Empirically, we join two settings typical from the literatures on institutions and predisposition to entrepreneurship: within country institutional differences (Guiso et al. 2004; Laursen et al. 2012) and twin studies (Nicolaou et al. 2008, Zhang et al. 2009). Our findings show that individuals with predisposition are more likely to be self-employed when the institutional environment favors entrepreneurship. The results suggest that institutions and predisposition are complementary and that predisposition can be seen as general talent (Baumol 1990).

Our study expands our understanding of how the favorable institutional environments encourage entrepreneurial activity. The role of a favorable institutional environment is not only limited to factors external to individuals, but they also play through individuals. We find that favorable institutions increase the stimuli and the rewards to individuals with predisposition. Further research should build on our findings and explore the relationship between entrepreneurship, individual characteristics, and specific mechanisms underneath institutions. For example, future studies can look at barriers to entry (Nanda and Kerr 2009), barriers to growth (Eesley 2016), and barriers to exit (Eberhart et al. 2017).

Our results also corroborate the finding of previous literature about the predisposition to entrepreneurship (Nicolaou et al. 2008). This study offers an additional evidence of how predisposition matters to entry into self-employment in a new country, other than U.K. (Nicolaou et al. 2008), Sweden

(Zhang et al. 2009; Lindquist et al. 2015), and U.S. (Nicolaou and Shane 2010). The results represent an empirical validation and an extension to one proposed mechanism through which predisposition matters, namely by interacting with the institutional environment (Nicolaou and Shane 2009).

Finally, we provided evidence in the direction of conceptualization of predisposition as a bundle of traits that can be associated to entrepreneurship (van der Loos et al. 2013), but also to other careers when institutional environment is not favorable. From a methodological perspective, this is the first twin study in entrepreneurship adopting a regression-based analysis (DeFries and Fulker 1985, LaBuda et al. 1986). This alternative methodology has the advantage of being more familiar to social science studies and to encourage more follow-up research (Smith and Hatemi 2013). Future research can keep up the findings with the established literature looking at incorporation and entrepreneurial performance (see, e.g., Lindquist et al. 2015).

We believe that our results may have implications for policy. Based on our findings, individuals are not born entrepreneurs; they are born with talent. Then, it is up to the institutional environment to allow such transition to take place more or less easily. Often, policy makers invest resources to implement a favorable environment for entrepreneurship without a clear goal in mind: would better institutions for entrepreneurship include those who do not have predisposition or create opportunities for individuals with predisposition and more likely to succeed? While this study cannot guide the direction of entrepreneurship policies, one important implication of this study is that it is important to have institutions supporting entrepreneurship. Without them, predisposition can do little.

Moreover, we also found that favorable institutions substitute for the role of family background. While it is likely that family background and predisposition co-occur often, it may not always be the case. According to our results, individuals with predisposition born in families with no entrepreneurial background can benefit from institutions favorable to entrepreneurship. If the institutional environment is unfavorable to entrepreneurship, it may be the case that individuals enter entrepreneurship due to their family background but not due to their predisposition. If a policymaker wants to favor entrepreneurship, they should look at changing the rules of the game to “offset undesired institutional influences” of an unfavorable environment (Baumol 1990).

Our results have several limitations worth noting. First, the study looks at self-employment, including entrepreneurship but not exclusively at it (Sørensen and Fassiotta 2011, Henrekson and Sanandaji 2014). Because of data limitation and the relatively small sample to study entrepreneurs, we are not able to distinguish whether self-employment takes place due to necessity or opportunity. It may be that institutions favoring entrepreneurship will have a negative interaction with predisposition, when it comes to necessity self-employment. At the margin, lower barriers to entry may mean that less predisposed individuals enter self-employment due to necessity because it is easier. Thus, lumping together self-employment and entrepreneurship may offer conservative results. Future research may look at this important limitation, which may be relevant for policy purpose, and distinguish between opportunity and necessity entrepreneurship.

As a second limitation, we focus on the extensive margin only. We studied whether individuals chose self-employment as a career option but we do not know about their performance. Earlier studies found differences between the extensive (selection into self-employment) and intensive margins (entrepreneurial performance) for factors like education. For example, a college degree positively impacts entrepreneurial performance but no conclusive evidence is found when it comes to selection into self-employment (van der Sluis et al. 2008). For what concerns entrepreneurial performance, e.g., venture funding, other factors may come into play since the lower barriers to entry may result in a disproportionate benefit for people with less predisposition, as hinted by Nanda and Kerr (2009). Future research can address this boundary condition through richer and maybe longitudinal data.

Third, our results hold for Italy, which is not per se a favorable institutional environment to self-employment. As benefits result from contradictions between institutions (Batjargal et al. 2013), the driver of our results may be the institutional inconsistency between a favorable institutional environment immersed in an unfavorable institution rather the effects of the former institution only (Eesley et al. 2016). This higher order interaction might also reconcile the difference in gender-specific results across samples from Sweden (Zhang et al. 2008) and United States (Nicolau and Shane 2010) and further comparative studies are needed to shed light about this mechanisms of how institutions and predisposition work.

Our study represents a step forward in gaining more understanding about the interaction between predisposition and institutional environment for entrepreneurial activity. We strived to provide a robust test

to two alternative and plausible theories, blending together approaches based on the institutional context and the individual characteristics (Thornton 1999). Albeit we used exploratory operationalization, our results produced consistent evidence. We hope that additional research may address the caveats of our research, confirming, challenging, or expanding our findings.

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APPENDIX

Table A1. Robustness test for the alternative twin in the pair.

	TWIN 2											
	Baseline			Entire-Baseline			Entire-Controls			Matched-Baseline		
	(1.MI)	(1.RM)	(2.MI)	(2.RM)	(1.m)	(1.f)	(2.m)	(2.f)	(3.m)	(3.f)	(4.m)	(4.f)
	Milan	Rome	Milan	Rome	Male	Female	Male	Female	Male	Female	Male	Female
Genetic Effect (GS)	0.599** (0.182)	0.0754 (0.118)	0.572** (0.189)	0.105 (0.119)	0.407*** (0.097)	-0.091 (0.079)	0.452*** (0.104)	-0.109 (0.078)	0.383*** (0.113)	-0.358** (0.133)	0.396** (0.121)	-0.440** (0.132)
Shared Environment (S)	-0.047 (0.166)	0.421*** (0.095)	-0.037 (0.171)	0.391*** (0.097)	0.200* (0.080)	0.518*** (0.065)	0.162+ (0.085)	0.532*** (0.064)	0.163+ (0.093)	0.741*** (0.117)	0.165+ (0.098)	0.782*** (0.117)
Identical Twins pair (G)	0.012 (0.054)	-0.020 (0.037)	0.027 (0.056)	-0.021 (0.037)	-0.033 (0.042)	0.001 (0.024)	-0.045 (0.045)	-0.006 (0.023)	-0.044 (0.052)	-0.021 (0.038)	-0.042 (0.054)	-0.010 (0.038)
<i>Adjusted-R²</i>	0.328	0.198	0.360	0.220	0.306	0.220	0.360	0.319	0.240	0.296	0.274	0.356
N	132	287	132	287	306	556	305	554	223	223	223	223
<i>Wald Test</i>	χ^2	<i>p-value</i>	χ^2	<i>p-value</i>	χ^2	<i>p-value</i>	χ^2	<i>p-value</i>	χ^2	<i>p-value</i>	χ^2	<i>p-value</i>
GS(fav)=GS(unfav)	4.98	0.03*	3.93	0.05*	6.31	0.01*	7.81	0.005**	8.04	0.005**	13.09	0.000***
GS(2.fav)=GS(1.fav)	0.19	0.66	0.38	0.53	0.00	1.00	0.01	0.91	0.24	0.62	0.11	0.77
GS(2.unfav)=GS(1.unfav)	0.00	0.96	0.01	0.91	0.12	.72	0.08	0.78	0.46	0.50	1.04	0.31

Notes: Robust standard errors in parentheses. Estimation results for twin 1. Dependent variable is: “individual *i* is entrepreneur”. Genetic Effect is the interaction between “Other twin entrepreneur” and “Identical twin pair”. Controls are a set of indicators variables per province of residence for models 2 and 4, and indicator variables for gender and education degrees (high school diploma, college degree) for model 6. The first Wald test confirms the hypotheses for the alternative twin, the second and the third Wald tests compare the coefficients within the pair. Significance levels: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$, **** $p < 0.001$

Table A2. Estimation of the Effect of Predisposition: Logistic Regression

	(1.1)	(2.1)	(1.2)	(2.2)	(1.2)	(2.2)
	Baseline		Interaction with Environment			
	Twin 1	Twin 2	Favorable Milan	Unfavorable Rome	Favorable Male sex	Unfavorable Female sex
Predisposition (GS ₂)	0.882 ⁺ (0.519)	0.882 ⁺ (0.519)	15.54 ^{***} (1.370)	0.313 (0.973)	2.015 ^{**} (0.754)	-0.387 (0.753)
Family Background (S ₂)	2.356 ^{***} (0.421)	2.356 ^{***} (0.421)	-12.44 ^{***} (1.172)	2.696 ^{***} (0.779)	1.350 [*] (0.602)	3.308 ^{***} (0.621)
Identical twin pair (G)	-0.104 (0.288)	-0.200 (0.324)	0.481 (0.719)	-0.071 (0.642)	-0.478 (0.397)	0.395 (0.453)
<i>Pseudo R</i> ²	0.227	0.244	0.245	0.219	0.236	0.212
<i>N</i>	862	862	130	283	306	556
<i>Wald Test</i>	χ^2	<i>p-value</i>	χ^2	<i>p-value</i>	χ^2	<i>p-value</i>
GS ₂ (x.1)= GS ₂ (x.2)	0.00	1.00	82.1	0.00	5.08	0.02

Notes: Robust standard errors in parentheses. Dependent variable is: “individual *i* is entrepreneur”

Significance levels: ⁺ $p < 0.10$, ^{*} $p < 0.05$, ^{**} $p < 0.01$, ^{***} $p < 0.001$

Table A3. Estimation of the Effect of Predisposition: with and without Population Weights

	(1.1)	(1.2)	(2.1)	(2.2)	(3.1)	(3.2)
	Baseline		Gender as Environment			
	No Weights	Weights	Favorable No Weights	Favorable Weights	Unfavorable No Weights	Unfavorable Weights
Predisposition (GS ₂)	0.196 ^{**} (0.067)	0.290 [*] (0.117)	0.437 ^{***} (0.118)	0.453 ^{**} (0.171)	-0.047 (0.085)	0.121 (0.169)
Family Background (S ₂)	0.392 ^{***} (0.055)	0.363 ^{***} (0.101)	0.208 [*] (0.100)	0.239 (0.154)	0.522 ^{***} (0.068)	0.443 ^{**} (0.136)
Identical twin pair (G)	-0.007 (0.023)	-0.014 (0.030)	-0.050 (0.046)	-0.058 (0.071)	0.020 (0.025)	0.018 (0.020)
<i>Adjusted R</i> ²	0.245	0.268	0.267	0.273	0.213	0.243
<i>N</i>	832	832	299	533	299	533

Notes: Standard errors in parentheses. Dependent variable is: “individual *i* is entrepreneur”

Significance levels: ⁺ $p < 0.10$, ^{*} $p < 0.05$, ^{**} $p < 0.01$, ^{***} $p < 0.001$

Table A4. Estimation of the Effect of Predisposition: Alternative Specification with Dummies

	(1) Baseline	(2) Milan vs. Rome	(3) Male vs. Female
Fraternal Twin, Other twin not entrepreneur, Unfavorable Environment (2 and 3 only)	0.077*** (0.016)	0.046* (0.023)	0.040** (0.015)
Fraternal Twin, Other twin entrepreneur, Unfavorable Environment (2 and 3 only)	0.392*** (0.090)	0.371* (0.145)	0.490*** (0.123)
Identical twin, Other twin not entrepreneur, Unfavorable Environment (2 and 3 only)	-0.007 (0.020)	-0.003 (0.028)	0.018 (0.020)
Identical twin, Other twin entrepreneur, Unfavorable Environment (2 and 3 only)	0.580*** (0.058)	0.430*** (0.112)	0.492*** (0.090)
Fraternal Twin, Other twin not entrepreneur, Favorable Environment		0.019 (0.043)	0.108** (0.039)
Fraternal Twin, Other twin entrepreneur, Favorable Environment		-0.046* (0.023)	0.360** (0.128)
Identical Twin, Other twin not entrepreneur, Favorable Environment		0.056 (0.043)	0.0572* (0.028)
Identical twin, Other twin entrepreneur, Favorable Environment		0.668*** (0.124)	0.717*** (0.069)
<i>Adjusted R</i> ²	0.257	0.238	0.273
<i>N</i>	862	413	862

Notes. Robust Standard errors in parentheses. + $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

CHAPTER 3. BADGE OF HONOR OR SCARLET LETTER? UNPACKING INVESTORS' JUDGMENT OF ENTREPRENEURS' PAST FAILURE

With Prof. Mirjam van Praag and Dr. Gary Dushnitsky

Abstract

Research shows that most ventures fail, yet it has devoted limited attention to the consequences of entrepreneurs' past failure for investors' decisions. Our motivation to address this research gap is the insight that failure can be due to bad luck, lack of skill or both. Therefore, failure conveys ambiguous information about skill. We predict that investors will discount entrepreneurs who experienced past failure. However, in the presence of a signal of skill, the magnitude of the failure discount is reduced. We test our predictions using an online experiment where respondents are potential investors in seed stage ventures via equity crowdfunding. Using a between-subjects design, we ask respondents to evaluate realistic investment opportunities, which differ from each other due to the manipulation of information about failure (due to bad luck) and entrepreneurs' skills. Our results confirm the predictions: investors discount entrepreneurs with failure experience. Past failure in the presence of a signal of skill, however, is not discounted. The "failed" label only is not discounted. Our analyses shed light on how investors view business failure. In a world where entrepreneurial failure is prevalent, we find that investors are mindful about its core drivers: luck and skill.

INTRODUCTION

“[...] though the incompetent men and the obsolete methods are in fact eliminated [...] failure also threatens or actually overtakes many an able man.” Schumpeter (1943, p. 39)

Over time, it has become easier and cheaper to become an entrepreneur as barriers to entry fell down through digitization (Greenstein et al. 2013). Nowadays, entrepreneurs have opportunities to access less expensive distribution channels, data storage, and resources. However, lower barriers to entry lead to more entrants and higher failure rates (Kerr and Nanda 2009). How do investors evaluate entrepreneurs who experienced past failure? This question becomes increasingly important with increasing numbers of serial entrepreneurs, often with failure experience.

A large and detailed literature investigated how entrepreneurs acquire and accumulate resources from investors towards the growth of their ventures (Martens et al. 2007, Zott and Huy 2007, Hallen 2008). These studies highlight the importance of information about the entrepreneur as a factor that influences investor decisions (Eisenhardt and Schoonhoven, 1990, Heeley et al. 2007, Jung et al. 2017). Several studies investigated the role of various entrepreneur’s characteristics on venture financing: education (Robinson and Sexton 1994, Colombo and Grilli 2005) industry experience (Agarwal et al. 2004, Chatterji 2009), and entrepreneurial experience (Hsu 2007, Gompers et al. 2010).

Possibly the most relevant signal of entrepreneurial skill is a founder’s past entrepreneurial experience. While we know that investors evaluate past success positively (Hsu, 2007, Gompers et al. 2010, Hallen and Eisenhardt 2012), we know little about how investors evaluate past failure. The literature on resource acquisition is particularly silent about the value of negative information and it offers little insights on its potential drivers; do investors view past business failure as signal of past mistakes (i.e., lack of skill) or merely an indication of one’s misfortunes (i.e., lack of luck)? This lacuna is striking giving the breadth of work from the entrepreneur’s perspective (see, for a review, Ucbasaran et al. 2013).

Borrowing insights from studies about failure, we argue that the information that failure conveys is different from success' (Pfarrer et al. 2010, Eggers and Song 2015). While success requires both skill and good luck, failure can be due to either a mistake—lack of skill—or a misfortune—bad luck (Cardon et al. 2011). In other words, past failure does not necessarily imply the absence of skill. It may simply reflect bad luck.

Consistent with previous research, we argue that investors discount past failure. the reason being that failure casts ambiguity over the skill of the entrepreneur. This ambiguity persists also in case of failure due to misfortune (Pfarrer et al. 2010). Investors may have two distinct ways of discounting misfortune, so we argue. On the one hand, if investors are discounting lack of skill only, positive information about the entrepreneur's skill should reduce the failure discount (Certo 2003, Heeley et al. 2007, Pope and Sydnor 2011). On the other hand, investors can see failure as damning *per se*, and have a bias against any entrepreneur who has failed in the past even due to misfortune. In this case, positive information about skill would be irrelevant, like with other behavioral biases (Franke et al. 2006, Lin and Viswanathan 2015). Based on this reasoning, we derive theoretical predictions that we test in an experimental setting.

We test our hypotheses through a “framed online field” experiment (Harrison and List 2004), using a 2x2 between-subjects design. The design draws on the insight that entrepreneurs differ in their past outcomes (i.e., some experience success while other failure), whereas for some entrepreneurs information about them being skilled is available, whereas for others this is lacking. We combine these two treatment dimensions: past venture experience—success versus failure—and the presence or absence of an additional piece of information about the entrepreneur being skilled. Table 1 shows the four experimental treatments.

Our setting is equity crowdfunding, where individuals can fund entrepreneurial projects through an online platform (e.g., AngelList, CrowdCube, and Seedrs) in exchange of equity. Early studies about equity crowdfunding indicated it causing increased opportunities for entrepreneurial entry (Ahlers et al. 2015, Bruton et al. 2015) and the setting has been subject of scholarly work on resource acquisition and investors decisions (Vulkan et al. 2016, Mohammadi and Shafi 2018).

Participants in the experiment are individuals with relevant investment experience and interest in crowdfunding—we call them prospective investors—who simulate an investment decision for one manipulated investment opportunity on an equity crowdfunding platform. Each respondent is randomly assigned to one of the four treatments and is asked for their willingness to invest and the amount they would commit.

Our results document the way in which critical resource providers react to past failure. Specifically, we capture the discounting behavior of investors with respect to their assessment of misfortunes, i.e., failure due to bad luck. As a sneak preview we reveal the result that investors shun entrepreneurs who experienced. However, when entrepreneurs provide objective information of the presence of skills, past failure is not penalized. Finally, we find no support for the failure bias often labeled as “stigma of failure”.

Our study aims to make three contributions to the literature about resource acquisition and entrepreneurial failure. First, we shed light on investors’ assessment of negative information such as past business failure. We show that past failure is not merely the opposite of past success. In absence of additional information about skill, past business failure is detrimental to resource acquisition. However, when the entrepreneur provides additional information about the presence of their skill, failure does not put the entrepreneur in a disadvantageous position.

Second, we incorporate (bad) luck into our framework. An investor facing an entrepreneur with past failure experience is confronted with greater ambiguity than when facing an entrepreneur with past success experience: even a highly skilled entrepreneur may fail due to bad luck (e.g., an adverse external event such as the 2008 financial crisis, the 9/11 terror attack, etc.). After accounting for bad luck or misfortune, it becomes apparent that the impact of failure is not the opposite of success: the information past failure conveys is not a precise indicator of skill. We answer a call for more mindfulness of this construct in recent literature (Liu and De Rond 2016)

Finally, we contribute to the crowdfunding literature through our setting. We provide evidence that investors in our sample are not exposed to behavioral biases about failure, interpreting the role of bad luck behind business failure. This helps alleviate some concerns about investors from new alternative sources of finance (Chemmanur and Fulghieri 2013, Mollick and Nanda 2015).

The study is organized as follows. Section 2 reviews the literature and develops theory and hypotheses. Section 3 describes the experimental design, the context and the procedure. Section 4 shows the results. Finally, section 5 discusses our findings and concludes.

THEORETICAL BACKGROUND

We study the resource provider's perspective of business failure. The issue is important for two reasons. First, it is increasingly common to see individuals who pursue a number of different entrepreneurial ventures. Second, evidence suggests that most entrepreneurial ventures fail. Taken together, this implies that many entrepreneurs may have past entrepreneurial experience, and oftentimes that experience concludes with the failure of the venture. Specifically, we ask the following research question: "how do investors evaluate entrepreneurs who experienced past failure?" In answering the research question, we further investigate whether the cost of failure is mitigated by the provision of information about the presence of skill.

To facilitate the theoretical discussion, we use the concepts of “skill” and “luck.” In doing so, we adopt labels used in seminal work (Schumpeter 1942, Baumol 1990). Extant work attributes business success to two fundamental components: an endogenous component, which we define broadly as “any factor where the entrepreneur has agency”—traditionally labeled as “skill;” and an exogenous component, which we define as “a random factor where the entrepreneur has no control”—labeled as “luck” (Liu and De Rond 2016).

Our theory development follows three steps. First, we clarify our definition of failure and situate the contribution of our study in the failure literature. Second, we review the literature on resource acquisition and highlight the investor perspective. Finally, building on our review, we derive our four hypotheses.

The Roots of Failure

This section presents a definition of entrepreneurial failure and discusses its two root causes. To build a theoretical argument, we employ an explicit definition of entrepreneurial failure. Following established studies, we define entrepreneurial failure as the “cessation of the founders’ involvement due to discontinuity of operations” (Singh 1997, Shepherd 2003, Hoetker and Agarwal 2007, Ucbasaran et al. 2013). This definition does not only refer to the termination of an entrepreneur’s involvement, but also to the termination of the business itself.

The definition features several advantages. First, it is consistent with the evidence that most entrepreneurial businesses fail (Gompers et al. 2010). Second, it avoids confusion that may arise if one were to focus on entrepreneur’s departure from the venture only: entrepreneurs may leave otherwise functioning ventures for a host of reasons, ranging from (a) the business’ underperformance, through (b) the business is performing well yet the entrepreneur is underperforming therein, and all the way to (c) irrespective of the business performance, an entrepreneur may depart for a better or different

opportunity. Third, our failure definition represents a characteristic of the history of the entrepreneur that is observable to prospective investors and other stakeholders (Hallen and Eisenhardt 2012).

Failure has been long under-researched (McGrath 1999, Liu and De Rond 2016, Josefy et al. 2017) and it has become object of scholarly attention only recently. A number of studies explored the consequences of failure for entrepreneurs, and investigated issues such as the costs, learning outcomes, and remedies that follow entrepreneurial failure (for a review, see Ucbasaran et al. 2013). For example, Eggers and Song (2015) explore the impact of failure from the entrepreneur's perspective. They show a negative association between failure and subsequent entrepreneurial performance; which is exacerbated when failure drives entrepreneurs to change an industry. They further find that entrepreneurs disregard any possible learning when failure is perceived as due to external factors. With few notable exceptions which undertake the perspective of the business media (Cardon et al. 2011) or investors (Cope et al. 2004); most of the research so far is from the entrepreneur's perspective. Research on the impact of past failure on other stakeholders, in particular investors' decisions, is scarce.

Understanding how investors evaluate past failure has important implications due to three critical observations. First, failure is more common than success, particularly for startups (van Praag 2003). Second, as more individuals make multiple attempts at entrepreneurship (Wright et al. 1997), it is more common to observe an entrepreneur who experienced past failure. Third, as the initial quote from Schumpeter (1942) notes, failure may take place not only due to lack of skill but also because of bad luck (Liu and De Rond 2016).

Extant research about business failure traditionally identified two roots of business failure: mistakes, i.e., failure due to low skill; and/or misfortunes, i.e., failure due to bad luck (Zacharakis et al. 1999, van Praag 2003, Cardon et al. 2011, Mantere et al. 2013). Below, we present brief anecdotes to illustrate the role of these two factors as roots of a venture failure. On the one hand, failure can be

classified as a mistake within the agency of the entrepreneur, for example poor risk management. Consider Plain Vanilla, an entrepreneurial venture that developed a successful interactive mobile game named QuizUp in 2012. The startup raised \$ 40 million in venture capital in four years but was sold in December 2016 for only \$ 1.2 million. In a post-mortem analysis, the founder reflects on his strategic mistake; his lack of effort towards diversifying the client base was at the core of their failure:¹²

“We placed our bets on the extensive collaboration with the television giant NBC. One could say that we placed too many eggs in the NBC basket. [...] When I received the message from NBC that they were canceling the production of the show, it became clear that the conditions for further operation, without substantial changes, were gone.”

On the other hand, failure can be due to a misfortune, something beyond the agency of the entrepreneur, e.g., an unforeseen regulatory change hitting one specific market. Consider HomeHero, a platform founded in 2013 to connect families and caregivers. The platform offered competitive prices by employing caregivers as independent contractors. In June 2015, the platform worked with 1,200 caregivers and the entrepreneurs raised \$ 20 million in Series A funding. Less than three months later, an unanticipated federal regulatory change required HomeHero to treat the caregivers as employees and not contractors. The regulatory shift raised the costs for users, forced the platform to become an employer of caregivers, and resulted in termination of 95% of the contracts with caregivers. By the end of February 2017, HomeHero ceased its operations. Absent the federal regulatory change external to the agency of the entrepreneur, HomeHero had a competitive advantage common to many marketplaces and would have survived.

¹² <https://www.cbinsights.com/blog/startup-failure-post-mortem/>

Understanding the root of failure—either mistakes, misfortunes, or both – is important as investors may use this information to judge the likelihood of success of the entrepreneur’s subsequent startup endeavors.

Resource Acquisition and the Role of Information

The resource acquisition literature studies the interaction between entrepreneurs and key stakeholders as the former gather the necessary resources towards startup innovation and economic growth (Certo 2003, Heeley et al. 2007, Vissa, 2011, Hallen and Eisenhardt 2012). Investors are a critical group of stakeholders as they are among the earliest and most impactful ties for early stage ventures (Stuart et al. 1999, Baum and Silverman 2004, Hallen 2008, Hsu 2007).

Investment in early stage ventures, however, is plagued by high levels of uncertainty. Accordingly, investors make inferences about the unobservable quality of the venture through any available sources of information (Stuart et al. 1999, Franke et al. 2006, Dushnitsky 2010). For example, past work investigated entrepreneurial rhetorical tools, such as narratives (Martens et al. 2007), or symbolic actions (Zott and Huy 2007). Other studies yet, document a host of quality signals; namely objective and verifiable information tightly connected to the quality of the venture.

The literature identifies several different types of signals. Affiliation with reputable third parties has been documented to serve as a quality signal. Throughout the IPO process, affiliation with a prominent financial underwriter—the investment banker that supports and facilitates a firm—represents a valuable source of information about the firm’s quality and it is associated with successful resource acquisition (Carter and Manaster 1990, Higgins and Gulati 2003). Affiliation with reputable venture capitalists (VC) plays a similar role. Indeed, a longstanding relationship between a venture and its VC-backer facilitates closer interaction and deep knowledge of the firm and its underlying quality. It is not surprising therefore that affiliation with reputable VCs is also positively associated with

subsequent funding success (Gulati and Higgins 2003, Hsu 2004, 2006). Finally, strategic alliances with prominent partners also signal firm's quality. In particular, alliance activity is associated with subsequent resource acquisition success; either securing funding prior to, or at, IPO as well as M&A (Stuart et al. 1999, Baum and Silverman 2004, Reuer et al. 2012, Plummer et al. 2016).

Another type of beneficial information consists of grants of intellectual property (e.g., patents). Patents are costly to pursue and can only be obtained by those with the necessary skill and knowledge base. Earlier studies showed the effectiveness of this type of information in securing venture capital investment, and conclude that patents act as signal of entrepreneurial innovativeness skill (Heeley et al. 2007, Conti et al. 2013, Hsu and Ziedonis 2013).

In summary, the signaling literature clearly demonstrates the positive signaling advantages associated with intellectual property or third party affiliation. Nonetheless, one may ask how entrepreneurs secure the resources necessary to obtain such IP or partners in the first place. During the earliest stages of the ventures, the main – if not only – asset an investor can assess is the entrepreneur themselves (Kaplan et al. 2009). Here, there is work on the impact of an individual's past educational and managerial experience (Robinson and Sexton 1994, Zucker et al. 1998, Colombo and Grilli 2005, Bernstein et al. 2017). Arguably, the most relevant individual experience is past entrepreneurial experience. Yet, there is scarce work on the topic and the findings are inconclusive, with some evidence of a positive (Hsu 2007), or a negative impact on subsequent funding (Baum and Silverman 2004). We expand on the informational value of prior entrepreneurial skill in the hypotheses section below.

Hypotheses Development

Our arguments pivot on an inherent difference in the information conveyed by success and failure experience. We assume entrepreneurial success requires both skill and luck. To the extent there are many skilled entrepreneurs who are vying for success; it is likely that those who are ultimately

successful were also lucky in addition to being skilled (Frank 2016). It follows that investors perceive an entrepreneur who was previously successful as highly skilled. Therefore, investors will unambiguously infer from past entrepreneurial success experience that the entrepreneur possesses high levels of skill and was subject to a lucky draw.¹³

As noted by Schumpeter (1942), highly skilled entrepreneurs may also fail. Thus, failure is a noisy signal of skill. Pfarrer and colleagues (2010) echo this idea: skill can be inferred through success, failure is less diagnostic. In fact, entrepreneurs with high levels of skill do fail if they experience bad luck, and unskilled entrepreneurs will likely fail irrespective of luck. Table 1 below represents the fundamental insight of our reasoning¹⁴.

Table 1. Success is an Unambiguous Indicator of High Skill, Failure is Ambiguous.

Luck/skill	Low skill	High skill
Bad luck	Failure	Failure
Good luck	Failure	Success

As Table 1 indicates, past failure may be due to an entrepreneur’s mistakes (e.g., Plain Vanilla developed a poor strategy by “placing too many eggs in one basket”), or misfortunes (e.g., regulatory shock inflicted on HomeHero). It is a noisy negative signal of skill—even in the case of bad luck. However, past success is a precise positive signal of skill. Consistent with earlier findings (Hsu 2007, Gompers et al. 2010) regarding investor’s actions when faced with entrepreneurs with past failure experience, as opposed to success, we hypothesize:

¹³ In this framework, we make an explicit assumption regarding the impact of learning. Specifically, we assume that investors believe the learning experiences of past failed and past successful entrepreneurs are similar (Arora and Gambardella 1997, Minniti and Bygrave 2001). Empirical studies provide support for the fact that learning takes place under failure too (Chen 2013, Eggers and Song 2015, Rocha et al. 2015).

¹⁴ For reasons of parsimony, we conceptualize levels of skill and luck as dichotomous. Dichotomous categorizations are common in research on luck (Liu and De Rond 2016) and in theoretical development about the quality of a venture (good/bad). We believe that our predictions would not change using a continuous conceptualization.

Hypothesis 1a. *Discount of Failure—Willingness to Invest.* Investors are less likely to fund a venture proposal by an entrepreneur who experienced past failure than by entrepreneurs with past success, ceteris paribus.

Hypothesis 1b. *Discount of Failure—Amount Invested.* Investors are likely to commit a lower amount to fund a venture proposal by an entrepreneur who experienced past failure than by entrepreneurs with past success, ceteris paribus.

The main remedy to ambiguity about early-stage ventures is additional information about the entrepreneur. And while there is little conclusive work on the impact of an (successful) entrepreneurial experience, there is related work on individuals' experiences more broadly. For example, higher levels of education are associated with successful resource acquisition (Robinson and Sexton 1994, Zucker et al. 1998) and subsequent venture growth (Colombo and Grilli 2005). Another type of experience studied is industry experience. Agarwal and colleagues (2004) report that past experience in the same industry in an incumbent firm is positively associated with subsequent entrepreneurial success. Chatterji (2009) shows that entrepreneurs' industry experience in incumbent firms is associated with higher venture capital funding. He postulates that the exposure to the industry reduces the uncertainty about the entrepreneur's ability to compete in the same industry, thus signaling higher skill. Others have conjectured that managerial experience should be viewed as a signal of individual skill (Sitkin 1992, Madsen and Desai 2010, Castellaneta and Zollo 2014). More recently, experimental evidence from the investment platform AngelList shows that information about an entrepreneur's elite education or prominent employer carries the largest informational value for successful investment decisions (Bernstein et al. 2017).

In summary, the aforementioned studies suggest information about an individual's past educational, industry and managerial experiences to play an instrumental role in mitigating ambiguity

and obtaining subsequent resource acquisition success. However, the most relevant individual experience – past entrepreneurial experience – is the subject of limited work and findings are inconclusive. Some report that prior founding experience is associated with greater likelihood of securing funding (e.g., Hsu 2007), while others report a negative association between prior entrepreneurial experience and resource acquisition (e.g., Baum and Silverman 2004).

Broadly speaking, the few studies on the topic tend to focus on past success and predominantly overlook information regarding the causes of past entrepreneurial failure. The lacuna is unfortunate given that entrepreneurial outcomes are power-law distributed; most attempts end in failure and only the minority succeeds (Kerr and Nanda 2009). Moreover, studies that mention the informational value of past failure, often conceptualize it as symmetric to success: if past success is a positive signal of skill, then past failure is constructed as a negative signal of skill (Eisenhardt and Schoonhoven 1990; Hochberg et al. 2013).

We postulate investors evaluate past failure differently from past business success, explicitly discerning the possibility of bad luck in their investment decision (Liu and De Rond 2016). It is possible that failure is driven by misfortune rather than mistakes. We emphasize that past failure *per se* constitutes an ambiguous signal, rather than a negative one. However, past failure need not always ultimately result in severe ambiguity. Importantly to our analysis, additional information can overturn the adverse effects of salient entrepreneurial traits and experiences. We argue that investors go beyond such a perspective of past failure. In the face of ambiguity, investors seek additional information about the unobservable skill so as to mitigate the noise or eliminate it altogether (Altonji and Pierret 2001). Pope and Sydnor (2011) show that investors of a crowdfunding platform are wary of funding individuals from certain groups, yet the adverse effect is minimized in the presence of signals of individual skill.

We conclude that to the extent that there is additional information, investors will incorporate it in their evaluation of the entrepreneurial skill, and hence their future prospects. Accordingly, the next hypothesis focuses on the event of past failure. Among those who failed, some entrepreneurs can provide additional positive information regarding their entrepreneurial track record that can mitigate the level of ambiguity and increase the likelihood investors' commit funding.

Hypothesis 2a. *Ambiguity Discount —Willingness to Invest.* When faced with a venture proposal by entrepreneurs who previously failed, investors are more likely to fund in the presence of positive information about skill than in the absence of such information.

Hypothesis 2b. *Ambiguity Discount —Amount Invested.* When faced with a venture proposal by entrepreneurs who previously failed, investors are more likely to commit a larger amount to fund in the presence of positive information about skill than in the absence of such information.

To fully understand the value of additional information, it is not sufficient to focus solely on those who have failed in the past, although the impact of additional information regarding skill should be sensitive to the outcome of entrepreneurial experience. It will be positive in the presence of past failure, and dissipates in the presence of past success.

The key insight is that additional information regarding skill is only as effective if it mitigates the level of ambiguity. If there is little ambiguity to begin with, then any additional information will not bring about a change in investment decisions. Formally, we conjecture as to the effect of additional information in the presence of past entrepreneurial failure and past success, respectively. Because failure may arise either due to lack of skill or due to bad luck, its root cause is inherently ambiguous. Additional information may clarify it. In contrast, the next hypothesis, considers the effect of additional information in the presence of past success. If indeed success requires both skill and luck, there is no ambiguity regarding its root cause. In this case, additional information should not impact investor's

actions. Taken together, we conjecture that the marginal benefit of a skill signal is higher in the presence of entrepreneurial failure in comparison to that of entrepreneurial success. The following hypotheses (Hypotheses 3a and 3b) complement the previous discussion (Hypotheses 2a and 2b) regarding the impact of signals of entrepreneurial skill.

Hypothesis 3a. *Comparing Effects of Information about Skill —Willingness to Invest.* The positive effect of additional information about skill on an investor’s likelihood of funding a venture proposal is larger given past failure than past success of the entrepreneur.

Hypothesis 3b. *Comparing Effects of Information about Skill —Amount Invested.* The positive effect of additional information about skill on an investor’s amount of funding is larger given past failure than past success of the entrepreneur.

So far, our predictions focus on scenarios where investors discount failure due to ambiguity. That needs not be the case, for example, in the presence of investors’ behavioral bias (see, for review Zhang and Cueto 2017). A bias exists whenever a distortion in the initial evaluation persists despite additional information. The origin of the bias has to do with the investor rather than the entrepreneur.

For example, investors tend to favor entrepreneurs who are similar in their background or location—a bias known as “similarity bias”—irrespective of quality considerations. Investors suffer from this bias, whereas similarity in education and past professional experience allows for undue benefits that abstract from quality (Franke et al. 2006). Investors also support entrepreneurs originally from the same location for reasons beyond their skill (Michelacci and Silva 2007). This bias persists also on online investment platforms (Dushnitsky and Klueter 2011, Agrawal et al. 2015, Lin and Viswanathan 2015).

Likewise, investors may also exhibit a bias against failure. Specifically, investors discount entrepreneurs who experienced bankruptcy irrespective of their actual or observed qualities (Sutton and Callahan 1987). For example, investors who have low tolerance for failure will seek to avoid it at all costs. Such an investor may assign a very high cost to failure *per se* (Tian and Wang 2011), irrespective of the information regarding the skill of the focal entrepreneur. Therefore, investors may have a behavioral discount towards the label of “failed entrepreneur.”

In a departure from the previous hypotheses, we now hypothesize about the funding decisions of biased investors who discount any and all entrepreneurs who are labeled as “failed”. A biased investor will discount venture proposals even in the presence of additional information about entrepreneurial skill (Altonji and Pierret 2001). In other words, biased investors confound misfortunes with mistakes and they withhold investment from those who experienced past failure even in the presence of additional information of entrepreneurial skill. Therefore, we hypothesize:

Hypothesis 4a. *Failure Bias—Willingness to Invest.* Irrespective from additional information about skill, investors are less likely to fund a venture proposal by entrepreneurs who experienced past failure than by entrepreneurs with past success.

Hypothesis 4b. *Failure Bias —Amount Invested.* Irrespective from additional information about skill, investors are likely to commit a lower amount to fund a venture proposal by an entrepreneur who experienced past failure than by entrepreneurs with past success.

In the next section, we discuss the experiment we have designed to test these four sets of hypotheses.

EXPERIMENT

Context

The setting of our experiment is the equity crowdfunding market in the United Kingdom. Equity crowdfunding is a particular form of crowdfunding where ventures ask capital to a pool of small

investors in exchange of equity through an online platform (Ahlers et al. 2015). Equity crowdfunding is a desirable setting for the following reasons.

First, ventures on equity crowdfunding platforms are usually in their seed stage, where information asymmetry is largest and investors are most sensitive to skill cues coming from information (Huang and Pearce 2015). Second, crowdfunding platforms are characterized by a limited impact of traditional constraints such as geography (Agrawal et al. 2015) and, to some extent, to social capital too (Dushnitsky and Klueter 2011). Therefore, it is more realistic that someone can make an investment into a startup without sharing some connections or being located in the same geographical area. Third, traditional investments in entrepreneurial ventures such as by business angels and venture capitalists are a dynamic process that would be hard to capture in an experiment. On crowdfunding platforms, the investment decision is more static because most of the information is available on the platform and investors have a lower degree of involvement after their investment decision (Chemmanur and Fulghieri 2013). Fourth, the outcome of the investment decision on crowdfunding platforms does not depart significantly the decision by traditional resource gatekeepers (Mollick and Nanda 2015). Finally, unlike other types of crowdfunding platforms like Kickstarter or Kiva, which are reward and donation-based, investments on equity crowdfunding platforms are mostly driven by financial considerations (Cholakova and Clarysse 2015).

We run our experiment in the United Kingdom because it is the largest and most developed market for equity crowdfunding at the time of writing. In 2015, the market for equity crowdfunding of UK was estimated between £167 million and £330 million (Crowdfundingshub 2016), while the market in the US was estimated around \$34 million.¹⁵

Design

¹⁵ Source: <http://www.inc.com/ryan-feit/equity-crowdfunding-by-the-numbers.html>. The US market grows slowly due to a sluggish regulatory process (Bruton et al. 2015).

We design a randomized 2x2 between-subjects experiment. Respondents who evaluate an investment opportunity are randomly assigned to one of the four treatments. A treatment consists in a controlled manipulation of the previous startup experience of the team (failure, success) in combination with or without positive information about skill.

Respondents are not only randomly assigned to one of the four treatments, but also to one of two investment opportunities that we selected from an established equity crowdfunding platform. Consistent with previous studies investigating investment decisions on entrepreneurial firms, we selected one past successful and one past unsuccessful project (Chen et al. 2009). Both ventures are digital platforms, one dealing with restaurant bookings and the other dealing with rental of storage space. The successful project asked for £ 350,000 and the unsuccessful £ 150,000, for an equity share of 19% and 17% respectively. We purposefully do not report the stage of the funding to avoid the phenomenon of herding, which takes place when agents extract information from the previous behavior of other agents (Vismara 2016). For privacy concerns, we anonymized the names of the ventures, the names of the entrepreneurs, and their faces. We informed respondents about this anonymization. The choice of two different ventures where to implement our manipulations provides a double advantage: on the one hand, we can control for the underlying quality of the venture¹⁶; on the other hand, we can contrast the behavior of our investors with the behavior of actual equity crowdfunding investors on the platform.

Each respondent reads about one single venture, whose proposal consists of three sections: business idea, founding team, and Q&A (see Appendix Figures A1-A3). These three sections represent the essential information available to an investor on an equity crowdfunding platform. The

¹⁶ In order to keep the projects as close as possible to the original ones, we did not change the amount requested and the equity offered. Controlling for the type of project does not only control for the quality, but also factors in potential anchoring effects in the investment behavior due to the different amounts of funds requested and equity offered.

first section is an executive summary of the business idea and provides information about the business model, the market, the use of proceedings, and the milestones achieved. It states the requested amount, the amount per share, and a pre-money valuation of the business (Figure A1). The second section looks like a short resume of each of the two entrepreneurs. Respondents read about the entrepreneurs' education, their alma mater, and the year of graduation. Investors also observe entrepreneurs' last employer, the associated job title, and the past venture they founded (Figure A2). The third section is a Q&A wall, a common feature on crowdfunding platforms. The Q&A section (Figure A3) is important because it allows investors and entrepreneurs to interact publicly. Investors request information or challenge them before making their investment decision. Entrepreneurs usually tend to respond timely and sincerely because of the public nature of the Q&A section.

Table 2. Overview of the Treatments

Manipulation	No skill signal	Skill signal
Success	<p>“2014-2016 Co-founder and CEO of [<i>Alpha</i>].” “2012-2014 Co-founder and CEO of [<i>Beta</i>].” “2010-2012 Manager of [<i>Sigma</i>].”</p> <p><i>What happened to Beta?</i></p> <ul style="list-style-type: none"> • Ran out of business • <u>Successful exit</u> <p><i>Why did it happen?</i> “The startup was successfully sold for £ 500,000”</p>	<p>“2014-2016 Co-founder and CEO of [<i>Alpha</i>].” “2012-2014 Co-founder and CEO of [<i>Beta</i>].” “2010-2012 Manager of [<i>Sigma</i>].”</p> <p><i>What happened to Beta?</i></p> <ul style="list-style-type: none"> • Ran out of business • <u>Successful exit</u> <p><i>Why did it happen?</i> “We were growing double digit, when the startup was successfully sold for £ 500,000”</p>
Failure	<p>“2014-2016 Co-founder and CEO of [<i>Alpha</i>].” “2012-2014 Co-founder and CEO of [<i>Beta</i>].” “2010-2012 Manager of [<i>Sigma</i>].”</p> <p><i>What happened to Beta?</i></p> <ul style="list-style-type: none"> • <u>Ran out of business</u> • Successful exit <p><i>Why did it happen?</i> “Our main business partner, who was key to that specific business, died in a car accident”</p>	<p>“2014-2016 Co-founder and CEO of [<i>Alpha</i>].” “2012-2014 Co-founder and CEO of [<i>Beta</i>].” “2010-2012 Manager of [<i>Sigma</i>].”</p> <p><i>What happened to Beta?</i></p> <ul style="list-style-type: none"> • <u>Ran out of business</u> • Successful exit <p><i>Why did it happen?</i> “We were growing double digit, when our main business partner, who was key to that specific business, died in a car accident”</p>

In order to harmonize the remaining characteristics of the proposals across the treatments, we edit the team section. We restrict the size of the founding team to two members, the most common team size (Coad and Timmermans 2014). We label one entrepreneur with managerial background as CEO and the other entrepreneur with technological experience as COO. In this way, we control for confounding elements like team composition (Beckman et al. 2007) and symbols like the job title (Zott and Huy 2007). A further manipulation in the team section makes sure that each of the entrepreneurs in a team had shared previous experience in the same startup for two years¹⁷. The

¹⁷ It is important to note that the joint entrepreneurial experience of the team may represent a positive piece of information. The fact the team decided not to split after a failure suggests strategic consensus (Vissa and Chacar 2009); their joint

information about the past startup is limited to its name, suggesting that the past venture was in the same industry as the proposed one. This edit is instrumental to our assumption about learning. We follow the study of Eggers and Song (2015), where they find that learning does not take place when entrepreneurs change industry, irrespective of the outcome of the entrepreneurial endeavor.

In order to implement the treatments, we edit the Q&A section. The Q&A section is the best place where information about past failure can be credibly revealed. Disclosure induced by third parties in a public space is typically perceived as more reliable information than self-reports of past performance (Gomulya and Mishina 2017). Thus, our treatments are based on the question of another investor about the outcome of the early venture the team founded before.

For the information about past success or past failure, we combine a closed form question about the venture's outcome (either positive or negative) with an open question to disclose the reason. The closed form for the type of outcome controls for decoupling attempts through grammar and linguistics (Crilly et al. 2016).

In the failure treatment, the entrepreneur selects the failure option in the closed form and explains that the startup “ran out of business because [their] main business partner, key to the previous business, died in a car crash”. Thus, we mimic bad luck by choosing a scenario as exogenous as possible. The choice of failure due to a misfortune is a parsimonious one for the following two reasons. First, the discount in Hypotheses 1a and 1b will represent lower bound estimation because it compares success against failure due to a misfortune. Second, failure due to a misfortune is more sensitive to additional information about skill. It is likely that failure due to a mistake leads to an even larger discount and requires more information to solve the ambiguity.

experience was productive and failure did not take place due to conflicts within the team. This could reinforce the belief of failure due to bad luck and provide a more conservative interpretation of our findings.

In the case of past success, the entrepreneur selects the success option in the closed part of the answer and explains that the past venture “was successfully sold for £ 500,000.” While the sum does not represent an exceptional success (Groupon reached the valuation of \$1.35 billion in two years), we chose an amount that would not bias the perception about the additional liquidity and resources of the entrepreneurs.

For the information about skill, the answer to the open question includes an additional sentence where we provide information about the performance of the past venture before its exit: “[the past startup’s] sales trajectory was growing double digit when, [success/failure occurred].” Our treatment is more closely related to entrepreneurial skill rather than general human capital like education and prominent employers (Chatterji 2009, Bernstein et al. 2017). The information about past venture’s sales trajectory suggests the investor that the entrepreneur was exerting some agency into this positive outcome, matching our broad definition of skill. Table 2 shows an overview of how the four treatments are revealed in the Q&A section: a dimension for past failure versus success (rows) and a dimension where positive information about skill is absent versus present (columns).

Procedure

We recruited our respondents on Prolific, an online UK-based platform for survey and experiment tasks, the highest quality platform at the time of our writing (Peer et al. 2017).¹⁸ We offered a monetary compensation of £ 1, the average payment for an 11 minutes task on Prolific. For the selection of target respondents, i.e, people with investment experience or willing to invest in crowdfunding in the near future, this is a very small, probably negligible incentive. Initially, we had the idea of incentivizing investors by rewarding correct estimates of the percentage pledged for the business case on the real equity crowdfunding platform. However, due to the manipulations to the

¹⁸ The experiment is available through <http://goo.gl/cxSNep>

team composition, a truthful comparison was impossible and we decided to refrain from implementing further incentives.

We applied a prescreening of subjects living in the European Union or the United Kingdom who had investment experience in the past. The prescreening question available on Prolific was the following: “*Have you ever made investments (either personal or through your employment) in the common stock or shares of a company?*” We recruited 600 prescreened respondents who opened the questionnaire including the business proposal and answered questions about their investment decision and socio-demographic information.

After their responses about investments and before providing their background information, respondents answer two attention checks in order to screen out those who answered carelessly. One attention check asked about the outcome of the previous venture, and the other attention check asked to answer about the performance trajectory of the previous venture before the exit took place¹⁹. We further excluded those whose completion time was two standard deviations below and two standard deviations above the average due to a possible lack of attention or focus. Finally, we excluded respondents providing inconsistent information (e.g., being professional investors at the age of 18, never invested at all despite the pre-screening question, or opposite gender to the one reported to Prolific) and those who showed neither investment experience nor any interest for *any* type of crowdfunding²⁰. All in all, this resulted in a valid sample of 246 respondents.

In the introductory part of the experiment, respondents are informed about the object of the study and the fictitious nature of the investment task. On the next page, subjects read the three sections about the venture: idea, team, and Q&A. In order to discourage subjects from searching the

¹⁹ We allowed for the use of a “back” button so that respondents could reread information.

²⁰ We discarded also an additional “No Experience” manipulation for two reasons. First, we had no theory to test involving no experience and it was working as a control. Second, the manipulation presented confounding issues as entrepreneurs had cumulated more industry experience, which added noise to comparisons. For easier interpretation of the results, and at the cost of less statistical power, we excluded these participants from the sample.

projects online, these anonymized pages are presented in “png” format. After reading the venture description, respondents answer questions about their investment choice. Respondents answer whether they would consider investing in the venture, and how much money. Moreover, a closed-form question requires respondents to rank potential drivers of their investment, i.e. the market, the business idea, or the entrepreneurial team.

We further collect information about respondents’ behavior related to financial decision making in general; about their private and professional past investments, and their participation both as a backer and requester in crowdfunding platforms. We administer respondents’ risk aversion based on a non-incentivized version of the multiple price list elicitation method, where respondents choose between a risky lottery ticket and a certain equivalent (Holt and Laury 2002). A final block of questions administered respondents’ socio-demographics, to be used as control variables in the analysis. Beyond information such as age, gender, education, employment status, and location, we added a question about house ownership as a proxy of wealth. To avoid a bias due to the sequence of responses, the order in which response possibilities for all closed form questions are shown is randomized.

Variables

Dependent variables. We operationalize subjects’ investment decisions with two variables. The first variable is a Likert scale derived from the questionnaire indicating subjects’ likelihood to invest in the venture on a scale from 1 to 5. This variable represents the extensive margin and tests Hypotheses 1a to 4a. The second variable represents the hypothetical amount invested (if any). We performed winsorization of the variable at the 95th percentile to mitigate outliers’ effect. The 95th percentile of the variable is £2,000. This variable represents the intensive margin and tests Hypotheses 1b to 4b.

Treatment variables. The theoretical framework can be summarized with the following equation:

$$Y_i = \alpha + \beta_F I(\text{Failure without info})_i + \beta_{FS} I(\text{Failure with info})_i \\ + \beta_{SS} I(\text{Success with info})_i + \gamma I(\text{high quality project})_i + \varepsilon_i$$

Where Y_i is the investment decision of investor i . Each but one of the experimental conditions are represented by a dummy variable, namely “Failure, no signal of skill”; “Failure, signal of skill”; “Success, signal of skill”, whereas the condition “Success, no signal of skill” is the baseline. The effect on investors’ evaluations of each of the treatments β_F, β_{FS} , and β_{SS} is estimated in comparison to the baseline condition “Success, no signal of skill” to be able to test hypotheses. The coefficient γ estimates the difference in the investment decision between investors assigned to higher with respect to lower quality project. Finally, ε_i represents the set of unobservables for investor i .

In order to test Hypotheses 1a and 1b (*Discount of Failure*) we look at the coefficient β_F . Since “Success without info about skill” is the baseline, the coefficient $\beta_F < 0$ would lend support to Hypotheses 1a and 1b. In the absence of additional signals, investors attach a lower value to entrepreneurial proposals by entrepreneurs with past failure experience (due to bad luck) than by entrepreneurs with successful experience.

To test Hypotheses 2a and 2b (*Ambiguity Discount*) we compare the coefficients β_F and β_{FS} . There is support to Hypothesis 2a and 2b if $\beta_{FS} - \beta_F > 0$. Investors attach a higher value to entrepreneurial proposals by entrepreneurs with startup failure experience in the presence of a positive signal of skill than in the absence of such a signal.

Support for Hypothesis 3a and 3b (*Comparing Effects of Information about Skill*) comes down to $\beta_{FS} - \beta_F > \beta_{SS}$. The positive effect of a signal of skill on an investor’s evaluation of an entrepreneurial proposal is higher given past failure experience (due to bad luck) than past successful experience of the entrepreneur.

In the same fashion: $\beta_{FS} - \beta_{SS} < 0$ would lend support to Hypotheses 4a and 4b (*Failure Bias*). In the presence of a signal of skill for entrepreneurs with past failure (due to bad luck), investors still evaluate the entrepreneurial startup proposal of these entrepreneurs to be of lower value than equal proposals of those with success experience.

Control variables. All models include a dummy variable for the successful project. Because of the unbalance between some observable characteristics, we further control for those variables. In an additional specification, we control also for college education, wealth proxy, residence outside the U.K., and past investment experience in reward, donation, and equity crowdfunding.

RESULTS

Descriptive Statistics

Table 3 shows the descriptive statistics of the experiment. The first two rows of Pane A describe the dependent variables. Our respondents are on average likely to consider investment in the opportunity offered (3.6 out of 5) and they would invest on average £313, which is not far from the median amount of £279 surveyed on a major equity crowdfunding platform in the UK (Vulkan et al. 2016). The rest of Pane A describes the control variables. Respondents are on average 37.5 years old, 82.5% of them have at least college education, and their risk profile is quite conservative, 3.2 out of 10. Slightly more than half (56.5%) own their house. The share of males in our sample, 56.5%, is similar to the share of male backers detected on other major crowdfunding platforms, like Kickstarter (Greenberg and Mollick 2017). Looking at the geography, 14.2% of the sample lives outside the UK and 13.8% lives in London.

Pane B of the table reports crowdfunding experiences and attitudes of the participants. Pane A already showed that 16.3% of respondents have professional investment experience. Because we excluded from the sample investors who reported to be “not interested” in all the categories of crowdfunding, we have limited the sample to those “at risk of investing” in crowdfunding, of any sort.

The average profile of our sample shows a selection of wealthier and more educated individuals, traditionally more “at risk” of investing in equity and crowdfunding.

Table 3. Descriptive Statistics

Pane A Dependent and Control Variables					
<i>Variable</i>	<i>Obs</i>	<i>Mean</i>	<i>Std. Dev.</i>	<i>Min</i>	<i>Max</i>
Investment Propensity	246	3.606	1.040	1	5
Amount Invested	246	313.199	543.884	0	2000
Age	246	37.496	11.199	21	67
College Degree or Higher	246	0.825	0.381	0	1
Risk Aversion	246	3.207	2.624	0	10
Owns House	246	0.565	0.497	0	1
Male	246	0.557	0.498	0	1
Living outside U.K.	246	0.142	0.350	0	1
Living in London	246	0.138	0.346	0	1
Professional Investor	246	0.163	0.370	0	1
Pane B Crowdfunding Experience of the Respondents					
<i>Type of Crowdfunding</i>	<i>Invested</i>		<i>Raised</i>		
<i>Donation</i>					
* Not Interested	45.6%	110	63.9%	156	
* Potential Investor	38.6%	93	32.4%	79	
* Investor	7.5%	18	3.3%	8	
* Serial Investor	8.3%	20	0.4%	1	
<i>Reward</i>					
* Not Interested	25.0%	59	57.3%	141	
* Potential Investor	40.7%	96	37.8%	93	
* Investor	14.4%	34	2.9%	7	
* Serial Investor	19.9%	47	2.0%	5	
<i>Equity</i>					
* Not Interested	36.6%	89	63.8%	157	
* Potential Investor	54.32%	132	33.0%	81	
* Investor	6.6%	16	2.0%	5	
* Serial Investor	2.5%	6	1.2%	3	
<i>Debt</i>					
* Not Interested	36.4%	84	58.8%	144	
* Potential Investor	53.3%	123	37.1%	91	
* Investor	6.9%	16	3.7%	9	
* Serial Investor	3.5%	8	0.4%	1	

In Table 4, we report the variables of interest along our experimental treatments and the randomization check. We observe some non-random attrition that might unbalance the samples. The number of respondents who passed the attention check is lower for the conditions with the skill signal. The skill signal required reading and understanding an additional question, which raised the bar for passing. The

samples are relatively balanced though in terms of the distribution of characteristics of respondents. Within some pairs of the main treatments, differences are present in terms of education, wealth, foreign status, and (reward and equity) crowdfunding experience. Because of the unbalance in the experimental data due to the attrition, we add the unbalanced variables as controls in the specification of our regressions (King et al. 2011).

Table 4. Randomization Checks

<i>Variable</i>	<i>Failure w/o Sig</i>		<i>Failure w/ Sig</i>		<i>Success w/o Sig</i>		<i>Success w/ Sig</i>	
	N	Mean	N	Mean	N	Mean	N	Mean
Age	66	36.515	52	37.173	97	38.588	31	36.710
College Degree or Higher ^{fh}	66	0.879	52	0.885	97	0.763	31	0.806
Risk Aversion	66	3.212	52	2.962	97	3.505	31	2.677
Owns Housing Solution ^{fg,hi}	66	0.455	52	0.481	97	0.639	31	0.710
Male	66	0.500	52	0.538	97	0.577	31	0.645
Living outside U.K. ^{ei}	66	0.197	52	0.077	97	0.113	31	0.226
Living in London	66	0.152	52	0.154	97	0.134	31	0.097
Professional Investor ^{dj}	66	0.152	52	0.115	97	0.165	31	0.258
Invested in Donation CF	66	0.197	51	0.157	93	0.161	31	0.065
Invested in Reward CF ^{gi}	64	0.344	51	0.431	91	0.330	30	0.233
Invested in Equity CF ^f	66	0.046	52	0.115	95	0.084	30	0.167
Invested in Debt CF	62	0.081	50	0.060	90	0.144	29	0.233

Notes: Crowdfunding experience operationalized here as whether investors invested or raised money already.

Difference significant at least at 10% level between:

- | | |
|---|--|
| e. Failure w/o Signal and Failure w/ Signal | f. Failure w/o Signal and Success w/o Signal |
| g. Failure w/o Signal and Success w/Signal | h. Failure w/ Signal and Success w/o Signal |
| i. Failure w/ Signal and Success w/ Signal | j. Success w/o Signal and Success w/Signal |

Main Results

In Table 5 we report the mean averages across our randomizations (failure due to bad luck, information about skill, and different type of project). The averages provide directional evidence to the theoretical framework. On average, investors tend to invest less in entrepreneurs who experienced failure, both in term of willingness to invest and in terms of amount invested (with the notable exception of investment in high quality project under failure with information about skill). However, the averages for failure with information about skills are consistently higher for both extensive and intensive margins. In the rest of the section, we analyze the data controlling for different types of projects and the unbalanced variables.

Table 5. Raw Averages per Treatments

	Overall	Low q project	High q project
	Mean	Mean	Mean
Success w/o info			
Investment is attractive	3.691	3.400	4.942
Amount invested	346.25	302.44	400.04
N	97	45	52
Failure w/o info			
Investment is attractive	3.470	3.107	3.737
Amount invested	184.55	123.571	229.47
N	66	28	38
Success w/ info			
Investment is attractive	3.645	3.647	3.643
Amount invested	401.613	334.12	483.57
N	31	17	14
Failure w/ info			
Investment is attractive	3.596	3.387	3.905
Amount invested	346.25	205.32	554.29
N	52	31	21

Table 6 shows the results of the experiment. All the specifications are OLS regressions with robust standard errors.²¹ The baseline is the condition (a) “Success without Signal of Skill”. Specifications w.1 to w.3 estimate effects on the extensive margin, i.e., the likelihood of investing. Specifications s.1-s.3 estimate the intensive margin – the amount invested. Each specification includes a dummy controlling for the different type of project where we implemented the manipulations. The positive and significant coefficient in each specification suggests that the respondents we pooled behave similarly to the investors on the equity crowdfunding platform we used. Specifications s.1 and w.1 include no further controls. Specifications w.2 and s.2 include controls balancing the variables that were different across manipulations (King et al. 2011), and specifications w.3 and s.3 include additional controls at the investor level. The results from testing these hypotheses are shown in Table 7.

²¹ Because of the nature of the data (ordered categorical variable for investment propensity, count variable for amount invested), we also replicated the specifications using ordered logit regression and negative binomial regression with no substantial difference in the results. We report the results of these analyses in the appendix (Table A1).

Table 6. The Effect of Failure on Investors' Behavior

	<i>Willingness to Invest</i>		<i>Amount Invested</i>	
	(w.1)	(w.2)	(s.1)	(s.2)
Higher quality project	0.491*** (0.131)	0.529** (0.110)	158.5* (57.39)	120.0 (59.22)
<i>Past Startup Outcome</i>				
β_F Fail no Signal	-0.241 (0.164)	-0.340+ (0.180)	-176.5* (74.00)	-185.0* (78.61)
β_{FS} Fail w/ Signal	-0.030 (0.179)	-0.034 (0.181)	12.59 (99.20)	27.65 (108.2)
β_{SS} Success w/ Signal	0.004 (0.197)	-0.121 (0.208)	60.33 (127.6)	-26.31 (127.5)
<i>Balancing controls included</i>				
	<i>No</i>	<i>Yes</i>	<i>No</i>	<i>Yes</i>
Constant	3.381*** (0.119)	3.195*** (0.294)	269.2*** (62.64)	-62.66 (157.9)
R ²	0.063	0.059	0.043	0.067
N	246	231	246	231

Notes. Robust standard errors in parentheses. Willingness to invest is an ordered variable ranging from 0 to 5. Amount invested is a winsorized count variable to prevent noise from outliers (upper bound 5%) count variable. Baseline for "Past Startup Outcome" is "Success no Signal." Balancing controls are: "ever invested in donation crowdfunding," "ever invested in reward crowdfunding," "ever invested in equity crowdfunding," "college education or higher," "owns housing solution," and "foreign investor."

Significance levels: + $p < 0.1$ * $p < 0.05$ ** $p < 0.01$ *** $p < 0.001$

Table 7. The Effect of Failure on Investors' Behavior: Hypothesis Testing

	<i>Willingness to Invest</i>		<i>Amount Invested</i>	
	(w.1)	(w.2)	(s.1)	(s.2)
H1: $\beta_F < 0$				
F statistic	2.15	3.58	5.69	4.21
<i>P value (two tailed)</i>	0.143	0.060	0.018	0.041
H2: $\beta_{FS} - \beta_F > 0$				
Wald statistic	1.14	2.37	4.21	3.33
<i>P value (two tailed)</i>	0.286	0.125	0.041	0.069
H3: $\beta_{FS} - \beta_F - \beta_{SS} > 0$				
Wald statistic	0.60	2.29	0.67	1.71
<i>P value (two tailed)</i>	0.439	0.132	0.413	0.192
H4: $\beta_{FS} - \beta_{SS} < 0$				
Wald statistic	0.01	0.17	0.12	0.11
<i>P value (two tailed)</i>	0.909	0.711	0.730	0.739

Figure 1: The effect of entrepreneurial experience on willingness to invest.

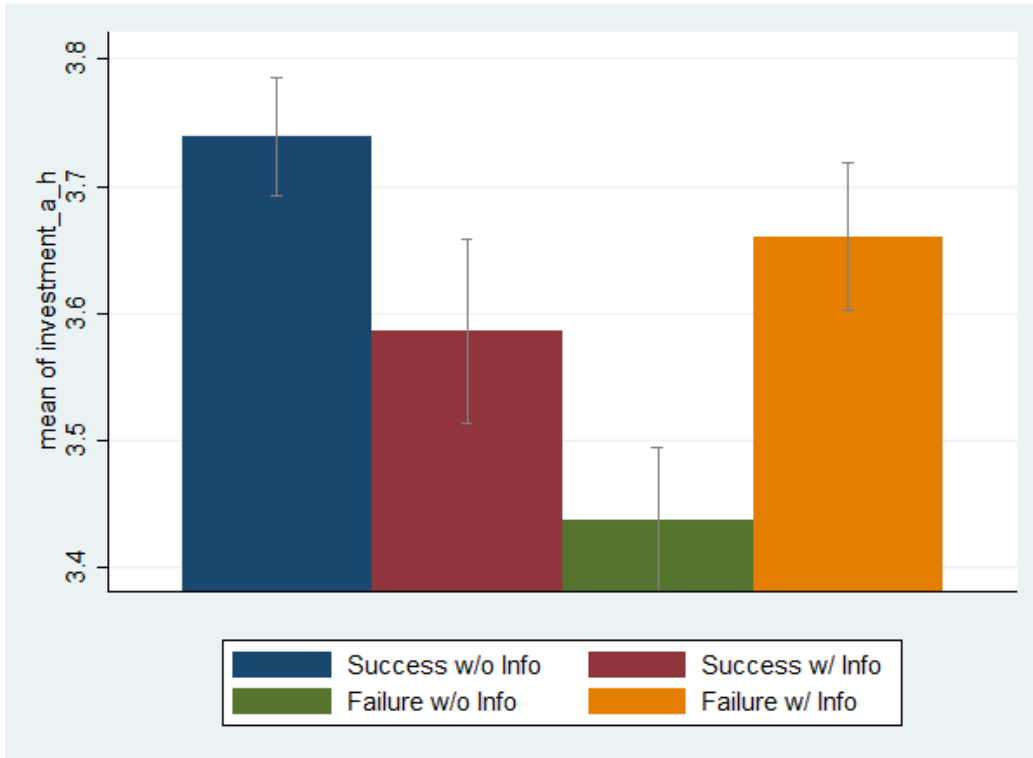
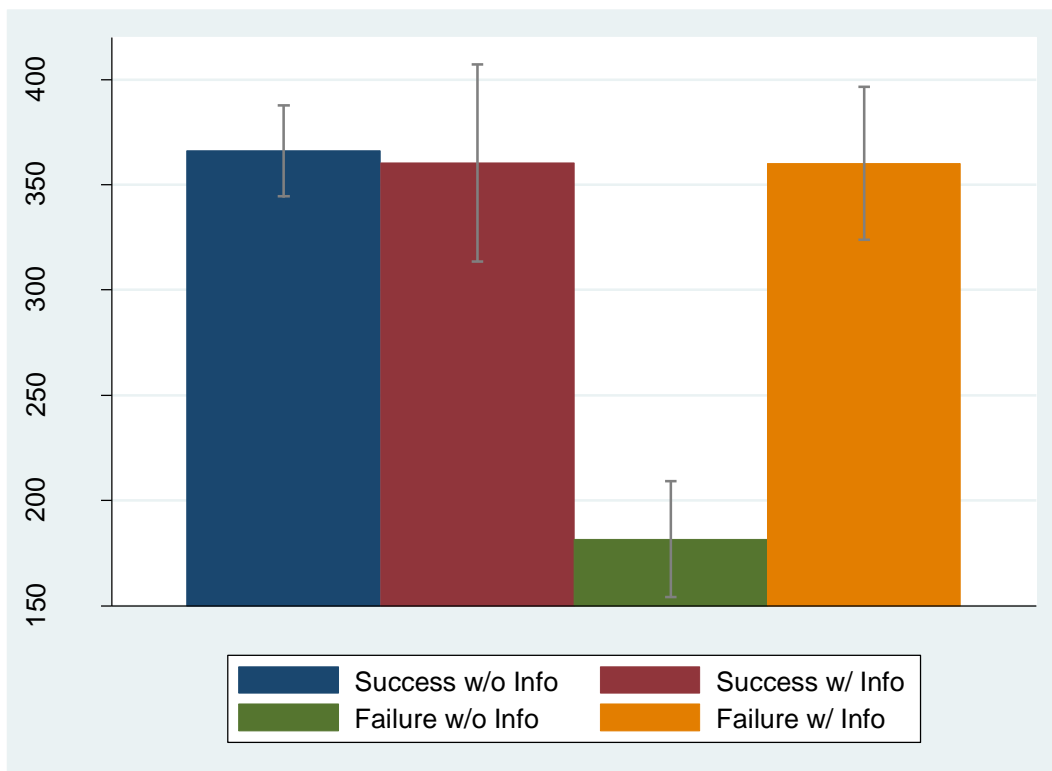


Figure 2: The effect of entrepreneurial experience on Amount Invested



In order to test Hypotheses 1a and 1b, we look at the coefficient β_F . For each dependent variable, a negative coefficient would lend support to Hypothesis 1 since “Success without info about skill” is the benchmark. As Table 6 shows, failure without any signal of skill has a negative effect both on the extensive and intensive margin. For the extensive margin, the negative coefficient becomes significant once we balance the samples by using controls. Investors give a lower average score ranging between 0.24 and 0.34, which is less 10% of the baseline. For the intensive margin, the coefficient is consistently negative and significant. Investors would apply a discount between £ 177 and £ 185, which is around 60% and 62% of the baseline. Figures 1 and 2, which report the predicted value for each condition show the differential size of impact respectively on the extensive and intensive margin. These results lend support Hypothesis 1a—after controlling for the unbalance—and Hypothesis 1b, see also Table 7.

To test Hypotheses 2a and 2b, that a signal of skill reduces the discount of failure, we compare coefficients β_F and β_{FS} . Meeting the condition $\beta_{FS} - \beta_F > 0$ would lend support to Hypothesis 2 for each dependent variable. In Table 6, we observe that the coefficient β_{FS} is not significant compared to the baseline condition of past success without information about skill. Since the coefficient β_F is negative and significant across specifications, there is qualitative evidence supporting Hypothesis 2a and Hypothesis 2b. Table 7 formalizes the comparison. We compare coefficients using a Wald test and find partial support to Hypothesis 2a (test would be significant with one tailed test) and support to Hypothesis 2b.

Table 6 provides directional evidence supporting Hypotheses 3a and 3b, i.e., the positive effect of a signal of skill is higher given past failure experience (due to bad luck) than past successful experience: $\beta_{FS} - \beta_F > \beta_{SS}$. The additional signal of skill reduces the discount due to past failure, turning the effect of condition β_{FS} not significant. However, the coefficient β_{SS} is not significantly different from the baseline. The additional signal of skill does not add any premium to past success.

In Table 7, we compare the differences formally. The evidence is less strong than for the other hypotheses, but it is significant (with one-tailed test) after controlling for imbalance: we found partial support to Hypothesis 3a and Hypothesis 3b.

The evidence from Hypothesis 3 is interesting as it is in line with our assumption. Earlier, we assumed that success requires both skill and luck. The insignificance of condition β_{SS} suggests that investors do not perceive that success can take place due to good luck only. If this were so, additional information about skill would be beneficial. Indeed, the coefficient β_{SS} in the first three columns of the upper panel of Table 7 is insignificantly different from the baseline case of previous success with no signal of skill. This implies that investors attach no value at all to the signal of skill in the case of business success.

Finally, we test the Failure Bias hypothesis, i.e., $\beta_{FS} - \beta_{SS} < 0$. When past failure is due to bad luck and information about skill is available, a discount of failure compared to success suggests disutility in dealing with “failed” entrepreneurs. The results from Table 6 compare the two coefficients β_{FS} and β_{SS} : both are not significantly different from the baseline condition of past success with no information. In Table 7 we test and find no difference between the two coefficients, i.e., when information about skill is available, the “failed” label carries no discount. We do not find support for Hypotheses 4a and 4b.

Additional Analysis

In this section, we perform additional analyses to check the robustness of our results. First, we identify two possible mechanisms underlying our results by estimating two alternative specifications. Second, we include the investors we screened out using the perception rather than the treatment as explanatory variable. Table 8 reports the formal testing of our four hypotheses as in Table 7, but using the three

alternative specifications.²² Third, we compound the extensive and the intensive margin in a composite variable that proxies for the expected investment amount. We report the formal testing of the hypotheses in Table 9, with the underlying regression Table A2 in the Appendix. Finally, we study whether the investors changed their behavior due to their perception about the team rather than other factors like the startup or the market. The results are shown in Table 10, and the underlying regressions in Table A3.

A first alternative mechanism that drives the result that failure due to bad luck is not punished (when there is a signal of skill) is compassion. Investors could feel compassionated about the exogenous failure and give entrepreneurs a second chance. This behavior could especially make sense in a setting where sense of community plays a role for investors (Butticé et al. 2017). If compassion drives the results, once controlling for it, the effect of the signal of skill should be null for past failure.

We did not measure investors' compassion, but we can control for one of its manifestations, charitable giving. If an individual shows no compassion, they are unlikely to donate any money. We have information about the investors' charitable giving twelve months before filing the pre-screening questionnaire. We use as a proxy of "compassionate" investor a dummy that takes the value of one if the investor donated any money in the past 12 months, and zero otherwise. In Models wr.1 and sr.1 in Table 8, we test the Hypotheses from a supplementary specification controlling for whether the investor donated any money in the last 12 months. The results for our experimental conditions do not change substantially. Hypothesis 1a and Hypothesis 1b are significant with one-tailed test and compassion does not seem a strong driver.

A second potential mechanism is similarity bias. Unobserved heterogeneity in raters' experiences could be the driver of our results – this concern is particularly salient in the case of attrition

²² The underlying regression table can be found as Appendix Table A1.

in education variables. If this were the case, we would observe our coefficients lose size and significance after controlling for similarity. Past literature showed presence of this bias among venture capitalists in terms of functional and industry background (Franke et al. 2006).

In order to take this into account, we create a set of four dummy variables, two controlling for the team and two for the industry. One variable takes on the value one if the investor has the same study background as one of the founders (business administration or computer science) and zero otherwise. Another variable indicates if the team characteristics (rather than industry or business idea) drove the investment decision. Together, these two dummy variables should control for the similarity between investors and teams in their functional background. We further create one dummy variable that takes the value of one if the industry experience of the investor matches the industry of the projects and zero otherwise. Also, we controlled for whether the investor's decision was driven by industry consideration (opposed to team or business idea). We use this set of dummy variables as an indicator of the similarity between investors and the industry of the investment proposal. We do not find evidence of similarity bias (see Table A1 of the Appendix). However, Table 8 shows that controlling for it does not affect the results in support of our hypotheses.

Other than concerns over omitted variables, we investigate whether investors' perceptions are driving the results by using perceived instead of actual treatments as alternative explanatory variables. For example, investors may label a sale for £ 500,000 is a failure, while the startup running out of business due to unexpected events was a success.

While we cannot perfectly take this into account, we can approximate this by using the response to the attention check about the outcome of the past venture rather than our treatment. By incorporating the people who failed the attention test, the sample increases to 311 respondents. The size of the coefficients of interest does not change substantially, but the estimates are more precise,

probably due to the larger sample (see model wr.3 and sr.3 of Table A1 in the Appendix). Table 8 shows overall support for our earlier findings using the perceived rather than the actual treatments. Investors' perception turns out to be an important explanation of the discount of failure. This adds credibility to the findings and the robustness of our results.

Table 8. Additional Analyses: Hypotheses Testing

	<i>Willingness to Invest</i>			<i>Amount Invested</i>		
	(wr.1)	(wr.2)	(wr.3)	(sr.1)	(sr.2)	(sr.3)
	Compassion	Similarity	Perception	Compassion	Similarity	Perception
H1: $\beta_F < 0$						
F statistic	3.79	3.18	9.53	4.43	3.80	9.70
<i>P value (two tailed)</i>	0.053	0.076	0.002	0.036	0.052	0.002
H2: $\beta_{FS} - \beta_F > 0$						
Wald statistic	2.29	2.27	5.75	3.27	3.04	6.91
<i>P value (two tailed)</i>	0.132	0.111	0.017	0.072	0.083	0.009
H3: $\beta_{FS} - \beta_F - \beta_{SS} > 0$						
Wald statistic	2.21	2.22	3.34	1.62	1.42	1.20
<i>P value (two tailed)</i>	0.139	0.138	0.068	0.205	0.235	0.275
H4: $\beta_{FS} - \beta_{SS} < 0$						
Wald statistic	0.09	0.18	0.07	0.08	0.06	0.04
<i>P value (two tailed)</i>	0.764	0.672	0.795	0.779	0.808	0.852

Another concern related to the analysis is the use of two different measures. In a further additional analysis, we aggregate the extensive and intensive margins into a composite measure by multiplying the amount invested by the Likert scale, rescaled in a way that a score of 5 equals 100% probability of investment. This should approximate the expected invested amount.

We reran all the analysis so far (see Table A3 in the Appendix) using the composite index and report the results of the hypothesis testing in Table 9. Using the composite index, the results are substantially the same through the main and the additional analyses. The statistical significance of the results is even stronger. For Hypotheses 1 and 2, there is support also in the baseline specification, without the balancing controls. For Hypothesis 3, there is support in almost all the specifications considering a one-tailed test.

Table 9. Composite Index: Expected Invested Amount. Hypotheses Testing

	<i>Expected Investment Amount</i>				
	(c.1)	(c.2)	(c.3)	(c.4)	(c.5)
	Baseline	Balancing Controls	Compassion	Similarity	Perception
H1: $\beta_F < 0$					
F statistic	6.78	4.78	4.96	4.53	11.84
<i>P value (two tailed)</i>	0.010	0.030	0.027	0.039	0.001
H2: $\beta_{FS} - \beta_F > 0$					
Wald statistic	5.32	4.28	4.22	3.82	8.41
<i>P value (two tailed)</i>	0.022	0.040	0.041	0.052	0.004
H3: $\beta_{FS} - \beta_F - \beta_{SS} > 0$					
Wald statistic	1.30	3.04	2.90	2.56	2.02
<i>P value (two tailed)</i>	0.256	0.083	0.090	0.111	0.156
H4: $\beta_{FS} - \beta_{SS} < 0$					
Wald statistic	0.00	0.56	0.49	0.40	0.01
<i>P value (two tailed)</i>	0.949	0.457	0.484	0.526	0.940

Finally, we address the concern that the effects of the treatments on the investment behavior are related to the perception of the skills of the entrepreneurs. In order to test for the similarity bias, we used a variable measuring for whether the reason for investing was the market, the startup, or the team. In the experiment, investors had to rank the driver of their investment decision. We use each variable to compose an index ranging from 1 to 6 measuring each of the constructs to be the drivers of the investment decision.

For each construct, we replicated the first two specifications of the main analysis, the baseline specification and the one including the balancing controls (see table A4 in the Appendix). The results show that the treatments have no effects for the Market and the Startup Driver indices, but they show a similar pattern for what concerns the Team Driver Index. Investors change their investment behavior by giving more salience to the team. Interestingly, there is strong support to Hypothesis 3 when considering the Team Driver Index.

Table 10. Additional Analysis of Drivers of Investment: Hypotheses Testing

	<i>Market Driver Index</i>		<i>Startup Driver Index</i>		<i>Team Driver Index</i>	
	(mkt.1)	(mkt.2)	(startup.1)	(startup.2)	(team.1)	(team.2)
H1: $\beta_F < 0$						
F statistic	0.09	1.37	0.24	1.56	14.96	15.80
<i>P value (two tailed)</i>	0.768	0.242	0.627	0.213	0.000	0.000
H2: $\beta_{FS} - \beta_F > 0$						
Wald statistic	0.01	0.59	0.62	1.69	3.65	4.70
<i>P value (two tailed)</i>	0.927	0.444	0.432	0.195	0.058	0.031
H3: $\beta_{FS} - \beta_F - \beta_{SS} > 0$						
Wald statistic	0.19	1.65	0.17	1.40	5.09	7.44
<i>P value (two tailed)</i>	0.662	0.200	0.681	0.237	0.025	0.007
H4: $\beta_{FS} - \beta_{SS} < 0$						
Wald statistic	0.11	0.58	0.03	0.34	0.01	0.30
<i>P value (two tailed)</i>	0.742	0.449	0.860	0.558	0.912	0.585

Overall, discount of failure seems to originate from ambiguity over the founder’s skill (Hypotheses 1a and 1b). Information about founders’ skill has an effect in removing the discount (Hypotheses 2a and 2b). We found also mixed support of the effect of the signal of skill to be more effective under failure than under success. This seems more likely to be the case on the extensive (Hypothesis 3a) rather than the intensive margin (Hypothesis 3b). The fact that the signal of skill has zero value with past success confirms our assumption that investors do not perceive success with good luck and poor skill as a possibility. Finally, we found no evidence of discount due to the “failed” label only (Hypotheses 4a and 4b).

DISCUSSION AND CONCLUSION

This study addresses the nature of the investors’ discount of entrepreneurs’ past failure. Failure is the most common episode of entrepreneurial life. Yet, we know little about how critical resource providers – investors – judge the founders’ past venture experience. If investors misattribute misfortunes as mistakes, this may prevent skilled yet once unlucky entrepreneurs from re-entering entrepreneurship (Eberhart et al. 2017). Accordingly, this study seeks to understand investors’ perception of failure. We have studied the consequences of failure experience for resource acquisition in an experimental study.

In our framework, we distinguish the information value of past failure against past success by incorporating luck (Liu and De Rond 2016). From the assumption that success requires both luck and skill (Frank 2016) while failure can result from a misfortune (bad luck) or a mistake (lack of skill), we theorize and test that past failure conveys a noisier signal of skill vis-à-vis past success. Based on this intuition, we develop four testable hypotheses. We find empirical support for our hypotheses through a “framed online field” experiment (Harrison and List 2004).

The experiment uses the setting of equity crowdfunding in the UK because it maximizes tractability and generalizability at the same time. When investors observe an additional signal of skill, investors change their investment decision. We also find that investors do not have a failure bias, i.e., they do not invest less in a venture led by an entrepreneur who failed (due to bad luck) against a past successful entrepreneur, once there is additional information about their skill.

Our study aims to contribute to the literature we surveyed in three different ways. First, we shed light on the investors’ assessment of a negative piece of information like business failure. Departing from existing studies that assumed failure signals symmetrically low levels of skill (Eisenhardt and Schoonhoven 1990, Hochberg et al. 2014), we claim that the information about skill failure conveys is noisier than success (see also Pfarrer et al. 2010). Consistently with earlier literature we show that past failure leads to a discount, but we when entrepreneurs provide information about skill, it does not differ from past success. Failure can represent a negative but complementary signal for resource acquisition (see also Bapna 2017).

Second, luck is a relevant construct in our framework to make a distinction between the informational value of past failure vis-à-vis past success. Luck is a necessary but not sufficient condition for success and it is the discriminant for failure’s ambiguity about skill. It could still be the case some entrepreneurs with high skills failed due to bad luck. We provide a mindful theoretical framework and a

careful empirical assessment of a topic often overlooked in the literature (Frank 2016, Liu and De Rond 2016).

Finally, we would like to contribute to studies about crowdfunding. Despite the notion that early stage investors invest both with cognition and emotion (Huang 2017), we find evidence of no failure bias. Similarly to professional investors (Cope et al. 2004), our “crowd” of potential equity crowdfunding investors recognizes that failure may take place due to sheer bad luck only and do not discount it²³. This may alleviate the concerns over crowdfunding investors as uninformed as finance literature pointed out (Chemmanur and Fulgheri 2013).

Our study has some relevant boundary conditions. First, it may be that investors do not discount the “failed” label only because we study small startups at the seed stage, which only involves the entrepreneur and investors. There might be cases where the failure bias bites harder due to layoffs, losses for pension funds, and other type of damages to stakeholders and society in general. This speculation would reconcile our results with findings about lower quality of stakeholders for entrepreneurs who experienced bankruptcy (Sutton and Callahan 1987). We expect, though, that failure due to a misfortune becomes progressively less likely at later stages when the firm grows. Future research could look at investors’ evaluation of ventures at later stages.

Second, our experiment tests for investors’ evaluation of the second attempt of an entrepreneur. It may be that investors make different decisions depending on the degree of the founders’ persistence in terms of number of attempts (see for example Fontana et al. 2016) or length of the spell (Parker 2013). Longer spells could make the information about skill stronger, while higher failure frequency makes the inference about skill from failure more reliable as consecutive misfortunes,

²³ <https://about.crunchbase.com/news/heres-likely-startup-get-acquired-stage/>

failures due to bad luck, are less likely. Further research could investigate differential effects based on the spell of past entrepreneurship or the number of earlier attempts.

Third, the study focuses on UK equity crowdfunding investors. Outside online platforms, business angels and venture capitalists analyze more information about skill to make their investment decision (Hallen and Pahnke 2016). It could be possible that the larger the order of magnitude of the investment, the larger is the amount of information investors require to trump the ambiguity over skill past failure casts. Moreover, our results are based on a country that is less failure tolerant compared to, for example, the United States (Cope et al. 2004). We speculate that a replication in the United States would result into a lower discount due to ambiguity and no behavioral discount of failure. Consequently, investors would require less information about skill to overturn the discount due to failure. All in all, we suggest that these results represent a conservative estimate of the “true” discount investors assign to failed entrepreneurs.

Finally, our information about skill is far from being a signal in the Spence (1973) sense. Our operationalization was not costly and easy to imitate. Referring to a “double digit” growth is ambiguous: it could range from 10% to 99%; moreover, growing from \$1 to \$2 sales is a triple digit growth. We expect that with a proper signal of skill the result would be stronger.

Our results have implications for both entrepreneurs and platform owners. At the seed stage, entrepreneurs may choose to be less reluctant about disclosing past failure. Past failure disclosure should be accompanied by an adequate signal of skill. We obtained our results using a rather weak signal of skill and we expect larger effects with stronger signals. The discussion as to whether and how to reveal previous failure experience to investors is an actual one among entrepreneurs. In an interview, Matthew Cain, author of the book “Made to Fail – 13 Surprising Start-up Lessons”, discusses how to

report business failure and suggests²⁴: “A start-up failure can be an interesting conversation with the right person. But it isn’t necessarily. Because failing doesn’t necessarily teach you anything. You’ll have to persuade the recruiter of what you learnt – and that it’s valuable for their business”. The advice recommends that failure disclosure needs to occur in a conversation and that some additional information needs to co-occur.

This study may offer insights to equity crowdfunding platforms. The way to mitigate the cost of failure is to provide opportunities for less noisy signals that contribute to reduction of information asymmetries. Platforms can improve the design and the options for interaction between investors and founders on the platform. Platforms should allow for certified skill signals from founders or “safe spaces” where disclosing past failure may increase the investment opportunities for the entrepreneur.

We showed that ambiguity about skill is the main driver of discount of past failure. All in all, conditional on more information about skill, founding teams run by entrepreneurs who failed in the past can carry their past failures as a badge of honor rather than a scarlet letter.

²⁴ <http://www.ukstartupjobs.com/career-advice/mention-failed-startup-cv/>

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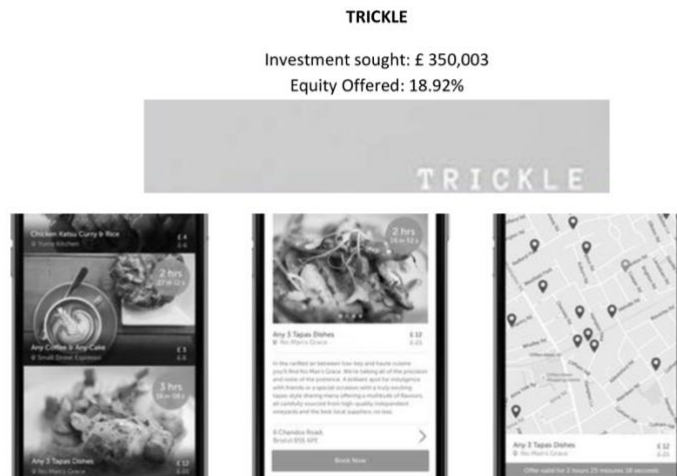
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APPENDIX

Figure A1. Example of Business Idea (page 1 of 4)



Introduction

Trickle is monetising a huge and largely untapped market within the restaurant, bar and cafe sector - with a revolutionary approach to efficiency and discounting - by repackaging empty tables and surplus stock from quality businesses as exciting, time-sensitive opportunities for thousands of potential local customers.


It's simple - local businesses reduce the price of their products to reach Trickle customers, who make cut-price last-moment purchases over Trickle in a couple of taps. These customers are provided with location and time-relevant offers from businesses tailored to their preferences - through a variety of channels.

Having proved our market with 440 local businesses signed up across Liverpool and London, and 35,000 downloads, Trickle is now preparing its technology for scalable-launch across the UK. The opportunity is for Trickle to be the comprehensive platform for local businesses to fill capacity, market themselves and get bums on seats.

Figure A2. Example of Team

TEAM

Ellis Turner



Experience

Co-founder and CEO – Trickle, from January 2014 until present


Co-founder and CEO – OtherDining, from February 2011 until December 2013

Senior Analyst – Accenture, from January 2009 until January 2011

Education

University of Liverpool, BA, Business Management – from 2006 to 2009

Abraham Philips



Co-founder and COO – Trickle, from January 2014 until present

Co-founder and COO – OtherDining, from February 2011 until December 2013

IT manager – Tesco, from January 2009 until January 2011

Education

University of Liverpool, BSc, Software Development– from 2004 to 2008

Figure A3. Example of Q&A (Success with no Signal of Skill)

Q&A

Investor 1 asked:
How do you plan to expand your employees base?

Ellis replied:

I appreciate this question. At this stage, we are investing in a solid sales force that can reach and deal with restaurants; part of the proceedings will go in that direction. In the future, we plan to involve data scientists for the analytics part of our business model.

Investor 2 asked:
What happened to your early startup?

Ellis replied:

- Failure
- Success

Thanks for your question. I learned a lot from my past experience with OtherDining. The startup was successfully sold for £ 500,000.

Investor 3 asked:
How will you react in case other players are copying the business model?

Ellis replied:

Thanks for pointing this out. We are offering restaurants special conditions in exchange of exclusive contracts for this specific business model. We also plan to develop loyalty programs to avoid multi-homing. Eventually, selling our business to a larger player like Tripadvisor may be an interesting exit strategy.

Investor 4 asked:
Will you ever develop a version compatible with Google and Windows-powered devices?

Ellis replied:

Thanks for your interest in Trickle and your question about the future of our product. At the moment, rather than designing a browser version, and an Android and a Windows mobile one, we will design the browser version of our app in order to be responsive to a mobile environment.

Appendix Table A1. Additional Analyses.

	<i>Willingness to Invest</i>			<i>Amount Invested</i>		
	(wr.1)	(wr.2)	(wr.3)	(sr.1)	(sr.2)	(sr.3)
	Compassion	Similarity	Perception	Compassion	Similarity	Perception
<i>Past Startup Outcome</i>						
β_F Fail no Signal	-0.375*	-0.327+	-0.392**	-166.4*	-158.5+	-183.7**
	(0.184)	(0.183)	(0.127)	(79.02)	(81.26)	(58.97)
β_{FS} Fail w/ Signal	-0.002	-0.003	-0.006	14.65	15.11	26.93
	(0.196)	(0.184)	(0.141)	(109.5)	(105.7)	(84.09)
β_{SS} Success w/ Signal	-0.040	-0.106	-0.060	-26.18	-19.28	51.80
	(0.205)	(0.213)	(0.185)	(123.0)	(128.7)	(121.6)
Charity donor	0.288			114.7		
	(0.415)			(161.0)		
Missing Charity	0.263			121.3		
	(0.440)			(151.2)		
Same functional background		0.118			140.9	
		(0.157)			(91.80)	
Same industry background		-0.206			-87.32	
		(0.244)			(100.6)	
Missing functional background		0.118			-228.4+	
		(0.157)			(135.4)	
Missing industry background		-0.059			-114.7	
		(0.179)			(72.1)	
Team drives investment		0.184			134.4	
		(0.173)			(100.8)	
Market drives investment		0.154			-33.00	
		(0.145)			(76.10)	
Constant	3.210***	3.298***	3.461***	25.92	91.33	279.6***
	(0.485)	(0.277)	(0.093)	(165.6)	(111.2)	(51.28)
Balancing Controls	Y	Y	N	Y	Y	N
R ²	0.063	0.073	0.094	0.069	0.097	0.042
N	231	231	370	231	231	370

Notes. Robust standard errors in parentheses. Willingness to invest is an ordered variable ranging from 0 to 5. Amount invested is a winsorized count variable to prevent noise from outliers (upper bound 5%) count variable. Baseline for “Past Startup Outcome” is “Success no Signal.” Balancing controls are: “ever invested in donation crowdfunding,” “ever invested in reward crowdfunding,” “ever invested in equity crowdfunding,” “college education or higher,” “owns housing solution,” and “foreign investor.” Significance levels: + $p < 0.1$ * $p < 0.05$ ** $p < 0.01$ *** $p < 0.001$.

Appendix Table A2. Effect of Failure on Composite DV: Expected Invested Amount

	<i>Expected Invested Amount</i>				
	(c.1)	(c.2)	(c.3)	(c.4)	(c.5)
	Baseline	Balancing Controls	Compassion Controls	Simil. Bias Controls	Perception
Higher quality project	143.3* (61.59)	103.1 (64.15)	102.6 (64.67)	121.7+ (64.25)	143.3* (61.59)
<i>Past Startup Outcome</i>					
β_F Fail no Signal	-168.4** (64.68)	-150.7* (68.97)	-153.2* (68.80)	-149.2* (71.69)	-168.4** (64.68)
β_{FS} Fail w/ Signal	27.58 (92.66)	38.68 (102.5)	35.28 (102.3)	28.30 (97.98)	27.58 (92.66)
β_{SS} Success w/ Signal	35.59 (112.4)	-54.07 (100.9)	-52.91 (101.8)	-49.72 (106.7)	35.59 (112.4)
Balancing Controls	N	Y	Y	Y	N
Compassion Controls	N	N	Y	N	N
Similarity Controls	N	N	N	Y	N
Adjusted R ²	0.029	0.031	0.024	0.041	0.029
N	246	231	231	231	246

Appendix Table A3. Additional Analysis of Drivers of Investment

	<i>Market Driver Index</i>		<i>Startup Driver Index</i>		<i>Team Driver Index</i>	
	(mkt.1)	(mkt.2)	(startup.1)	(startup.2)	(team.1)	(team.2)
	Baseline	Balancing Controls	Baseline	Balancing Controls	Baseline	Balancing Controls
Higher quality project	0.760** (0.240)	0.537* (0.242)	0.773*** (0.225)	0.694** (0.230)	0.576*** (0.162)	0.518** (0.166)
<i>Past Startup Outcome</i>						
β_F Fail no Signal	-0.087 (0.296)	-0.351 (0.300)	-0.131 (0.269)	-0.349 (0.280)	-0.768*** (0.199)	-0.851*** (0.214)
β_{FS} Fail w/ Signal	-0.056 (0.327)	-0.094 (0.326)	0.127 (0.310)	0.076 (0.310)	-0.332 (0.217)	-0.331 (0.233)
β_{SS} Success w/ Signal	-0.201 (0.406)	-0.434 (0.405)	0.053 (0.378)	-0.173 (0.380)	-0.365 (0.272)	-0.506+ (0.283)
Adjusted R ²	0.025	0.084	0.032	0.073	0.084	0.080
N	246	233	246	233	246	233

Chapter 4. RECRUITING TALENT FOR EARLY-STAGE VENTURES: AN ONLINE EXPERIMENT ON STARTUP JOB ADS

Abstract

Early employees, labeled “joiners”, are an important resource for business success and their recruitment is a critical task for startups. Compared to incumbents, startups have more difficulty to recruit employees due to a lack of cognitive legitimacy and reputation, and often use rhetorical strategies. The literature studying the processes attracting joiners to startups assumed perfect information between founders and joiners, and overlooked the role of startup’s information. We argue that startups can convey two types of messages. Substantive messages work like signals of quality and convey distinctiveness. Ceremonial messages work like symbols and convey membership. We further theorize that these messages have different impacts on joiners with different levels of human capital and risk propensity. We test our predictions using an online framed field experiment. We recruit 160 American respondents who are randomly assigned to a manipulated job ad following a 2x2 design. One treatment is a substantive message against a neutral message and another treatment is a ceremonial message against a different neutral message. Our results partially support our hypotheses and show that substantive and ceremonial messages are different and have differential effects on different types of joiners. We further discuss implications for startups’ recruitment strategies.

INTRODUCTION

The early human capital of startups, labeled “joiners,” is a crucial factor for their success (Castanias and Helfat 1991, Williamson 2000). However, startups have difficulties in hiring beyond the founders’ personal network (Williamson et al. 2002). During the recruitment process, startups face two main challenges compared to established firms. Because of the fundamental ambiguity surrounding startups, potential employees have a hard time to comprehend the startup and assess its quality. Compared to an established firm, the startup lacks of cognitive legitimacy and reputation, and potential employees are less likely to join (Stinchcombe 1965, Aldrich and Fiol 1994). Another challenge for startups is mismatches. Individuals with low human capital and/or low risk propensity may join a startup as a second-best option and leave soon for another job (Sauermann 2017). Compared to established firms, it is more likely to observe mismatches in startups (Roach and Sauermann 2017). Because of these two challenges, it is important for startups: (1) to be able to access a large pool of applicants and (2) to be able to select the fittest to the job, e.g. those with high levels of human capital and those with high risk propensity. In this paper, our research question is the following: “can startup use different types of information to attract different types of joiners?”

Studies in the literature about joiners assume perfect information between them and the founders (see, e.g., Honore and Ganco 2016), and usually investigated realized transactions (Ouimet and Zarutskie 2014, Burton et al. 2017). We identify and address two specific issues in the literature. First, startups have been found to traditionally rely on a vast array of rhetorical tools such as narratives (Lounsbury and Glynn 2001), symbols (Zott and Huy 2007), and labels (Granqvist et al. 2013) to gather resources. This means that startups can strategically convey information in order to attract human capital. Second, due to the risk of mismatch, earlier studies focused mostly on the realized match and

overlooked the process of attraction between the startup and the joiner. Overall, we know little about the relationship between startup information and joiners' tendency to apply for a startup job.

We address this gap by investigating which piece of information attracts joiners to a specific startup. We answer our research question by bringing insights from resource acquisition and the literature about joiners. The resource acquisition literature informs us about the relevance of information revealing to attract resources²⁵—financial in most cases (Stuart et al. 1999). The literature about joiners allows us to test and verify whether specific messages are effective for joiners and for which type of joiners, dependent on human capital and risk propensity.

We draw from resource acquisition literature the basis for our classification. We identify two messages, which can be either “substantive or “ceremonial” (Kirsch et al. 2009). Substantive messages convey distinctiveness by signaling quality. Quality signals help reputation transfer and make the startup more attractive. Notable examples are intellectual property (Hsu and Ziedonis 2013), human capital (Chatterji 2009), or inter-organizational endorsement (Stuart et al. 1999). Ceremonial messages convey membership to a certain category. Stronger membership to a certain category makes the understanding of the nature of the startup easier, and increases the cognitive legitimacy. As a result, the startup will be more attractive. Notable examples are symbols (Zott and Huy 2007), labels (Granqvist et al. 2013), and narratives (Martens et al. 2007). We hypothesize that the two different messages attract more joiners.

Drawing from literature about joiners, we theorize differential effects of these two types of messages based on their human capital and risk propensity (Roach and Sauermann 2015, Sauermann 2017). We theorize that substantive messages are more effective for individuals with higher levels of

²⁵ The economics of advertising (Bagwell 2007) offers similar views on the nature of the advertisement messages. Messages can be either informative (they give information about the quality of the product) or complementary (they give information about the symbolic “complementary” values of the product).

human capital but lower levels of risk propensity. On the contrary, ceremonial messages are more effective for individuals with lower levels of human capital but higher levels of risk propensity.

We test for heterogeneous effects of types of information using a framed online experiment. The scenario-based nature of the experiment allows us to collect information about risk propensity that would be harder to retrieve in a regular field experiment. Respondents are 160 residents in the United States looking for new employment opportunities. Each respondent evaluates a job ad where we randomize the type of information startups convey. We design a 2x2 between-subjects experiment where we manipulate a job ad with two treatments. One treatment group is the presence of a substantive message as inter-organizational endorsements, and the control group is the presence of a neutral sentence. The other treatment group is the presence of ceremonial messages as labeling strategy around the “disruptive” label, common in the startup world; and the control group is the presence of another neutral sentence. Respondents express their interest in the job ad reporting the job attractiveness, and their probability to accept and the indifference salary to join that startup compared to a competing similar offer from an established firm.

In line with our expectations, we find that substantive messages increase the attractiveness of a startup. Contrary to our expectations, we find that substantive messages do not attract individuals with high human capital, and they are more effective on individuals with high risk propensity. As for ceremonial messages we find at least partial evidence in the direction of our hypotheses: ceremonial messages discourage individuals with high human capital and attract individuals with higher risk propensity.

Our study contributes to the extant literature on joiners in three ways. First, this study pioneers the relationship between joiners and startup’s information. It is important for startups to understand which specific information they should highlight to attract specific joiners. Second, to the best of our

knowledge, the study represents an early experimental contribution to the above mentioned field. This experimental study relaxes assumptions about perfect information between joiners and founders of archival studies, allowing for strategic use of information (Ganco and Honore 2016). Finally, the study extends the literature about information and resource acquisition (Kirsch et al. 2009) looking at a different type of resource, labor.

The next section summarizes the reasoning behind the formulation of the hypotheses; the third section describes the design of the experiment; the fourth section presents the results; and the fifth section discusses the results and concludes.

THEORETICAL BACKGROUND

Joiners and Startup Information

The role of human capital as source of competitive advantage is well-established in the management literature (Ryners and Barbers 1990, Castanias and Helfat 1991). In startups, resources are limited and the contribution of joiners to performance is even larger. Despite this relevance, research has only recently started to investigate joiners along two streams.

One stream of this relatively recent literature focuses on the workplace. Ouimet and Zarutskie (2014) study the characteristics of employees joining firms that are both young and small. Burton et al. (2017) search for systematic differences within jobs' characteristics: given identical stocks of human capital and compared to incumbents, small firms pay less but young firms pay more. Kim (2017) addresses the issue further by surveying MIT graduates. He finds a wage premium for individuals working for VC-backed startups, suggesting that the latter can attract better human capital.

Another stream of literature focuses on individuals and tried to assess the systematic differences between joiners and both entrepreneurs and other employees. Joiners have different motives, trait-like characteristics, than employees of established firms (Roach and Sauermann 2015). Another important

trait where joiners differ systematically is risk propensity, which contributes to explain the differential performance of startup employees (Sauermann 2017).

Overall, these studies highlight the importance of understanding the mechanisms behind the attraction between startup and joiners (Chen 2013, Honore and Ganco 2016). They often rely on the assumption about perfect information between founders and joiners, which becomes particular restrictive when attraction and recruitment of human capital happens beyond the social network of the founders (Williamson et al. 2002). In this study, we release this assumption, which allows us to theorize that founders have discretion over selectively releasing information and there is room for agency in the attraction and recruitment of joiners.

Startup hiring and Information Asymmetry

The extant literature has focused on recruitment practices in large and medium firms, thus not taking into account that young and small firms could have or require different practices (Williamson 2000, Williamson et al. 2002, Cardon and Stevens 2004). Startups are affected by the liability of newness (Stinchcombe 1965), which implies that stakeholders have a hard time to comprehend their nature and their quality. Because of lack of resources and track records, startups employ rhetorical strategies such as narratives (Garud et al. 2014), category labels (Granqvist et al. 2013), and symbolic action (Zott and Huy 2007). The goal of these approaches is to frame “the unknown in such a way it becomes believable” (Aldrich and Fiol 1994), thus conveying a mix of distinctiveness and membership (Lounsbury and Glynn 2001). Fundamentally, startups reveal information selectively and strategically reveal different messages (Aldrich and Fiol 1994, Kirsch et al. 2009). We argue that startups can either convey messages about their quality or they can stress their membership.

Substantive messages convey distinctiveness through high quality of the startup, irrespective of its membership. Notable examples in resource acquisition literature are interorganizational endorsements

(Stuart et al. 1999) and intellectual property (Hsu and Ziedonis 2013). Such messages are costly and higher for low quality startups than for high quality startups. Through endorsements, stakeholders can infer the quality of the startup because they assume that an established third party evaluated the benefits and costs of interacting with the startup, which is more likely to be positive for high than low quality startups (Stuart et al. 1999). Another example of information with high cue validity due to monetary and non-monetary costs are patents. A patent costs \$ 35,000 on average and it involves the opportunity cost of managing the application process. As a signal, a patent is particularly taxing for a startup (Hsu and Ziedonis 2013). Thus, a startup that patents a technology of little value would incur higher relative costs than a startup that patents a technology of high value.

Ceremonial messages convey startup's membership through cognitive legitimacy, irrespective from its quality. Such information carries a symbolic value that helps stakeholders to make sense of the nature of the startup and contributes to reducing the ambiguity surrounding it. Research has shown how firms in new industries can benefit from references to familiar understandings. Hargadon and Douglas (2001) illustrate the case of electric lighting, which got adopted also thanks to a design that anchored it to the more familiar gas lighting. Similarly, Etzion and Ferraro (2010) explain the success of sustainability reporting thanks to analogies with financial reporting. When it comes to new businesses, a certain dress code or familiar job titles increase the perception of the startup as legitimate (Zott and Huy 2007). Organizational ecology documents the importance of isomorphism, i.e., the practice of mimicking the existing legitimate players in the industry (DiMaggio and Powell 1983). Similarly, narratives about the venture and the use of category labels help stakeholders to locate the venture in the categorical space in the effort of achieving membership (Lounsbury and Glynn 2001, Santos and Eisenhardt 2009). For example, claiming membership in a category helps stakeholders overcome the discount due to lack of legitimacy and achieve superior performance (Smith and Chae 2016). This

approach can have drawbacks, as stakeholders punish more startups with high membership that fails to meet expectations (Garud et al. 2014).

We argue that resource providers are fraught with ambiguity over quality and legitimacy due to liability of newness. As a result, we draw on insights coming from resource acquisition, which studied the role of startups' and founders' information and investment, to analyze the effect of substantive and ceremonial messages on the decision to join a startup.

Substantive Messages

Founders can use information about the venture strategically to build effective narratives (Lounsbury and Glynn 2001). A strategic balance between distinctiveness and membership is salient for startups for attracting prospective employees and may lead to competitive advantage (Deephouse 1999, Williamson 2000). We argue that substantive messages contribute to strategic balance by conveying distinctiveness (Lounsbury and Glynn 2001).

Information about partnerships with established players reduces ambiguity over quality. A relationship with prominent actors increases the quality perception because it transfers reputation (Baum and Oliver 1991, Heil and Robertson 1991, Rao 1994, Rindova et al. 2005). Reputation is considered the main driver to attract potential employees (Williamson et al. 2002). At the margin, more applicants will apply to a startup of higher quality and it is perceived as more distinct.

Experts, exposed to substantive messages, tend to be quicker in the reception and the interpretation of information about the venture (Heil and Robertson 1991). In the resource acquisition literature, prospective financiers are more receptive of information about venture capital affiliation than other stakeholders, such as prospective employees (Vanacker and Forbes 2016). At the margin, when startups use substantive messages, they will attract individuals with higher levels of human capital.

Substantive messages may have a downside. Mismatches are the chief cause of startups' failure (Roach and Sauermann 2017). Sauermann (2017) highlights how risk propensity is one of the main explanations of differential performance among startup employees.

Due to the pervasive incidence of failure during the first years (Gompers et al. 2010), venture jobs are volatile. Potential employees of high tech startups perceive the security of a startup job as significantly lower than for jobs in established firms (Roach and Sauermann 2010). Startups attract employees who have higher levels of risk propensity. However, when a venture, even a startup, relies on substantive messages, stakeholders perceive the startup as more likely to survive and the marginal applicants will have lower risk propensity. All in all, we argue:

Hypothesis 1. *Substantive message – main effect.* Compared to a neutral message, individuals are more likely to apply to a startup job when they are exposed to a substantive message

Hypothesis 2. *Substantive message – interaction with human capital.* Compared to a neutral message, individuals with higher human capital are more likely to apply to a startup job when they are exposed to a substantive message

Hypothesis 3. *Substantive message – interaction with risk propensity.* Compared to a neutral message, individuals with lower risk propensity are more likely to apply to a startup job when they are exposed to a substantive message

Ceremonial Messages

We further argue that ceremonial messages contribute to strategic balance by conveying membership (Lounsbury and Glynn 2001). When a startup is just born, stakeholders have a hard time to make sense of it and thus the venture lacks cognitive legitimacy (Aldrich and Fiol 1994). Firms engage in isomorphic behaviors (DiMaggio and Powell 1983) and convey information to stakeholders in order to become meaningful (Petkova et al. 2013).

The goal of ceremonial messages differs from the goal of a substantive message: they allow stakeholders to locate the venture in the categorical space referring to the prototypical startup.

Examples of ceremonial messages are symbolic actions (Zott and Huy 2007). One example is to reproduce the formal organizational structures of larger firms. This similarity helps stakeholders perceive the startup as appropriate and to assimilate to familiar categories.

Startups can also convey cognitive legitimacy using words or phonemes like names (Smith and Chae 2016) or category labels (Pontikes 2012). Smith and Chae (2016) suggest that the use of deliberate names can mitigate the discount due to cognitive legitimacy arising from atypical organizations. Granqvist et al. (2013) provide precise theorizing about the strategic use of category labels to shape and guide stakeholders' perceptions of the firm. Ventures without the characteristics implied by a certain category can still claim membership if this facilitates access to resources. Ceremonial messages convey meaning to a startup and they may increase its cognitive legitimacy. Potential employees may understand the business idea better and they can relate it to existing understandings. With a better meaning of the boundary of the firm and its associated category, more prospective employees are likely to apply.

Intuitively, more expert individuals tend to weigh ceremonial messages less. Mollick and Nanda (2015) compare the way professional and crowdfunding investors evaluate projects seeking resources on Kickstarter. They argue that the crowd is more sensitive to more ceremonial information, such as videos, pictures, and informal language. Individuals with higher human capital endowments discount ceremonial messages because they have less needs of cognitive legitimacy. A possible mechanism is taken-for-grantedness, which makes awareness harder (Hsu and Grodal 2015). People who have been exposed to startups through education or experience know more about them and do not pay attention to ceremonial messages. On the contrary, individuals who have been rarely exposed to ceremonial messages find them more valuable. Thus, a ceremonial message alone will increase the number of employees applying, but also be more effective on individuals with lower level of human capital.

We also argue that ceremonial messages have different effect on individuals with different risk propensity. A ceremonial message conveys membership as a startup through cognitive legitimacy. Startups are typically risky: up to 78% of firms fail in their first two years (Gompers et al. 2010). By conveying membership, a ceremonial message exacerbates the uncertain nature of the job: it may deliver disproportionate rewards in case of success, but it can also fail due to sheer bad luck (Schumpeter 1942). Another channel could be the nature of the expected salary. Typical startups tend to offer a higher share of variable pay, which is by nature more uncertain (Burton et al. 2017). The promise of high rewards with high risk is more attractive to individuals that have higher risk propensity, and they are more likely to apply. This leads to the following hypotheses:

Hypothesis 4. *Ceremonial message – main effect.* Compared to a neutral message, individuals are more likely to apply to a startup job when they are exposed to a ceremonial message

Hypothesis 5. *Ceremonial message – interaction with human capital.* Compared to a neutral message, individuals with lower levels of human capital are more likely to apply to a startup job when they are exposed to a ceremonial message

Hypothesis 6. *Ceremonial message – interaction with risk propensity.* Compared to a neutral message, individuals with higher risk propensity are more likely to apply to a startup job when they are exposed to a ceremonial message

EXPERIMENT

In order to study our research question, we propose a 2x2 between subjects experimental methodology. Experiments take place in a setting where the information is controlled and we expose participants to two random treatments. The randomization in a controlled environment allows identifying the causal link between two constructs. This effect of information would be hard to study with observational data for two reasons. On the one hand, there would be selection in the information

startups provide. On the other hand, there would be unobserved heterogeneity which is hard to track outside a controlled environment, especially for those who decided not to apply.

Our online framed field experiment (Harrison and List 2004) consists in proposing likely scenarios to representative individuals. An online field experiment is a compromise between feasibility (typical of lab experiments) and generalizability (of field experiments). A lab experiment would be attractive in terms of its feasibility. As a caveat, the student population would not be representative of the entire population of applicants for a job in a startup, who may include people like former founders or employees at an established firm. A field experiment would be more generalizable. However, deception would pose a particular threat for the substantive messages and it would be hard to find suitable partners both at the platform and startup level. In the next sections, we describe the design and the procedure of our experiment.

Design and Procedure

Each respondent evaluates one job offer from a startup that offers a “competitive” salary. We purposely do not report the location to avoid it may be imbued with symbolic value (Zott and Huy 2007), for example a biotech startup located in Cambridge, Massachusetts. The job ad is for a business developer in the digital service business. This general job title is likely to be more general and attract a larger and more heterogeneous pool of joiners compared to more specific job titles, such as “full-stack developer.” We chose an industry that sounds more gender neutral compared to, e.g., videogames or fashion. In order to study differences in human capital better, the requirements for the position are broad enough to attract applicants with different education levels²⁶. We anonymize the name of the employer to avoid that respondents may know them. This is not an uncommon practice in human resources, where agencies advertise jobs hiding the name of the employer. Each manipulated job offer

²⁶ One may argue that the position requires at least college education. We reran the analysis using individuals with at least a college degree and found no different effects for job attractiveness.

consists of three sections. One about the startup, one about the job task, and the final section is about the environment and perks. We present each section in bullet points. The treatments take place in the first section of the job ad, which is about the startup.

The design is between subjects with two treatments (substantive message and ceremonial message) and two different neutral sentences as controls. We are aware that we use two different neutral sentences as controls, rather than one only to allow for an experimental condition with neither a substantive nor a ceremonial message. We use two different neutral sentences to be sure that the differential effect is due to the *nature* of the information rather than the *amount* of information. Interviews with managers of online platforms for startup jobs revealed that they found correlation between length of the job ad and the probability to apply. For this reason, we chose a control sentence with neutral value and same length in term of characters. The substantive message (or its control sentence) appears as the last bullet point and consists of one sentence. The ceremonial message (or its control sentence) appears as the first bullet point and consist of one sentence.²⁷ In Figure 1, we report an example of the job ad the respondents observe.

²⁷ We use first and last bullet points as they are more salient than the central ones, but we do not randomize their order. A following wave of the experiment can randomize the order, showing either the ceremonial or the substantive message as the first sentence of the list.

Figure 1. Example of Job ad (with Substantive and Ceremonial messages and No Substantive and No Ceremonial messages).

Business Developer

Salary: Competitive

Date: Posted yesterday

Digys

The startup

- We are a digital consulting firm serving small and medium businesses
- Thanks to our proprietary algorithms, we sustain our clients' growth
- We seize the new openings in the digital service business
- We are aiming to ally with the world's technology leaders

The position

- Arrange business meetings with prospective clients
- Conduct research to identify new markets and customer needs
- Build long-term relationships with new and existing customers
- Work with passion in the digital service business

The perks

- Learn up to 5x faster in a startup
- Flexible working
- Share options

Business Developer

Salary: Competitive

Date: Posted yesterday

Digys

The startup

- We want to bring disruption in the digital service business
- Thanks to our proprietary algorithms, we sustain our clients' growth
- We seize the new openings in the digital service business
- We have perfected an alliance deal with Google and Facebook

The position

- Arrange business meetings with prospective clients
- Conduct research to identify new markets and customer needs
- Build long-term relationships with new and existing customers
- Work with passion in the digital service business

The perks

- Learn up to 5x faster in a startup
- Flexible working
- Share options

In Table 1, we report the four manipulations. For the substantive message, we use a sentence about interorganizational endorsement (Stuart et al. 1999): “We have perfected an alliance deal with Google and Facebook.” For the control, we use the following neutral sentence: “We are aiming to ally with the world’s technology leaders.” Alliances are a generally desirable feature of a company that does not relate to a “startup” identity²⁸. For the ceremonial message, we use a sentence about labeling and narratives (Lounsbury and Glynn 2001, Granqvist et al. 2013): “We want to bring disruption in the digital service business.” Disruption is very much present in the startup discourse, and it conveys the typical features of a startup that aspires to be high growth. As a control, we use the following neutral sentence: “We are a digital consulting firm serving small and medium businesses.”

Table 1. Overview of Treatments

	Substantive	Neutral 2
Ceremonial	<ul style="list-style-type: none"> • We want to bring disruption in the digital service business • Thanks to our proprietary algorithms, we sustain our clients’ growth • We seize the new openings in the digital service business • We have perfected an alliance deal with Google and Facebook <p>N=42</p>	<ul style="list-style-type: none"> • We want to bring disruption in the digital service business • Thanks to our proprietary algorithms, we sustain our clients’ growth • We seize the new openings in the digital service business • We are aiming to ally with the world’s technology leaders <p>N=38</p>
Neutral 1	<ul style="list-style-type: none"> • We are a digital consulting firm serving small and medium businesses • Thanks to our proprietary algorithms, we sustain our clients’ growth • We seize the new openings in the digital service business • We have perfected an alliance deal with Google and Facebook <p>N=42</p>	<ul style="list-style-type: none"> • We are a digital consulting firm serving small and medium businesses • Thanks to our proprietary algorithms, we sustain our clients’ growth • We seize the new openings in the digital service business • We are aiming to ally with the world’s technology leaders <p>N=38</p>

²⁸ It is true that if startup benefits disproportionately from alliances and this message can be seen as ceremonial. We exploit this design issue in the Appendix. We reran the analysis with the alternative interpretation of contrasting a ceremonial versus a substantive message and results are overall consistent with the findings of the main analysis.

We pre-screen 200 people on Prolific, a job market platform specialized in scholarly studies (Peer et al. 2017). Our goal is to select a pool of people who are “at risk” of applying to a startup job. The screening question is: “Have you ever considered a career move as a (paid) employee in a startup?”

Respondents are then introduced to the job ad as follows: “[Y]ou will be presented with the following information about a job opportunity in a startup: a description of the company, a description of the task, and additional information about the benefits. For the purpose of this study, the name of the venture is anonymous. Finally, you will be asked to note your application decision.” The respondents read the job ad and answer questions about our outcome variables of interest, a manipulation check, their risk propensity, and a set of control variables. The task takes on average 5 minutes and we rewarded it with £ 50p, a nominal fee.

Variables

Outcome Variables

In this study, we use three outcome variables that are all measuring the individual’s intention to join²⁹. The first two variables relate to the likelihood to apply for the job and the probability to accept it vis-à-vis a comparable offer at an established firm. These two variables look more at the extensive margin, i.e., whether the job is more attractive and succeeds in securing a joiner. The third variable relates to a more granular wage premium required to accept the job at a startup. This variable captures the relative cost of the talent acquisition and reflects the intensive margin.

Job Attractiveness. We want to measure the propensity to apply. Respondents answer the item: “How attractive do you think the opportunity is?” They answer using a Likert scale from 1 to 7.

Probability of accepting. We want to measure the probability to accept a startup job. This outcome variable is based on our question: “Assume that you have the required skills and the startup is interested in

²⁹ We also ran the analysis factoring the three variables in one latent variable. The results are not departing from the results presented in the main analysis.

hiring you. You also have an offer for a similar job in a larger established company with more than 500 employees. What is the probability of joining the startup?” Respondents answer by reporting a probability from 0 to 100. Together with job attractiveness, we believe these two variables represent the extensive margin on the willingness to join.

Indifference salary. We want to measure the cost of the hire. We ask about the salary that makes respondents indifferent between joining the startup and accepting an alternative offer for a similar position in a large company for a yearly salary of \$ 50,000. This variable represents the intensive margin as represents the premium (or discount) joiners are willing to ask in order to choose a startup as employer and, consequently, it measures the costs for the startup. We adapt the question from Roach and Sauermann (2015): “What is the salary the startup should offer you to make you indifferent and make you join? Please indicate the yearly salary before taxes in US Dollars.” Respondents report the answer both in salary brackets and by quoting a precise expected salary. We compare these dual answers and use the comparison as an attention check. We screen out subjects with an inconsistent set of responses. The precise expected salary is used as outcome variable and enters the regression in logarithmic form.

Explanatory Variables

Substantive and Ceremonial Messages. The main explanatory variables are dummy variables for each of the cells of our design (Substantive, No Ceremonial; No Substantive, Ceremonial; Substantive, Ceremonial). The baseline in our analysis is “No Substantive, No Ceremonial.”

Quality of human capital. We proxy the quality of human capital through a dummy variable that takes the value of one if the individual has postgraduate education like Master or PhD, and zero otherwise. This operationalization of higher human capital is common in the management literature, and it has been found tightly related to entrepreneurial performance (Colombo and Grilli 2005, Eesley 2016).

Risk aversion. To elicit risk propensity, and consequently risk aversion, we follow the strategy method of Holt and Laury (2005) without monetary incentives. Respondents read about 10 decisions between a risky option that pays off with a 50% probability and a certain equivalent. The 10 decisions are of increasing expected value, and the respondent is required to indicate their switching point from the certain equivalent to the lottery.

Control Variables

Albeit randomization in an experiment makes control variables unnecessary for unbiased estimation of the variables of interest, we collect and control for several variables to test random assignment and measure what else might affect the attractiveness of jobs for certain people. We control for the quality of human capital using measures of education attainment in terms of type of degree (high school, bachelor, master, and PhD) and dropout status. We control for gender, as females are usually less likely to be joiners (Easley and Wang 2017, Rocha and Van Praag 2017) and age since younger people are more likely to work for startups (Outimet and Zarutskie 2014). Finally, we also include as control the minutes the respondents took to fill the survey, to approximate for the level of attention of the participants. We cluster standard errors at the two-digit zipcode level, which is more granular than the state level to take into account unobservable heterogeneity across regions.

RESULTS

Descriptive Statistics

We posted a call for 200 respondents living in the United States who reported to have recently considered joining a startup as a future career move. We screen out a total of 40 respondents who provided inconsistent answers and failed the attention test or who completed the survey in less than 2 minutes or more than 15 minutes. Table 2 reports the descriptive statistics pertaining to the remaining 160 subjects.

The job prospect is considered on average relatively attractive, supporting the idea that we surveyed individuals who expressed a clear interest in joining a startup as a next career step. Interestingly, when choosing between a similar offer from an established company and our startup, only 47% of the respondents would accept the offer from the startup. This is reflected by the indifference salary: an offer from a startup requires an extra salary of on average 24%, i.e., \$ 67,000, to compete with a \$ 50,000 offer from an established firm.

Respondents are on average 31 years old, and 60% of them are male. Both the relatively young age and the high percentage of men is consistent with the employee population in startups studied by Ouimet and Zarutskie (2014) for the United States, and Burton et al. (2017) studying employees in startups in Denmark. For what concerns education, the vast majority of respondents, 84%, have at least some college education. More specifically, 65% have college education, 18% have master education, and 3% have doctoral education. Among respondents, 13% dropped out from their education. Finally, we look at the risk propensity. Based on (the inverse of) the Holt and Laury (2005) methodology to elicit risk aversion, respondents have relatively low levels of risk propensity, scoring 3.84 out of 10 on the index of risk propensity. At a first glance, the result may be surprising. There are two explanations to the result. First, the relationship between risk propensity and joining a startup is lower than the relationship between risk propensity and founding a startup (Roach and Sauer mann 2015). Second, we elicited the risk propensity of the individuals rather than asking their subjective self-assessments, whereas the latter can correlate more to their perceived identity.

Table 2. Summary Statistics

Variable	N	Mean	Std. Dev.	Min	Max
<i>Dep Var:</i>					
Job Attractive	159	4.572	1.375	1	7
Prob Accepting	159	46.862	24.450	0	95
Indiff. Salary	159	67069.18	44425.74	1000	500000
<i>Gender:</i>					
Female	159	0.384	0.488	0	1
Other	159	0.013	0.112	0	1
Age	159	30.962	9.589	19	61
<i>Education:</i>					
High School	159	0.126	0.333	0	1
College	159	0.654	0.477	0	1
Master	159	0.176	0.382	0	1
PhD	159	0.031	0.175	0	1
Dropout	159	0.132	0.340	0	1
Risk Propensity	159	3.843	2.794	0	10

Table 3 shows the descriptive results of the experiment: At a first glance, it seems that individuals find the job more attractive and they are more likely to accept when there is a substantive message. This is not the case with a ceremonial message, whereas the differences are smaller and in the opposite direction of our hypotheses. Through regression analysis, we investigate the results further.

Table 3: Results per Treatment

	N	Job Attractiveness	Probability to accept offer	Indifference Salary
<i>Condition:</i>				
No Substantive, No Ceremonial	38	4.342	44%	68,157
Substantive Only	42	4.976	53.17%	59,556
Ceremonial Only	38	4.289	42.95%	62,158
Both Substantive and Ceremonial	42	4.667	47.31%	78,943

The effect of substantive and ceremonial messages on becoming a joiner

Table 4 shows the regression results. We test three models, each using a different outcome variable: job attractiveness (job) in Model 1; probability to accept the offer (prob) in Model 2, and (log of)

indifference salary (sal) in Model 3. As described in the variable section, Models 1 and 2 represent the extensive margin, and Model 3 represents the intensive margin of our willingness to join. For each model, we run an additional specification that includes the control variables for age, gender, and education and we cluster the standard errors at the 2-digit zipcode level. The results for the coefficients of our treatments do not change in size when adding controls to the regression equations. The explanatory variables are the four experimental conditions in our design: (1) substantive message only; (2) ceremonial message only; (3) substantive and ceremonial messages. The baseline is the absence of substantive and ceremonial messages. Each model is an OLS regression in order to ease the interpretation of the coefficients³⁰.

We observe that a substantive message has a positive effect on the perception of the job offer from the startup. The coefficients of the substantive message for the job attractiveness are positive and significant at the 5% level in Model 1. Compared to a baseline score of 3.65, a substantive message makes respondents perceive the job between 16% and 18% more attractive. The effect of the substantive message is possibly stronger when respondents compare the offer with an alternative job from an established company. The coefficients are positive and significant at the 10% level in Model 2. Compared to a baseline of 37%, a substantive message proportionally increases the probability of accepting a startup job of between 24% and 26%. Finally, in Model 3 we look at the effect of the substantive message on the indifference salary. In this specification, a negative coefficient means that a respondent is willing to accept a lower salary compared to an alternative job offer from an established firm. In the specification without the controls, the coefficient is negative but insignificant. The coefficient is negative but still marginally insignificant after controlling for age, gender, and education.

³⁰ For robustness, we run also ordered logit and Poisson specifications without notable changes, thus not reporting them in this version.

The results suggest more willingness to join at the intensive margin at least directionally. The results provide partial support to Hypothesis 1: a substantive message makes individuals more inclined to apply and join the startup.

For what concerns the ceremonial message, we find no evidence of its effectiveness across the three models. The presence of a ceremonial message is negative and not significant both for job attractiveness and the probability to accept. The effect of a ceremonial message on the indifference salary is also insignificant, albeit with a negative coefficient. Overall, we find no consistent results both in terms of significance and directions in support for Hypothesis 4. We cannot reject the null hypothesis that a ceremonial message does not make respondents more inclined to join a startup.

A potential explanation may be that respondents do not appreciate the value of a ceremonial message without the co-occurrence of a stronger signal of quality. If this was a potential explanation, then the co-occurrence with a substantive message would have a positive effect, meaning that their interaction is positive. When we look at the condition of co-occurrence of ceremonial and substantive messages, we find, if anything, the opposite result. The interaction between substantive and ceremonial messages is negative, in the sense that the presence of a ceremonial message dilutes the effect of the substantive message.

Table 4. Effect of Substantive and Ceremonial Messages on Job Attractiveness

	(1)	(1.c)	(2)	(2.c)	(3)	(3.c)
Dependent Variable	Job Attractiveness	Job Attractiveness	Probability to accept offer	Probability to accept offer	Indifference Salary	Indifference Salary
Specification	Baseline	Joiners' Controls	Baseline	Joiners' Controls	Baseline	Joiners' Controls
<i>Message:</i>						
Substantive	0.664* (0.259)	0.589* (0.248)	8.852+ (5.113)	9.698+ (5.792)	-0.219 (0.156)	-0.259 (0.169)
Ceremonial	-0.033 (0.300)	-0.052 (0.323)	-1.08 (5.432)	-0.579 (5.832)	-0.043 (0.077)	-0.109 (0.098)
Substantive <i>and</i> Ceremonial	0.331 (0.316)	0.303 (0.330)	3.127 (5.025)	4.284 (5.335)	0.100 (0.090)	0.045 (0.112)
Time (minutes)	0.147*** (0.038)	0.149*** (0.038)	1.693+ (0.875)	1.776* (0.858)	0.046** (0.017)	0.042* (0.018)
Age		-0.007 (0.012)		-0.059 (0.262)		0.006 (0.004)
<i>Gender:</i>						
Female(=1)		-0.0518 (0.218)		-2.258 (3.829)		-0.025 (0.101)
Other(=1)		0.366 (0.295)		15.95** (5.966)		0.0243 (0.121)
<i>Education:</i>						
College (=1)		-0.323 (0.288)		0.714 (5.097)		0.434+ (0.223)
Master (=1)		0.201 (0.337)		-0.0809 (7.448)		0.572* (0.237)
PhD (=1)		-0.675 (0.816)		3.734 (11.77)		0.485+ (0.247)
Constant	3.636*** (0.299)	4.095*** (0.505)	36.14*** (5.457)	36.90*** (8.346)	10.81*** (0.0883)	10.31*** (0.278)
R ²	0.089	0.122	0.045	0.054	0.069	0.169
N	160	159	160	159	160	159

Notes: Robust Standard errors in parentheses for Baseline, clustered standard errors at the 2-digit zipcode level for Controls. Base levels are: “No Substantive and No Ceremonial messages” for *Information*; “Male” for *Gender*; and “High School” for *Education* + $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

To test Hypotheses 2 and 5, we look at the different impact of substantive and ceremonial messages on individuals with high and low levels of human capital. Individuals with high human capital—with postgraduate education like master or doctorate—are about 20% of the sample. We reran the analysis of Table 4 with controls (excluding education dummies) and compared the coefficients for

the two messages in the two subsamples—which we label High and Low Human Capital. We report the results in Table 5³¹.

For what concerns substantive messages, we find no support for Hypothesis 2. The coefficient for substantive messages among individuals with high human capital is positive and larger than the coefficient for individuals with low human capital, but the difference is not statistically significant. On the contrary, for the indifference salary, a substantive message has a positive and not significant coefficient, suggesting that individuals with high human capital are not sensitive to substantive message when they think about their indifference salary. On the contrary, individuals with low human capital are attracted by the substantive message: they would require a lower indifference salary when a substantive message is present. Overall, we found no support for Hypothesis 2, and opposite results when the coefficients were significant.

For what concerns ceremonial messages, we find only partial support to Hypothesis 5. The coefficients for ceremonial message are positive and larger for individuals with high human capital than for individuals with low human capital in Models 1 and 2. This result is *per se* directionally against Hypothesis 5. Moreover, all the coefficients are not significant and their difference is neither. In Model 3, the indifference salary, we find evidence in support of Hypothesis 5. For individuals with high human capital, the coefficient for the ceremonial message is positive and significant. This suggests that individuals with high human capital require a higher indifference salary to join a startup when they are exposed to a ceremonial message. On the contrary, a ceremonial message has a negative and significant coefficient for individuals with low human capital. This suggests that individuals with low human capital require a lower indifference salary to join a startup when they are exposed to a ceremonial

⁷ We found similar results operationalizing as “Low Human Capital” individuals with no college degree and splitting the sample between those with and without college degrees.

message. The difference in coefficient is statistically significant at 5% level (p -value=0.011). Overall, we find support to Hypothesis 5, limited to the indifference salary.

Table 5. Interaction of *High Human Capital* with *Ceremonial* and *Substantial* Messages

	(1.hc)	(1.lc)	(2.hc)	(2.lc)	(3.hc)	(3.lc)
	Job	Job	Prob	Prob	Salary	Salary
Human Capital	High	Low	High	Low	High	Low
<i>Message:</i>						
Substantive	0.931 (0.583)	0.638* (0.280)	23.13+ (12.37)	11.23+ (6.024)	0.198 (0.127)	-0.351+ (0.186)
Ceremonial	0.527 (0.962)	-0.128 (0.336)	2.188 (17.32)	1.794 (5.861)	0.329* (0.166)	-0.160* (0.077)
Substantive And Cerem	0.748 (0.739)	0.252 (0.337)	26.34** (9.940)	2.452 (5.871)	0.205+ (0.106)	0.017 (0.110)
Constant	4.970** (1.035)	3.792*** (0.469)	17.78 (31.35)	36.87*** (7.285)	10.95*** (0.203)	10.64*** (0.178)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
p-value Δ S	0.660		0.376		0.017	
p-value Δ C	0.521		0.982		0.011	
p-value Δ SC	0.527		0.042		0.206	
R ²	0.264	0.086	0.252	0.052	0.134	0.107
N	31	128	31	128	31	128

Notes: Clustered Standard Errors at the 2 digit level zip code in parentheses. Controls are age and dummies for Gender. All specifications control for Time to complete. Significance levels: + $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

In Table 6, we test Hypothesis 3 and Hypothesis 6, i.e., the interactions between substantive and ceremonial messages and risk propensity. Hypothesis 3 predicts that substantive messages are more effective on people with low risk propensity. Hypothesis 6 predicts that ceremonial messages are more effective on people with high risk propensity. We divide the sample between those whose risk propensity is above or below the median value. We label those with risk propensity above the median value as “High Risk Propensity” and those whose risk propensity below the median value as “Low Risk Propensity.” For what concerns the substantive message, the results are in the opposite direction. Throughout the three models, the substantive message is positively correlated to the propensity to join

both on the extensive and intensive margins when the individuals have higher risk propensity. The differential effect is significant in Models 2 and 3, the probability of joining and the indifference salary. We found evidence in the opposite direction with respect to Hypothesis 3.

For what concerns the ceremonial message, the results are in the direction we hypothesized. For Model 1, the coefficient for ceremonial message is positive for individuals with high risk propensity, and negative for individuals with low risk propensity. The difference is significant at 5% level. For Models 2 and 3, the effect of the ceremonial message is large and significant when individuals have higher risk propensity, while it is negative and not significant when individuals have lower risk propensity. The difference is statistically significant at least at the 10% level.

Overall, we found no support for Hypothesis 3 and opposite results, and support for Hypothesis 6. Substantive and ceremonial messages go in the same direction, and make a startup more attractive to individuals with high risk propensity.

Table 6. Interaction of *Risk Propensity* with *Ceremonial* and *Substantive* Messages

	(1.hc)	(1.lc)	(2.hc)	(2.lc)	(3.hc)	(3.lc)
	Job	Job	Prob	Prob	Salary	Salary
Risk Propensity	High	Low	High	Low	High	Low
<i>Message:</i>						
Substantive	0.957* (0.424)	0.198 (0.275)	20.56** (7.168)	3.465 (7.322)	-0.855** (0.299)	0.029 (0.069)
Ceremonial	0.484 (0.398)	-0.611 (0.424)	10.93+ (6.380)	-8.184 (7.494)	-0.393* (0.169)	-0.007 (0.061)
Substantive And Cerem	0.957+ (0.513)	-0.289 (0.356)	13.44** (5.158)	-1.792 (7.089)	-0.249 (0.172)	0.184 (0.116)
Constant	3.174*** (0.705)	5.084*** (0.631)	52.23*** (10.97)	21.12+ (11.13)	9.953*** (0.424)	10.87*** (0.140)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
p-value ΔS	0.146		0.084		0.003	
p-value ΔC	0.042		0.050		0.032	
p-value ΔSC	0.033		0.079		0.027	
R ²	0.227	0.133	0.212	0.093	0.387	0.102
N	68	90	68	90	68	90

Notes: Robust Standard Errors in parentheses. “High Risk Propensity” means score for risk propensity above the respondents’ mean. Baseline is: “No Substantive and No Ceremonial messages” for *Information*. Controls are age, dummies for Gender and Education. All specifications control for Time to complete. Significance levels: + $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 7 summarizes the Hypotheses and their support according to the results of our experimental analysis. We find partial support for Hypothesis 1: substantive messages make the job ad more attractive and they are more likely to join. However, a substantive message would not make individuals more likely to ask for a lower salary to join a startup vis-à-vis an established firm. We find no support for Hypothesis 4: a ceremonial message does not make individuals more attracted to a startup job. The interaction between the two messages suggests that ceremonial messages dilute the effects of substantive messages.

We found no evidence of the hypothesized different effects of substantive messages on the two subsamples we analyzed. Hypothesis 2 suggested that a substantive message makes the job ad more

attractive for individuals with higher human capital. Our only significant results are pointing in the opposite direction. A substantive message is more effective only on individuals with lower human capital endowments. Hypothesis 3 suggested that a substantive message makes the job more attractive for individuals with lower risk propensity. We found the opposite evidence: individuals with high risk propensity are more sensitive to substantive messages.

For ceremonial messages we find at least partial support to our hypotheses. In Hypothesis 5 we argued that ceremonial messages make the job more attractive to individuals with low human capital. A ceremonial message does not only make the startup job more attractive to individuals with low human capital, but it also discourages individuals with high human capital, providing some evidence to our theorizing. Hypothesis 6 predicts that ceremonial messages are more effective among individuals with high risk propensity. In our analysis we found evidence across all models that individuals with high risk propensity are more attracted to a startup job when a ceremonial message occurs, while it is not the case for individuals with low risk propensity.

Table 7. Summary of the Hypothesis testing

Hypothesis	Support
1: <i>Substantive message – main effect.</i>	Partial Support
2: <i>Substantive message – interaction with human capital.</i>	Not Supported, opposite
3: <i>Substantive message – interaction with risk propensity.</i>	Not Supported, opposite
4: <i>Ceremonial message – main effect.</i>	Not supported
5: <i>Ceremonial message – interaction with human capital.</i>	Partial Support
6: <i>Ceremonial message – interaction with risk propensity.</i>	Supported

DISCUSSION AND CONCLUSION

Our study originates from the desire to understand how joiners react to the information a startup conveys. Earlier studies on the topic of early human capital assumed perfect information between founders and joiners. As a consequence, we know little about the role of strategic revealing of startup information. Drawing from the resource acquisition literature (Kirsch et al. 2009), we have argued that the startup has some agency in attracting early human capital by conveying different messages. Substantive messages convey distinctiveness and quality; and ceremonial messages convey membership and cognitive legitimacy.

We tested our proposed hypotheses using an online experiment on 160 potential joiners interested in a startup career in the United States who were randomly assigned to a manipulated job ad for a generic business developer job in a startup. Each subject expressed their evaluation of the job attractiveness, their probability of joining if they were offered the advertised position, and their indifference salary with respect to a competing offer from an established company.

Our results provide mixed evidence to our hypotheses: substantive messages increase the pool of applicants as predicted by Hypothesis 1, but they have stronger effects on individuals with lower

human capital and higher risk propensity, conversely from Hypotheses 2 and 3. For ceremonial messages, we find no main effects, thus no evidence in support of Hypothesis 4. The heterogeneous treatment effects are in line with the theorized hypotheses: ceremonial messages are more effective on individuals with low human capital and high risk propensity, thus in line with Hypotheses 5 and 6. We discuss some of the findings and speculate about alternative explanations in the next paragraph.

First, the finding that individuals with higher human capital are not sensitive to substantive message is somewhat surprising. One possible explanation can relate to the perception of the substantive message we conveyed. Individuals with higher human capital can interpret that working with industry leaders is more of a necessary rather than a sufficient condition for success³². Second, we found that substantive messages are more effective among individuals with high risk propensity. Substantive messages may also convey growth potential—especially among startups. Therefore, higher potential for growth prospects higher (uncertain) wages in the future, which are more palatable to joiners with high risk propensity.

This study makes a contribution to the entrepreneurship literature on human capital of startups in three ways. First, it pioneers the relationship between joiners and information about the startup. This study complements the studies on joiners' characteristics (Ouimet and Zarutskie 2014, Roach and Sauermann 2015) by showing which startup's messages attract them.

Second, to the best of our knowledge, the study represents an early experimental contribution to the field of literature about joiners. An experimental study is important to relax assumptions about perfect information between joiners and founders (Ganco and Honore 2016). This study complements earlier studies that found evidence of positive sorting between workers and founders in terms of ability,

³² We tested (not reported) whether the coefficients for substantive and ceremonial messages were different. In the main analysis individuals perceive substantive and ceremonial messages differently. On the extensive margin, the messages have different effects on individuals with lower human capital, but not for individuals with high human capital, where the two messages seem to have the similar effect. The two messages seem not to be different on the intensive margin, thus supporting the idea that joiners with higher levels of human capital may see these messages as equally ceremonial.

by showing that startups can sort joiners in terms of risk propensity by conveying both substantive and ceremonial messages³³. This may be desirable for founders of early stage ventures because risk aversion has been found to be hindering performance of innovative tasks (Sauer mann 2017).

Finally, the study borrows concepts from resource acquisition literature (Kirsch et al., 2009). Our results inform and extend the resource acquisition literature by looking at a different type of resource, labor. Entrepreneurs need to manage information strategically not only to collect financial resources (Stuart et al. 1999), but also to be able to attract human capital at the best economic conditions. Conveying the right information at the early stage has an effect on the salary joiners expect to prefer a startup job vis-à-vis a job in an established firm.

Our study has important boundary conditions. First of all, the study is limited by design to late stage joiners. These joiners are usually outside the founders' network (Williamson et al. 2002). It could be that private information about the founder would overwhelm the information provided by ceremonial and communicative messages about the startup for early joiners. Another issue with late stage startups is the formalization process they undergo. Early stage joiners may be more attracted by learning opportunities to found a startup themselves, while later stage joiners may appreciate formalization and the higher chances of survival, leading to a more secure position in the startup (Sirigiri 2017). Future research can help clarifying this distinction between early and later stage joiners.

As a second boundary condition, the job ad is of managerial nature. We chose a job with a managerial nature to increase the number of participants that would realistically be interested in our study. A managerial job is attractive for a larger pool of joiners due to its general nature than a more technical position. However, individuals with technical backgrounds can respond to different sources

³³ We do not find evidence of sorting based on human capital, but we find that both substantive and ceremonial messages increase the pool of individuals with higher risk propensity. It may be that the quality of the venture was too uncertain even with the additional information to find sorting based on quality of human capital (we provided no information about the founder, there may be sorting based on the quality of the founder).

of information (Easley et al. 2014). For example, they can be more interested in the task rather than the startup and be insensitive to any information about the latter. The focus of their attention can shift towards the details of the tasks required. Future research should distinguish between managerial and technical joiners and establish the more effective type of message that can attract them to a startup job.

The third boundary condition is related to the location of the information. In the job ad, the manipulations take place in the description about the startup. Individuals with higher levels of human capital may look at different types of information in different sections of a job ad—for example, they may want to know more about the founder or about the task they are required to perform.

Finally, we are measuring stated intentions and not actual ones. We know that the link may be weak, especially when the experimental task does not have an incentive. Future research should build on these initial results to design a proper field experiments that measures actual intentions in a real life setting.

Despite its preliminary stage, this study provides some counterintuitive insights that startups and online recruitment services can keep in mind about different types of messages that can elicit different types of reactions. We hope that this paper can open the field to a more thorough analysis of the information for effective recruitment of human capital for startups.

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APPENDIX

Table A1. Substantive message only, without ceremonial messages.

	(1.c)	(2.c)	(3.c)
Dependent Variable	Job Attractiveness	Probability to accept offer	Indifference Salary
Specification	Joiners' Controls	Joiners' Controls	Joiners' Controls
<i>Message:</i>			
Substantive	0.641* (0.275)	8.474+ (4.955)	-0.286+ (0.157)
Time (minutes)	0.085 (0.057)	0.408 (1.334)	0.066+ (0.039)
Age	0.000 (0.017)	-0.091 (0.365)	0.010 (0.008)
<i>Gender:</i>			
Female(=1)	-0.264 (0.273)	-9.338+ (4.968)	-0.112 (0.165)
Other(=1)	0.640+ (0.334)	18.82*** (5.451)	0.085 (0.115)
<i>Education:</i>			
College (=1)	-0.056 (0.390)	0.074 (5.044)	0.788+ (0.405)
Master (=1)	0.440 (0.430)	-1.677 (8.100)	0.889* (0.424)
PhD (=1)	-2.116*** (0.457)	35.44*** (8.437)	0.551 (0.402)
Constant	4.019*** (0.695)	48.14*** (9.945)	9.833*** (0.559)
R ²	0.075	0.025	0.185
N	80	80	80

Table A2: Interaction of *High Human Capital* with *Substantial* Messages (No *Ceremonial*)

	(1.hc)	(1.lc)	(2.hc)	(2.lc)	(3.hc)	(3.lc)
	Job	Job	Prob	Prob	Salary	Salary
Human Capital	High	Low	High	Low	High	Low
<i>Message:</i>						
Substantive	1.172 (0.898)	0.708* (0.293)	18.87 (25.06)	10.38+ (5.416)	0.037 (0.227)	-0.332+ (0.186)
Constant	6.103** (1.571)	3.894*** (0.583)	19.58 (43.86)	50.38*** (10.77)	11.29*** (0.398)	10.32*** (0.370)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
p-value ΔS	0.561		0.546		0.071	
R ²	0.367	0.113	0.124	0.153	0.184	0.131
N	13	67	13	67	13	67

Notes: Robust standard errors in parentheses. Controls are age and dummies for Gender. All specifications control for Time to complete. Significance levels: + $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table A3: Interaction of *Risk Propensity* with *Substantial Messages* (No *Ceremonial*)

	(1.hc)	(1.lc)	(2.hc)	(2.lc)	(3.hc)	(3.lc)
	Job	Job	Prob	Prob	Salary	Salary
Risk Propensity	High	Low	High	Low	High	Low
<i>Message:</i>						
Substantive	0.880 (0.523)	0.271 (0.291)	20.79** (7.321)	0.835 (7.510)	-1.103** (0.306)	0.037 (0.075)
Constant	3.504*** (0.922)	4.995*** (0.762)	56.04*** (12.91)	33.45+ (19.69)	9.308*** (0.539)	10.88*** (0.198)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
p-value ΔS	0.295		0.034		0.001	
adj. R^2	0.313	0.171	0.390	0.127	0.596	0.089
N	33	47	33	47	33	47

Notes: Robust Standard Errors in parentheses. “High Risk Propensity” means score for risk propensity above the respondents’ mean. Baseline is: “No Substantive and No Ceremonial messages” for *Information*. Controls are age, dummies for Gender and Education. All specifications control for Time to complete. Significance levels: + $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

CHAPTER 5. FAMILIARITY, CREATIVITY, AND THE ADOPTION OF CATEGORY LABELS IN TECHNOLOGY INDUSTRIES

With Prof. Fernando Suarez and Dr. Stine Grodal

ABSTRACT

The literature on technology management has increasingly focused on the socio-cognitive elements of the industry life cycle. One of these elements, category labels (words, in most cases) and its role in shaping market understandings, has recently become of interest to scholars. As industries evolve, stakeholders generate a plethora of category labels. However, we know relatively little about why some category labels are used repeatedly, while others are abandoned. Drawing on semantic networks theory, we argue that the familiarity and creativity of category labels drive their adoption. We hypothesize that low levels of familiarity hinder comprehension, but too much familiarity increases the cost of obviousness. Likewise, low levels of creativity do not trigger curiosity, while too much creativity spurs dissonance. We use two methods to address these hypotheses. First, we study the early smartphone industry, finding support for an inverted U-shaped relationship between both the familiarity and creativity of category labels and their adoption, even after controlling for alternative explanations, such as technology and design characteristics. Second, we find consistent results through two online experiments that broaden the scope of our study and address potential endogeneity concerns in our field data. Our paper expands the literature on the evolution of technology industries by showing that familiarity and creativity are distinct dimensions that influence the socio-cognitive dynamics of an emerging industry. We also contribute to the categorization literature by theorizing about the contestation that occurs among category labels and providing empirical evidence of the factors that affect their adoption.

INTRODUCTION

During an industry's early stages, stakeholders hold multiple, simultaneous understandings of the industry's products (Kaplan and Tripsas 2008, Anthony et al. 2016). Scholars have examined this socio-cognitive dimension through technological frames (Orlikowski and Gash 1994, Gurses and Ozcan 2015), field frames (Lounsbury et al. 2003), schemas (Bingham and Kahl 2013, Rindova and Petkova 2007), and narratives (Lounsbury and Glynn 2001). Recently, much attention has been paid to examining the socio-cognitive dimension of industries by studying categories (Zuckerman, 1999, Porac et al. 2001, Suarez et al. 2015, Cattani et al. 2017). Categories are socially constructed partitions that group together objects perceived to be similar; category labels are words or phonemes used to invoke these partitions (Bowker and Star 2000, Pontikes 2012). During the early period of industry emergence, stakeholders experiment by creating a variety of category labels that reflect diverse understandings. Multiple category labels therefore co-exist and refer to the same industry (Benner and Tripsas 2012, Durand and Paoletta 2013, Grodal et al. 2015, Dalpiaz et al. 2016). For example, in the early stages of what we today would call the smartphone industry, the label "computer phone" suggested that the new technology product was a small computer that could also make phone calls. In contrast, the category label "camera phone" implied that the new device was a camera that could also make phone calls. The use and choice of category labels is important because they may influence product demand (Navis and Glynn 2010, Verhaal et al. 2015, Kahl and Grodal 2016). However, we know little about why some category labels gain traction and others falter (Kennedy and Fiss 2013).

To understand how category labels are created and retained in emerging industries, we draw from existing studies on technology adoption. New technology products are typically the result of a recombination of existing designs (Fleming 2001). Earlier studies of industry evolution suggest that the

type of recombination shapes how technology products are understood (Clark 1985, Hargadon and Douglas 2001, Rindova and Petkova 2007). On the one hand, successful technology products need to recombine elements that invoke existing understandings for the audience. Such recombination both minimizes the audience's natural reluctance towards something new and conveys reassurance by evoking familiarity; that is, similarity to and continuity with pre-existing elements (Hargadon and Douglas 2001, Bingham and Kahl 2013, Gerlach et al. 2014). On the other hand, successful technology products also need to generate surprise and capture the audience's imagination; in other words, convey ideas of creativity via the recombination of elements seldom used together in the past (Schumpeter 1939, Abernathy and Utterback 1978, Utterback 1994). Existing research has suggested that a product's familiarity and creativity can be conveyed through a technology's functionality (Hargadon and Douglas 2001) or its outer form (Rindova and Petkova 2007, Eisenman 2013). However, in this paper we argue that familiarity and creativity can also be created through the category labels associated with the technology products in an emerging industry.

Just as new technology products are created through recombination of existing designs and products, most category labels are created through recombination of existing words or labels (Lo and Kennedy 2014).³⁴ These recombinations result in compound words, for example, "digital camera," "typewriter," or "videogame." The words chosen to make up compounds can elicit different levels of familiarity and creativity. Newly created category labels receive their meaning through the existing semantic networks of their component words – i.e. the set of links between a focal component word and other words (Quillian 1969, Collins and Loftus 1975). Category labels that include words commonly used or recognized by the intended audience tend to be perceived as more familiar because their component words have a denser semantic network. Category labels that combine words seldom

³⁴ Single-word labels exist, but they are much less common, and we account for them in our empirical analysis below.

used or seen together are unanticipated by the audience. Unanticipated labels tend to be perceived as more creative because the semantic networks of the component words seldom overlap. We hypothesize that if a category label is not sufficiently familiar, audiences will not comprehend it. Labels that are more familiar will be better comprehended, but too much familiarity will render them obvious. Similarly, labels that are not creative will not provoke curiosity and interest. Labels whose recombination of words make them more creative will elicit curiosity, but too much creativity will create dissonance.

Empirically, we studied these hypotheses using two methods. First, we conducted an archival study in the early stages of what became known as the smartphone industry. We collected data from the official product launches of each smartphone introduced between 2000 and 2010 in the United States and the United Kingdom, tracking the category labels used by smartphone producers. The results confirm our hypotheses and rule out alternative explanations. In addition, we designed and ran two online experiments that broaden the scope of our study and address potential endogeneity concerns in our field data. The results of the experiments are consistent with those of our regressions.

Our study theorizes and provides empirical evidence to identify familiarity and creativity as two important drivers of why category labels “emerge and fall out of use” (Kennedy and Fiss 2013, p. 1139). We show that rather than being two opposite ends of a spectrum, familiarity and creativity are distinct constructs. In addition to our contribution to the categorization literature, our study also contributes to the literature of technology evolution (Anderson and Tushman 1990, Utterback 1994, Schilling 1998, Suarez et al. 2015) by showing that these constructs play an important role in the contestation that takes place in emerging industries.

THE FAMILIARITY AND CREATIVITY OF CATEGORY LABELS IN TECHNOLOGY PRODUCTS

The Familiarity and Creativity of New Technology Products

The focus of technology management scholars has broadened over time. Early scholars focused primarily on how innovative products obtain their competitive advantage through technological superiority (Abernathy and Clark 1985, Tushman and Anderson 1986, Foster 1988). Schumpeter (1939) was one of the earliest scholars in the field to emphasize the importance of using technological innovation to leapfrog the competition and produce a “creative destruction” in a given industry. Subsequent scholars added to this early focus on technological performance by stressing the socio-cognitive dimensions of how technologies are understood and used in specific contexts. Clark (1985, p. 244) exemplifies this new focus:

The formation of concepts [in early technology industries] involves the establishment of meaningful connections between the functional and aesthetics of the physical object and words stored in memory. Two aspects of the process are critical. The first is grouping, in which the unfamiliar product is associated with other known product concept to which it is similar or related. The second is distinguishing, that is, identifying those dimensions of the products that differentiate it from the group in which it has been placed.

Subsequent literature has elaborated on these socio-cognitive dimensions of technology industries by offering interesting extensions to the earlier writings. Garud and Rappa (1994), for instance, detail how cochlear implant researchers’ beliefs and expectations are shaped by both the researchers’ routines and the technology they are developing. Paying close attention to the socio-cognitive dimensions of technology led some scholars to hone in on the tension to which Clark (1985) had hinted: grouping a new technology to familiar objects and distinguishing it from that grouping.

Along these lines, Hargadon and Douglas (2001, p. 480) propose the notion of “robust design” and argue that innovators can strike a balance if they “carefully choose designs that couch some features in the familiar, present others as new, and keep still others hidden from view.” The authors use this concept to explain how Edison triumphed over the gas industry when introducing electric light into the market. Similarly, Rindova and Petkova (2007) argue that innovators use product design to convey not only the new functionality provided by the technological underpinning behind the innovation, but also sensory experiences and cultural references that can link the new product to existing ones. Anthony et al. (2016) document how some early synthesizer producers stressed the novelty of their products by presenting them as a totally new instrument capable of creating new sounds, while other producers presented their products as an emulator of existing instruments, such as the piano.

Taken together, this newer stream of research suggests that an audience’s perception of both creativity and familiarity aids product adoption (Norman 2004). Scholars have used different terms to refer to these two basic constructs integral to the introduction of technology products. Familiarity has also been referred to as “stability” or “continuity” (Hargadon and Douglas 2001, Bingham and Kahl 2013, Gerlach et al. 2014), while creativity has also been referred to as “novelty” or “originality” (Hargadon and Douglas 2001, Rindova and Petkova 2007). Despite the different terms, scholars are referring to similar underlying processes. Familiarity implies the use of elements that by invoking existing understandings facilitate comprehension. Creativity implies the recombination of elements that evoke surprise or curiosity.³⁵

Creativity is important to attract the audience’s curiosity. Products that convey creativity break with people’s existing expectations, allowing for the emergence of new use possibilities and new paradigms by which to evaluate the new products. While many recombinations are possible, those

³⁵ We treat familiarity and creativity as two distinct, independent constructs. Given that a semantic network consists of indefinite linkages among words, we expect both the measures of familiarity and creativity to be continuous.

recombinations least expected will elicit the most surprise or curiosity in stakeholders. For instance, Google Glass was perceived as creative because it combined two distant technologies, mobile computing and eyeglasses, in obtaining high visibility and strong reactions from stakeholders. Although surprise and curiosity elicited by creative products is positive, products that are too creative conflict with existing understandings, generating dissonance (Rindova and Petkova 2007).

Perceived creativity is therefore not enough. To be adopted, a new technology must also be perceived as familiar, i.e. embedded in existing understandings to facilitate comprehension. For example, while the Segway initially received rave reviews and was touted as a creative product, it was never a commercial success because people did not understand how to incorporate it into their existing routines (Gourville 2006). Similarly, Kahl and Grodal's (2016) study of the early computer industry shows that companies emphasizing the creativity of their products (such as Remington Rand) were less successful than companies emphasizing their familiarity (such as IBM). Hsu (2006) suggests that products that stray too far from stakeholders' expectations tend to underperform, which has led scholars to highlight the importance of familiarity to the success of new technology products.

Although these authors point to this important tension when introducing new products, they still have not clarified whether familiarity and creativity are two opposite ends of one spectrum or separate constructs. The same can be said of other studies that examine these constructs in different settings. For instance, Uzzi et al. (2013) study how the frequency with which scientific articles are cited is related to their use of familiar or creative recombinations of knowledge, as evidenced by the breadth and mix of fields in the articles' references. They operationalize familiarity and creativity as opposite ends of a spectrum, calculated from the same measure. They find that the most highly cited articles draw primarily on cohesive and familiar knowledge and incorporate a few creative citations not previously linked to that literature. The authors therefore seem to believe that familiarity and creativity

can be achieved simultaneously, even if they are unclear on how. In contrast, studying the early computer industry, Bingham and Kahl (2013, p. 15) perceive a trade-off between the two constructs in claiming that their study resolves “a conundrum related to the process of emergence—how to manage the simultaneous existence of two inconsistent states.” They propose that these “inconsistent states” can be overcome through a temporal strategy, i.e. by focusing first on familiarity and then on creativity.

In short, despite its importance and intuitive appeal, the literature on familiarity and creativity has highlighted the importance of these two constructs for adoption but has yet to clarify if they are ends of a spectrum or distinct.

Category Labels and the Familiarity and Creativity of Technology Products

The tension highlighted above can be observed in several rhetorical strategies that industry stakeholders use to convey meaning for new technology products, such as stories (Lounsbury and Glynn 2001), frames (Orlikowski and Gash 1994), analogies (Etzion and Ferraro 2010), and schemas (Martins et al. 2015). For example, Lounsbury and Glynn (2001) call for the use of stories to overcome the ambiguity around high technology new ventures; specifically, they suggest that to gain attention, stories need to simultaneously convey membership to the industry and distinctiveness. Similarly, Etzion and Ferraro (2010) show how industry participants made the new concept of sustainability reporting seem familiar by drawing analogies to financial reporting. While these approaches have contributed to our understanding of how stakeholders perceive new products, recent contributions by categorization scholars have created a theoretical apparatus (Cattani et al. 2017) that appears well suited to study the socio-cognitive tensions in early industries. This literature has documented the multiplicity of category labels in early industries (Suarez et al. 2015). Category labels are the first manifestation of stakeholders’ understandings of new technology products, each conveying different meanings (Pontikes 2012, Porac

et al. 2001). Stakeholders can exploit nuances in meaning in category labels to signal different levels of familiarity and creativity for a given technology product.

Most category labels are compounds created by recombining existing words (Grodal et al. 2015). When faced with a novel compound category label, even if a person encounters a specific word combination for the first time, they might make sense of it through the semantic network that the component words elicit (Bingham and Kahl 2013). A semantic network is formed by the semantic links that a word has to other words and category labels (Quillian 1969). A word's semantic network is derived from the prior contexts in which the word has been used. When words are used in the same context, links form between them. For example, if the word "food" is frequently used together with the word "restaurant," the two words will become associated in the semantic network. The semantic network can be used to theorize and distinguish the familiarity and creativity of category labels.

A word's semantic network can be conceptualized along three dimensions. The first is the hierarchy embedded in the taxonomy of language. A taxonomy is a "system by which categories are related to one another by means of class inclusion" (Rosch 1978, p. 30). Categories are nested vertically at different levels of abstraction, which correspond to different levels of inclusiveness. The category "color laser printer," for instance, is part of a higher level of abstraction. Thus, "laser printer" in turn is part of the superordinate category "printers."

The second dimension is the density of the network, which is formed from a word's number of semantic links. Networks range from sparse to dense. Words with denser networks are perceived as more familiar because they promptly evoke more semantic connections, which makes them more readily comprehended (Quillian 1969, Collins and Loftus 1975). In contrast, words with sparser networks have few semantic connections, their meaning is harder to infer, and thus perceived as less familiar. For example, the word "tool" has a dense semantic network because it has semantic links to

many other words like “box,” “kit,” “garden,” but also “software” and “rhetorical.” A word like “centrifuge” has a sparser semantic network because of semantic links to a more limited set of words, making it less familiar.

The third dimension is the degree of overlap that exists in the semantic connections between words. If the semantic networks of two words do not overlap, these words will probably never appear together. If two words that never or seldom appear together are jointly used to form a category label, then this label will be perceived as more creative than a label formed by two words that frequently occur together. For example, the two words “digital” and “sponge” rarely appear together, hence the label “digital sponge” will be perceived as more creative than “shower sponge” as the latter two words do appear together more frequently.

In sum, we conceptualize familiarity in terms of the density of the semantic network and creativity in terms of the overlap between semantic networks. We use this conceptualization to theorize the relationship between familiarity, creativity, and the adoption of category labels. An example is John Burton Carpenter’s creation, in the 1970s, of the compound label “snowboard,” which drew meaning from the existing superordinate category of “boards” that already included established horizontal categories, such as “surfboard” and “skateboard.” At the same time, both “snow” and “board” had dense semantic networks that infuse meaning. For instance, snow is associated with cold and mountains and board is associated with thrill and body balance; however, these semantic networks only partially overlapped, to the extent that both were associated with vacations, fun, and physical activity.

We argue that familiarity and category label adoption have an inverted U-shaped relationship because of two opposing mechanisms: a) the *benefit of increased comprehension* and b) the *cost of increased obviousness*. These two mechanisms are both related to the semantic networks of the words that comprise a focal category label. Comprehension refers to how easily a label is associated with existing

category labels through semantic links. Labels with dense semantic networks activate more semantic links that provide meaning, making the labels easier to understand. Obviousness refers to the degree to which a category label is taken-for-granted, and thus not consciously processed due to an oversaturation of its semantic network. While additional semantic links ease comprehension, they also gradually increase the likelihood that the meaning they provide become taken-for-granted, making a label more likely to be ignored.

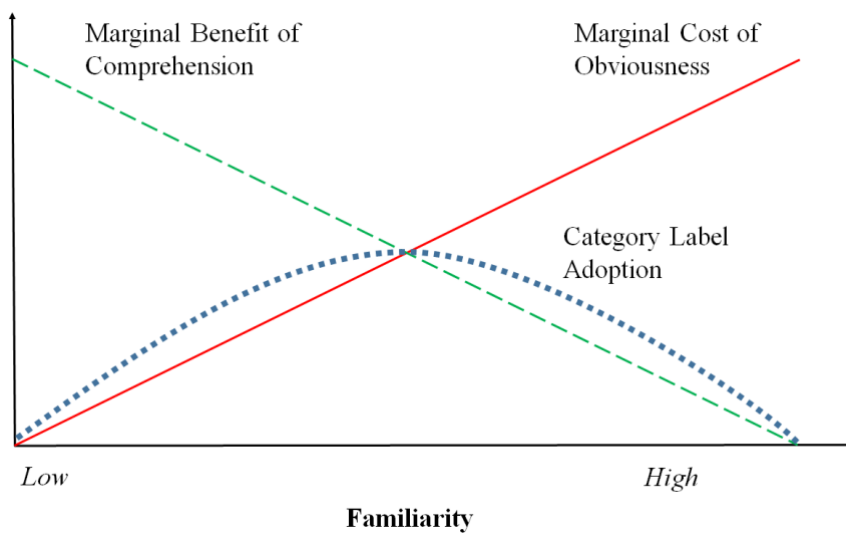
At low levels of familiarity, category labels have no semantic connections and are thus incomprehensible. The first semantic connections have a disproportionate contribution to a person's understanding of a focal label, as they link the label to a larger meaning structure. An increase in familiarity enhances comprehension; however, each additional semantic link adds less to the comprehension of the label since it builds upon the previously established semantic links. The opposing mechanism also operates as familiarity increases: the cost of obviousness is on the rise. When familiarity is low, semantic links of the category label have higher salience and are less likely to be unconsciously ignored. As familiarity goes up, the increasing saturation of the semantic network makes the probability of unconsciously ignoring the category label higher. This process continues to a point where the cost of obviousness overtakes the benefits of comprehension, resulting in lower levels of adoption of the focal category label. Figure 1, Pane A shows these relationships. At low levels of familiarity, the curve of the marginal benefit of comprehension lies above the marginal cost of obviousness, leading to a positive association between familiarity and category label adoption. Conversely, at higher levels of familiarity, the marginal cost of the obviousness curve lies above the marginal benefit of comprehension, leading to a negative association between familiarity and category label adoption, and thus forming an inverted U-shaped relationship.

It follows that,

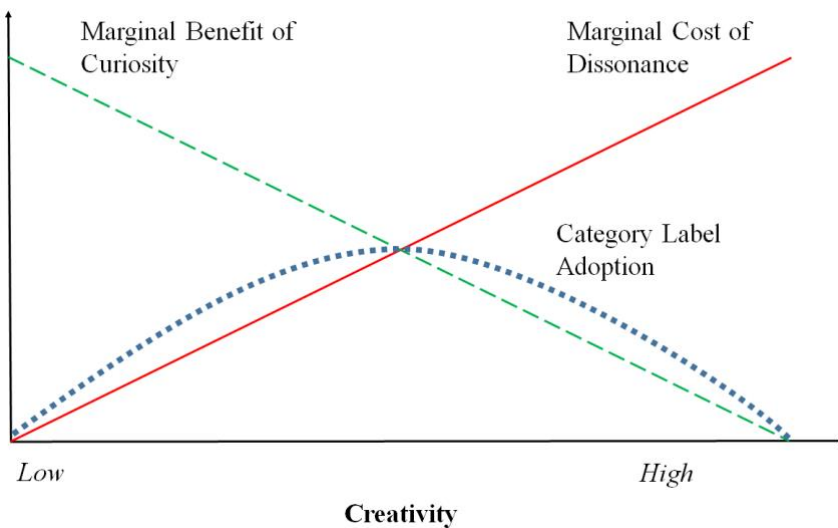
Hypothesis 1. Familiarity. There is an inverted U-shaped relationship between the familiarity of a category label and its degree of adoption in an emerging industry.

Figure 1. Familiarity, Creativity and Category Label Adoption

Pane A: The Marginal Benefits and Marginal Costs of Familiarity



Pane B: The Marginal Benefits and Marginal Costs of Creativity



We also argue that creativity and category label adoption have an inverted U-shaped

relationship because of two opposing mechanisms: a) the *benefit of arousing curiosity* and b) the *cost of increased dissonance*. These two mechanisms are both related to the degree of overlap between the semantic networks of the words that comprise a focal category label. Curiosity refers to the desire to know or learn about something, which is both unexpected and challenges an individual's cognition. This is more likely to occur with labels whose component words have semantic networks with low overlap. Labels whose words have low-overlapping semantic networks suggest new and different perspectives, making labels more salient and likely to be adopted. Dissonance refers to the level of incoherence between the words that comprise a focal category label. Dissonance increases because the label is composed of words whose semantic networks are increasingly less overlapping. When labels have words whose semantic networks are increasingly less overlapping, the meanings they evoke create a discomfort and imply high levels of cognitive effort that make individuals more likely to stray away from those labels.

At low levels of creativity, category labels have a nearly complete overlap of semantic networks and are therefore uninteresting; the component words co-occur almost all the time, and thus elicit no curiosity. An increase in creativity fuels curiosity because now the label uses words that do not always co-occur. The first departure from complete semantic overlap arouses more curiosity than subsequent departures, implying that the marginal benefit of curiosity is decreasing. At the same time, however, as creativity increases, dissonance also increases. This increasing lack of harmony results in a corresponding cost in terms of category label adoption. This process continues to a point where the marginal cost of dissonance overtakes the marginal benefit of curiosity, leading to an inverted U-shape. Figure 1, Pane B illustrates this process.³⁶ At low levels of creativity, the curve of the marginal benefit of curiosity lies above the marginal cost of dissonance, leading to a positive association between

³⁶ Note that our arguments here hold even in the case where the marginal benefits of curiosity are constant, or even increasing, if they increase at a lower rate than the cost of dissonance – which seems to be a reasonable assumption.

creativity and category label adoption. Conversely, at higher levels of creativity, the marginal cost of the dissonance curve lies above the marginal benefit of curiosity, leading to a negative association between creativity and category label adoption, thus forming an inverted U-shaped relationship.

It follows:

Hypothesis 2. *Creativity.* There is an inverted U-shaped relationship between the creativity of a category label and its degree of adoption in an emerging industry.

There are cases where a category label is both unfamiliar yet not creative or, conversely, creative while still using familiar words or phonemes. Two words that are quite unfamiliar can still result in unsurprising recombination. For example, although words, such as “catheter” and “dialysis” are relatively uncommon in the English language, they often co-occur. Therefore, when the category label “dialysis catheter” was introduced, it was not surprising. Conversely, the words “charge” and “plate” are quite familiar. However, when “charge plate” was introduced as a label to describe what later became known as the “credit card,” it failed to gain traction (Grodal et al. 2015). The semantic networks of these words did not overlap much: charge was associated with electricity, while plate was associated with words like “kitchen” and “cars.” In the following two sections, we test our hypotheses. First, we perform a regression analysis using an extensive dataset from the smartphone industry. Second, we conduct two online experiments that add precision and generalizability to our theorizing and robustness to our empirical analysis.

FAMILIARITY AND CREATIVITY OF CATEGORY LABELS: RESULTS FROM FIELD DATA ANALYSIS

Setting: The Smartphone Industry

The smartphone industry emerged from the broader mobile phone industry: the first attempt (by IBM) to combine telephony, computing, and personalization features dates to 1992 (Cecere et al. 2015);

however, it was not until the late 1990s when the smartphone industry began to emerge. Smartphones are different from regular mobile phones in that their processing capacity allows them to run significantly more powerful operating systems and application software.

We chose this industry for several reasons. First, the smartphone industry represents a recently emerged market space and therefore labels can be tracked and collected from the industry's beginnings. Second, the heterogeneity of products resulted in many category labels competing for adoption. Third, due to the extensive and far-reaching technological possibilities offered by smartphones and the rapid pace of technological change, there was significant cognitive uncertainty around the category.

With such uncertainty and profusion of labels, discerning the differences between labels and the products they were used for was often difficult for industry stakeholders. For instance, in 2003 Nokia launched a major new product, the N-Gage, using the label "game deck." Despite a massive advertising campaign, the N-Gage game deck was poorly understood by industry stakeholders and poorly received in the market (Suarez and Lanzolla 2005). An article in the technology section of *Fortune Magazine* in 2003 asked, "Has Nokia gone insane?" and sarcastically depicted the confusion around what the game deck actually was by describing how bizarre the typical customer would have to be: "I currently carry in my pockets an MP3 player, a Nintendo Game Boy Advance game console, a mobile phone, a transistor radio, and a taco." The article concluded that, "the N-Gage ultimately succumbs to the Law of More Is Less."

Data and Variables

Data

To test our hypotheses, we constructed a unique dataset of category labels. For each smartphone introduced in the United States and the United Kingdom between 2000 and 2010, we identified the *first*

press release that producers issued to introduce the product to the market. These first press releases are important because they signal producers' initial positioning of the product within the market *vis-à-vis* other products and category labels then in the industry. Although producers did not create all category labels, they were certainly active in creating some of them, and we can assume that over time they retained primarily those labels preferred by other stakeholders.

We collected press releases from Factiva and individual company websites. Press releases contain a reliable record of the category labels associated with novel technology products. We identified words as category labels if they were used as the main descriptor of the technology product in the press release. We collected all main descriptors of the technology products to create a comprehensive list that avoids selection on the dependent variable. For example, introducing the model N96 in 2008, Nokia used two category labels to describe it: “converged device” and “multimedia computer;” we coded these two labels and counted the number of times they appeared in reference to the model. Table 1 provides examples of category labels from our data. Note that we break down labels into their component words for our analysis. That is, a category label, such as “camera phone,” was coded as two words, “camera” and “phone.” Consistent with linguistics practice (e.g., see Bauer, 1990), we also deconstructed the category label even when the words were written together. For instance, the category label “smartphone” was coded as the words “smart” and “phone.” The final dataset contains 390 category labels extracted from 382 press releases, which producers created recombining 206 unique words. We counted a total of 308 smartphones introduced during our time period (some press releases were specific to the United States or the United Kingdom only; others were joint). Our dataset consists of 1,900 label-year observations.

Table 1. Examples of Labels

Labels with 2 words	Labels with 3 words	Labels with more than 3 words
Camera phone	Arc-slider phone	All-in-one communications device
Compact PDA	Enterprise-class communicator	All-in-one handheld device
Mobile computer	Mobile email device	Connected mobile jukebox
Office phone	Mobile game deck	Integrated mobile multimedia device
Pocket pc	Mobile TV device	Multimedia compact PDA
Smartphone	Multi-function phone	Multimedia messaging capable terminal
Superphone	Picture mail phone	Multipurpose communication tool
Qwerty phone	Pocket pc phone	Pocket-size mobile office
Touch phone	Smart handset	Pocket-size movie player
World phone	Social smartphone	Touch-screen handset

Dependent Variables

Label Adoption. We measure the level of a category label adoption in a given year by counting the number of press releases that used a given category label at least once. This measure provides greater granularity than alternative measures, such as label survival. The category label showing the highest level of adoption in our dataset was used in 82 press releases in a single year, while many category labels were used in just one press release.

We also use a second measure of adoption, “frequency of label use in given year,” computed as the total number of times a category label was used in all press releases by any smartphone producer in a given year. This dependent variable can be thought of as measuring the intensity of producers’ adoption of a given category label because it discriminates between a press release that contains just one mention of a given category label and another that uses the label several times.

Explanatory Variables

Label Familiarity. We measure the familiarity of a category label in a given year by following these steps. First, we counted the number of times each word in the category label appeared in the

Factiva database that contains 102 “key sources from the United States covering general and business news,”³⁷ with a one-year lag. This count approximates how common the word was in the English language at that time, since major general and business news publications, unlike technical publications, are aimed at a broad readership. Second, we average the frequency of each word in the category label and divide a label’s average frequency by the highest frequency found for all labels that year to obtain a scale from 0 to 100. Third, we take the logarithm to account for the skewness of the resulting distribution. Given our hypotheses, familiarity enters the regressions both in linear and quadratic terms with a one-year lag.

Label Creativity. For each of the 390-word combinations in our category labels, we collected their co-occurrence in three major general and business news publications. For example, for the category label “computer device,” we count the number of times “computer” and “device” co-occurred in a corpus. We did this by looking at the co-occurrence of these words at the paragraph level of a random sample of 54,374 articles published in the weekday editions of *The New York Times*, *The Wall Street Journal*, and *USA Today*.³⁸ We begin by computing the ratio of the number of co-occurrences of two words in the label over the number of times the two words are mentioned individually in those paragraphs. By taking this ratio, we control for the fact that more commonly used words will tend to co-appear in a same paragraph more often than words that are less common. To measure the creativity of a category label in a given year, we calculate the difference between the value of one and the co-occurrence ratio. For category labels with more than two words, we take the average of each pair

³⁷ The full list of sources is available at http://factiva.com/sources/factivasearch/index_cs.aspx

³⁸ Due to limitations in the computing power, we had to restrict the creativity corpus to a subset of the familiarity corpus. We included all articles from one random day of each month published by the three newspapers with the highest circulation in the United States.

combination; for single-word labels, such as “device,” we assign a default value of one.³⁹

Theoretically, if our variable creativity equals zero, the words A and B are always mentioned together (always co-occur), while if creativity equals one, the words A and B have not co-occurred in that year. Creativity enters our regressions both in linear and quadratic terms, with one-year lag and in transformed logarithmic form.

Control Variables

We control for several other category labels characteristics that may correlate with their adoption. We control for the length of the category label. Longer labels, both in number of words and in word length, are less likely to gain adoption. We therefore include a dummy variable to capture the number of words and a variable that counts the total number of characters in a category label. Since we divided the category labels into their component words, we use a dummy variable to control for split words written together (no space between them) or joined by a hyphen. We also control for the use of words derived from verbs, such as “communicator” or “computer.” We include year dummies to account for nonlinear trends in adoption over time and to control for technology vintage effects. We also control for the age of the category label, defined as the difference between the focal year t and the label’s year of introduction (first appearance in a press release from any manufacturer). We use dummy variables to control for labels that contain trademarks (e.g. Galaxy), reference specific technologies (e.g. LCD), reference technology generations (e.g. 3G), and operating systems (e.g. Android). We use these controls to capture the importance of highlighting technology features in the labels adopted when introducing smartphones in the market. In the robustness section below, we introduce more granular

³⁹ The choice of a default value of 1 hinges upon the theoretical notion that a one-word category label would be the same as a compound with no overlap in the semantic network. However, it could also be argued that a one-word category label represents a compound completely overlapping in its semantic network. Thus, we also re-ran our analysis using the value of 0 for one-word category labels. We also omitted one-word labels from the analysis. In all cases, the sign and significance of the coefficients did not change.

variables that pertain to the technology of the smartphones behind each of the labels we observe. This additional analysis significantly mitigates concerns that technology is an omitted variable in our regressions.

Additional controls are added for the use of suffixes, such as “enabled,” “powered,” or “enhanced,” such as “Bluetooth enabled device.” The inclusion of these specific elements in a category label—some of which are actively promoted by their sponsors—may drive adoption beyond the effect of our explanatory variables. We further control for labels that reference certain lifestyles, such as “business phone” or “fashion phone,” as they may reflect different positioning strategies. In the robustness section below, we introduce more granular controls by considering the price of smartphones using a particular category label, which also captures elements of producers’ positioning strategy. Finally, consistent with our theorizing, we add controls for the structure of the labels’ semantic networks using head-nouns, such as “phone,” in the label “smartphone” or “device” in the label “handheld device.”⁴⁰ This helps us rule out the possibility that our results may be driven by the fact that labels used to introduce smartphones could be nested in existing classification systems and thus relate to an established category from which they derive meaning.

Method

In our regressions, the unit of analysis is label-year. Due to the count nature and the overdispersion of our dependent variable, we use a negative binomial regression, a generalization of the Poisson model that does not rely on the assumption that the expected value and the variance of the dispersion index are the same. To test for the appropriateness of the negative binomial over the

⁴⁰ Compounds consist of a head-noun and one or more modifiers, which alter the original meaning of the head-noun (Downing 1977; Guevara and Scalise 2009). For example, in the category label “smartphone,” “phone” is the head-noun and “smart” is the modifier.

Poisson regression, in each model we provide the estimate of $\ln(\alpha)$. In a Poisson model, α is constrained to 1; thus, whenever $\ln(\alpha)$ is not different from zero, α is equal to 1. If $\ln(\alpha)$ is significant, it provides support for the use of the negative binomial over the Poisson regression, which is the case in all models reported in Tables 2, 3, and 4.

The baseline negative binomial regression equation is then:

$$Adoption_{it} = f(BX_i, \gamma_1 \text{Familiarity}; \gamma_2 \text{Familiarity}^2; \delta_1 \text{Creativity}; \delta_2 \text{Creativity}^2; \tau)$$

Where X is the vector of time-invariant characteristics of the category label i , and τ are a set of dummies for each year in the sample.

Results

Table 2 reports the descriptive statistics of the variables, and their correlations. The table shows that, on average, category labels use slightly more than three words: they are 23 characters long, 44% join words together by having no space in between or using a hyphen (as in “smartphone” or “data-phone”), and 5% use some form of derivation, such as “communicator” or “computer.” Labels are on average three years and three months old. Around half of the category labels reference technological features, 13% reference an operating system, 9% reference a technology generation, 6% contain a trademark term, and about 13% of category labels use a suffix, such as “enabled,” “powered,” or “enhanced,” and 4% refer to a lifestyle, such as “business” or “fashion.” Table 1 also shows that our measures of familiarity and creativity enter our analysis with a 0.43 negative correlation; and these variables do not seem to be particularly correlated with the features reported above—with the highest correlations 0.27 between familiarity and use of joined words and 0.24 between familiarity and number of words.

Table 2. Summary Statistics

Variable	N	Mean	S.D.	Min	Max	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
(1) Number of Articles	1,900	0.81	3.36	0	84	1.00														
(2) Cites per label	1,900	2.03	12.75	0	345	0.91	1.00													
(3) Log(Familiarity) _{t-1}	1,900	2.07	0.98	-4.39	4.61	0.02	0.00	1.00												
(4) Log(Creativity) _{t-1}	1,900	4.59	0.02	4.40	4.61	-0.04	-0.01	-0.43	1.00											
(5) Age	1,900	3.24	2.95	0	14	0.15	0.17	0.08	-0.05	1.00										
(6) Number of words	1,900	3.22	1.31	1	9	-0.17	-0.16	0.24	-0.12	-0.07	1.00									
(7) Number of chars	1,900	23.41	5.88	13	53	-0.18	-0.16	0.01	-0.03	-0.02	0.76	1.00								
(8) Unified words	1,900	0.44	0.50	0	1	-0.01	-0.02	0.27	-0.05	-0.05	0.51	0.23	1.00							
(9) Trademark	1,900	0.06	0.25	0	1	-0.02	0.00	-0.07	0.10	-0.06	0.00	0.00	0.08	1.00						
(10) Generation	1,900	0.09	0.29	0	1	-0.03	-0.03	-0.02	0.05	-0.09	0.10	-0.01	0.04	0.09	1.00					
(11) Technology	1,900	0.52	0.50	0	1	-0.12	-0.11	-0.09	0.10	-0.12	0.41	0.30	0.20	-0.07	0.31	1.00				
(12) Operative System	1,900	0.13	0.34	0	1	-0.02	-0.03	0.00	-0.06	-0.10	0.29	0.36	-0.02	0.02	0.05	0.38	1.00			
(13) "enabled" suffix	1,900	0.13	0.34	0	1	-0.04	-0.04	-0.10	0.06	-0.09	0.31	0.36	-0.05	-0.04	-0.03	0.28	0.34	1.00		
(14) Lifestyle reference	1,900	0.04	0.21	0	1	-0.03	-0.03	0.11	0.00	-0.03	-0.07	0.08	-0.15	-0.06	-0.03	-0.13	0.02	0.00	1.00	
(15) Derivation	1,900	0.05	0.23	0	1	-0.03	-0.02	0.05	-0.03	0.06	-0.11	0.06	-0.13	-0.04	0.03	-0.08	-0.09	-0.09	0.03	1.00

Note: Summary Statistics of Category Labels between 2000 and 2010, which appeared at least in a given year.

Table 3 shows the results for the tests of Hypotheses 1 and 2. Models 1 and 2 include the control variables described above. The two models differ in their dependent variable: in Model 1 the dependent variable is the number of press releases that use the category label, while in Model 2 it is the number of times a category label is used (counting it in multiple times within each press release). Models 3 and 4 add a set of dummies for the head-nouns to each of the first two models. These dummies control for the alternative explanation that category labels' nestedness into existing classification systems could be an omitted variable explaining our results.

The first two rows of Table 3 show the results for familiarity. The linear term is positively related to the dependent variables, while the quadratic term is negative. The linear and quadratic terms are significant at 1% levels for the number of press releases using the label. They are even more significant, at 0.1% when the dependent variable is the number of label usages. Once we control for head-nouns in Models 3 and 4, the coefficients for familiarity retain the expected size and significance. The results suggest that the relationship between familiarity and the adoption of labels is not mediated by the existing classification systems. Overall, these results provide substantial evidence that familiarity and degree of adoption of a category label have an inverted U-shaped relationship, lending support to Hypothesis 1.

The third and fourth rows in Table 3 show the coefficients for creativity. The coefficients for the linear term of creativity are positive and significant when either of the two dependent variables is used, at 0.1% significance level. The coefficient for the quadratic term is negative and significant in both Models 1 and 2, with significance levels similar to those of the linear term. When controlling for the head-nouns in Models 3 and 4 the coefficients do not change in their sign and significance. Consistent with the results for familiarity, we find no evidence that the existing classification systems mediate the relationship between creativity and label adoption. Our results therefore provide evidence that creativity and degree of adoption of a category label have an inverted U-shaped relationship, lending support to Hypothesis 2.

For both familiarity and creativity, we further tested the nature of the inverted U-shaped relationship following a procedure suggested by Haans et al. (2016). In order to confirm the existence of an inverted U-shaped relationship, it is not sufficient that the coefficient for the quadratic term be significant. Two additional features should occur. First, the slopes at the ends of the data range are significant and of the expected sign: positive slopes at the smallest value and negative slopes at the highest value. Second, the inflection point must be located within the data range.

At the bottom of Table 3 we report the results of the additional analyses of the inverted U-shaped relationship and show that the slopes at the extremes of our data range are of the expected sign and significant after controlling for the head nouns. Moreover, the inflection point falls consistently within our data range; we estimate the confidence interval of the inflection point through the Fieller method (Fieller 1954).⁴¹

In Figure 2, we plot two panes displaying the quadratic fit of our dependent variable with respect to the measures of familiarity and creativity, respectively. These visual representations provide additional insights about the specific shape of the inverted U and, hence, the costs and benefits relationships that drive the mechanisms. The shapes of the respective inverted U-shaped curves in Figure 2 suggest interesting nuances in these relationships. In Pane A we observe the curve for familiarity. The positive slope is steeper than the negative slope, and the tipping point happens at relatively high levels of familiarity. This suggests that it takes high levels of familiarity for the cost of obviousness to offset the benefit of comprehension, meaning that the penalty for too much familiarity is only activated at high levels. This result is consistent with the slopes at the minimum and maximum of familiarity reported in Table 3. In Pane B we observe the curve for creativity. Compared with the familiarity plot, the creativity curve suggests that the benefit of curiosity and the cost of dissonance are fairly symmetric. In Table 3, the slopes at the minimum and

⁴¹ We do not find support for linear effects for familiarity (not reported), which provides further evidence of an inverted-U shape in the relationship instead of a curvilinear effect with a plateau.

maximum for creativity are closer than those for familiarity in line with the insights provided by the curves in Figure 2.

Table 3. Test of Familiarity and Creativity on Count of Press Releases and Citations

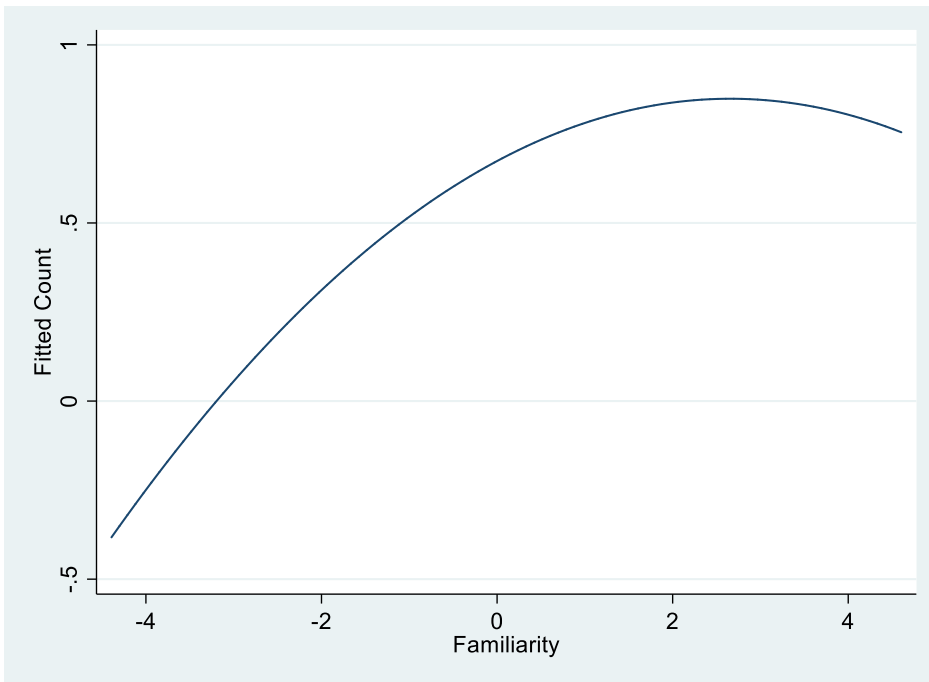
Dependent Variable	(1) Number of Articles	(2) Cites per label	(3) Number of Articles Head dummies	(4) Cites per label Head dummies
Log(Familiarity _{t-1})	0.509** (0.18)	0.514*** (0.12)	0.557** (0.18)	0.754* (0.35)
Log(Familiarity ² _{t-1})	-0.150** (0.05)	-0.166*** (0.03)	-0.157*** (0.04)	-0.211** (0.07)
Log(Creativity _{t-1})	1933.895*** (526.38)	2193.425*** (618.77)	1943.102*** (477.95)	2171.840*** (644.74)
Log(Creativity ² _{t-1})	-214.361*** (58.28)	-243.389*** (68.58)	-215.217*** (52.79)	-240.873*** (71.25)
Label Controls	Yes	Yes	Yes	Yes
Year Dummies	Yes	Yes	Yes	Yes
Head Dummies	No	No	Yes	Yes
Ln(<i>alpha</i>)	0.813*** (0.10)	1.359*** (0.08)	0.554*** (0.08)	1.151*** (0.07)
<i>Familiarity</i>				
<i>Slope at min</i>	4.665**	5.114***	4.897***	6.592**
<i>Slope at max</i>	-0.877**	-1.019**	-0.890**	-1.192**
<i>Inflection point within the range</i>	Yes	Yes	Yes	Yes
<i>Creativity</i>				
<i>Slope at min</i>	131.230***	146.652**	133.241***	146.229**
<i>Slope at max</i>	-40.447***	-48.273***	-39.122***	-46.680***
<i>Inflection point within the range</i>	Yes	Yes	Yes	Yes
Pseudo R ²	0.116	0.126	0.147	0.153
N	1900	1900	1900	1900

Notes: Negative Binomial Regression with standard errors clustered at the Label level for Models 1 and 2, and at the Head level in Models 3 and 4 in parentheses. “Label Controls” are: *Derivation, Trademark, Generation, “Enabled” suffix, Lifestyle, Spatially Unified Compound, Operating System* dummy variables, *Age, Number of Characters* and a set of dummy variables for the number of words. “Year Dummies” are a set of dummy variables for years from 2000 until 2010. Unit of analysis is label-year.

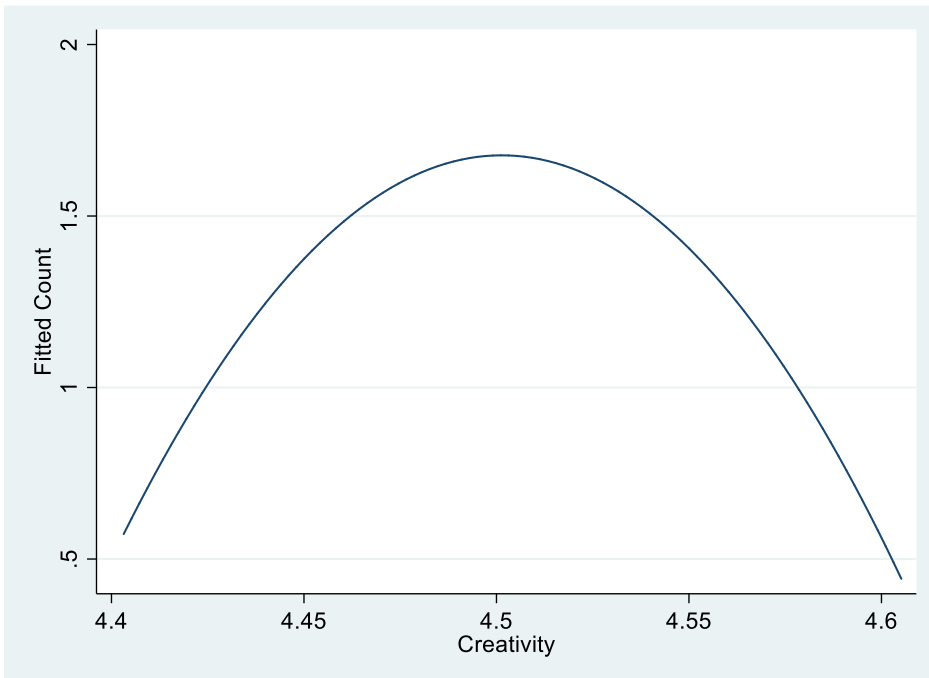
Significance levels: + p<0.1, * p<0.05, ** p<0.01, *** p<0.001

Figure 2. Quadratic Fit of Category Label Adoption

Pane A: Relationship between Familiarity and Category Label Adoption



Pane B: Relationship between Creativity and Category Label Adoption



Additional Analyses

Robustness Tests

We perform several types of robustness specifications to test the sensitivity of our results. First, one valid concern may arise from the fact that our dependent variable is constructed counting all different category labels that appear in a press release. This could lead to measurement error because some labels may be more important than others. To correct for this possible error, we re-ran our regression restricting the dependent variable to only the most used category label per press release, i.e. the category label with the highest frequency of use in each press release.⁴² Second, another concern could arise because we use measures based on U.S. newspapers while some of the smartphones in our dataset were also released in the United Kingdom. To appease this concern, we re-ran the regression based on U.S. devices only. For a third robustness check, we ran our models using the generalized estimation equation (GEE) method to consider possible autocorrelation of the standard errors. A fourth robustness check was conducted to mitigate possible concerns that our measures of familiarity and creativity could be two opposite ends of a spectrum. We followed two procedures to accomplish this we: (a) included the interaction terms at the linear and quadratic level into the regression; and (b) split the sample between early and later stage of the industry using the launch of the iPhone in 2007 as a watershed moment. Note that early and late industry stages are typically divided by the emergence of a dominant design (Suarez and Utterback 1995), and most industry experts agree that the iPhone was an innovation shock (Argyres et al. 2015), which paved the way for the dominant design in the industry. The results across these three robustness checks remain consistent, as reported in Table 4.

Model 1 in Table 4 has the same specification as Model 1 in Table 2 but considers only the label with the highest frequency. Model 2 has the same specification as Model 1 in Table 3, but only

⁴² For further robustness, we also ran regressions: (a) omitting the label “smartphone” from our sample, (b) omitting the labels longer than three words, and (c) omitting labels with references to technologies or trademarks. Our findings remained consistent.

considers U.S. devices and their associated labels. Model 3 reports the GEE specification that accounts for possible autocorrelation in the standard errors. Model 4 in Table 4 has the same specification as Model 1 in Table 3, but controls for the interactions between familiarity and creativity. Models 5 and 6 in Table 4 are a split sample analysis of the dataset before and after 2007.

As for the first robustness test, the larger size of the coefficients in Model 1 in Table 4 with respect to Model 1 in Table 3 suggests that when only the label with the highest frequency in a press release is considered, the effect of familiarity is stronger while the effect of creativity is weaker, but the inverted U-shaped relationship is still retained for both. Regarding the second robustness test, the results in Model 2, Table 4 are consistent in terms of sign and significance with those in Model 1, Table 3. We further use a Wald Test to inspect the equality of the coefficients across specifications to make sure that our measures are equally capturing adoption with and without the inclusion of U.K. devices. We found no significant differences in the coefficients both for familiarity in linear terms ($\chi^2 = 1.48$ p-value= 0.223) and creativity in linear and quadratic terms ($\chi^2 = 0.05$ p-value= 0.817 and $\chi^2 = 0.06$ p-value= 0.802, respectively). The difference for the coefficient for familiarity in the quadratic term is significant at the 10% level ($\chi^2 = 3.52$ p-value= 0.061). Overall, these results suggest that our measures are robust: some smartphones in our database were released in the United Kingdom. The third robustness check, regarding the possible autocorrelation of the unobservable characteristics, is presented in Model 3, Table 4. The results with the GEE method, both in the sign and the significance of the coefficients, are consistent with our original specification.

The final robustness check addresses the possibility that familiarity and creativity might be two opposite ends of a spectrum. We first included interaction terms between the two variables to check if the coefficients for the main effects changed after their inclusion. Model 4, Table 4 shows the result: the coefficients have the same sign, but those for familiarity do not reach significance. This is probably likely because adding interaction terms exacerbates the collinearity between the

variables. In Models 5 and 6 in Table 4, we ran an additional analysis to test for possible different trends for familiarity and creativity in the split samples. For the pre-2007 period, both familiarity and creativity follow an inverted U-shaped relationship. For the post-2007 period, familiarity retains an inverted U-shaped relationship with label adoption, but the relationship between creativity and label adoption becomes linear and negative. As we note in the discussion section, this finding has interesting implications for the boundary conditions of our theory. Taken together, our robustness tests are largely consistent with our hypotheses and main results.

Table 4. Robustness Checks

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent Variable	Number of articles	Number of articles	Number of articles	Number of articles	Number of articles	Number of articles
	Most used label	Only US smartphones	GEE	Interaction controls	Before 2007	After 2007
Log(Familiarity _{t-1})	2.001** (0.744)	0.362* (0.15)	0.299** (0.09)	67.197 (132.08)	0.334* (0.14)	0.641+ (0.33)
Log(Familiarity _{t-1}) ²	-0.439** (0.165)	-0.095* (0.04)	-0.093*** (0.02)	-8.620 (10.69)	-0.101** (0.04)	-0.207** (0.08)
Log(Creativity _{t-1})	1385.331* (614.476)	1868.743*** (552.93)	28.816*** (6.63)	1803.110* (823.95)	740.144+ (415.09)	-46.410*** (7.83)
Log(Creativity _{t-1}) ²	-153.987* (67.576)	-206.547*** (61.06)	-4.448*** (0.72)	-199.163* (87.19)	-82.124+ (45.78)	. (.)
Label Controls	Yes	Yes	Yes	Yes	Yes	Yes
Year Dummies	Yes	Yes	<i>Trend</i> only	Yes	Yes	Yes
Interaction Controls	No	No	No	Yes	No	No
Ln(<i>alpha</i>)	0.261* (0.233)	0.273+ (0.16)	- -	0.809*** (0.10)	0.050 (0.15)	1.151*** (0.11)
Pseudo R ²	0.163	0.133	-	0.117	0.125	0.135
N	338	1021	1821	1900	928	972

Notes: Negative Binomial Regression with standard errors clustered at the Label level in parentheses. “Label Controls” are: *Derivation*, *Trademark*, *Generation*, “Enabled” *suffix*, *Lifestyle*, *Spatially Unified Compound*, *Operating System* dummy variables, *Age*, *Number of Characters* and a set of dummy variables for the number of words. “Year Dummies” are a set of dummy variables for years from 2000 until 2010. Unit of analysis is label-year. Significance levels: + p<0.1, * p<0.05, ** p<0.01, *** p<0.001

Alternative Explanations

In Table 5, we report the results from performing additional sensitivity analyses conducted to rule out alternative explanations and to mitigate omitted variable biases. We show that our main analysis is robust to several alternative models. Model 1 in Table 5 replicates the main analysis presented in Table 3, Model 1, as a starting point for comparison.

A first test for alternative explanations for our results relates to the structure of the words being used. Indeed, a potential source of bias arises because we omit the number of syllables contained in each label. Syllables are a vocal sound or set of sounds uttered with a single effort of articulation and they capture the amount of time to process a category label phonemically.

For example, the two category labels, “touch phone” and “superphone,” both have two words and the same number of characters, but the former has only two syllables while the latter has three. For our robustness check, we coded the number of syllables in each word, added all syllables in a label, and included this additional variable in the analysis. We included a full set of dummies for the number of syllables, to consider nonlinear trends. We report the results in Model 2, Table 5, which demonstrates that adding the syllables variable in the model does not alter our main findings.

Other alternative explanations refer to the possible effects from the underlying technology of smartphones that use a particular label; that is, label adoption could be driven by technology characteristics and not category label characteristics. In order to address this concern, we collected data regarding the technology characteristics of each product in our dataset. We coded the following variables: size (width, depth, height in millimeters); screen size (in inches); screen resolution (in pixels); camera resolution (in megapixels); and memory (in MB). We also coded for the generation of wireless technology for which a device was capable (2G, 3G, or higher). We then performed a principal component analysis with all technology characteristics.⁴³ We retained the three principal components whose eigenvalues were greater than one. Together, they explain about

⁴³ The results of the principal component analysis are in the Appendix, Tables A1-A3.

70% of the total variance, and come out with meaningful factor loadings. The loadings of the first factor relate to the size of the smartphone; the loadings of the second factor relate to screen characteristics; and the loadings of the third factor relate to key technology capabilities possessed by the smartphones: camera resolution, memory size, and wireless technology generation. For the analysis, first we grouped smartphones according to the labels they used in a given year and then, within each group, averaged their scores on the three principal components. When a category label was not used, we retained the technology scores from the last year that the label was in use.⁴⁴ Model 3 in Table 5 shows that the sign and significance of the coefficients do not change when compared with our main analysis.

Similarly, another possible alternative explanation for our results could be the products' form factor (Rindova and Petkova 2007). The form factor of the products that use a particular label could explain why those labels get adopted. If controlling for the relationship between form factor and adoption reduces the size and significance of our hypothesized relationships, then form factor was an omitted variable. To test for this possibility, we included in the analysis a form factor variable that captures the seven most common smartphone forms. This information enters our regression as the share of smartphones that use a specific form factor in a given year, for each category label. We report the results in Model 4, Table 5: the size and significance of the coefficients do not change and thus our main hypotheses hold.

A fourth alternative explanation for our results could be that they were driven by the characteristics of the firms introducing the labels. For instance, if a market leader introduces a given category label, it could have an oversized effect on the adoption of that label. For this reason, we added dummy variables to account for the market leaders at different stages of the industry: Nokia, Motorola, RIM, Samsung, and Apple. We add these controls to Model 5 and find no difference in the sign and significance of the coefficients that capture the relationship among familiarity,

⁴⁴ We run an additional analysis excluding those category labels not used. The sign and significance of our results are unchanged.

creativity, and adoption.

A fifth alternative explanation we explore relates to the firms' strategy to introduce the products. Specifically, we want to capture the effect of an aggressive price strategy that may drive adoption by the low end of the market, or a premium price strategy that may affect adoption by differentiation and status effects. Therefore, we computed the average price of the products using a certain category label in a given year. In order to retain observations, we coded with a dummy variable the observations with missing price information. We include the logarithm of the average price in both linear and quadratic terms and present the results in Model 6, Table 5. The coefficients for familiarity and creativity of category labels show no change in their size and significance, and thus our main hypotheses hold.

A sixth alternative explanation for our results could be that label adoption is driven by the past performance of the phones that used a given category label. Stakeholders are more likely to adopt labels associated with successful products. Unfortunately, data about smartphone sales by model are extremely difficult and expensive to obtain. As an alternative, we approximated product success with the count of media mentions for each smartphone in the three years following its introduction, using Factiva as our data source.⁴⁵ We averaged the number of mentions of the smartphones using a given category label for each year, which enters our regression in lagged log form. Model 7, Table 5 presents the results, showing that producers are indeed more likely to adopt labels associated with previously successful products. However, even after controlling for this effect, our main results hold.

Model 8 in Table 5 brings together all additional controls used in the alternative explanation analyses. Once again, our main results hold even in this full model. Taken together, our analyses provide strong evidence of the role of familiarity and creativity in label adoption.

⁴⁵ We made sure the smartphone mentions were not biased by negative reviews and ran a sentiment analysis on each paragraph mentioning each device. On a scale that goes from -1 (completely negative) to 1 (completely positive), each paragraph mentioning a smartphone had an average sentiment of 0.12 and the share of paragraphs with negative score is 3.63%. The results of the Sentiment Analysis can be found in Table A4 of the Appendix.

Table 5. Additional Robustness Specifications

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dependent variable	Number of articles	Number of articles	Number of articles	Number of articles	Number of articles	Number of articles	Number of articles	Number of articles
Alternative explanations	Baseline	Syllables	Technology	Design	Firms	Strategy	Celebrity	Pooled
Log(Familiarity _{t-1})	0.509** (0.18)	0.316* (0.13)	0.375** (0.13)	0.522** (0.17)	0.426** (0.15)	0.488*** (0.13)	0.513** (0.17)	0.321** (0.12)
Log(Familiarity _{t-1}) ²	-0.150** (0.05)	-0.151*** (0.04)	-0.096** (0.04)	-0.158*** (0.05)	-0.133** (0.04)	-0.143*** (0.04)	-0.149** (0.05)	-0.116** (0.03)
Log(Creativity _{t-1})	1933.895*** (526.38)	1853.410*** (458.07)	1544.463*** (359.63)	1854.992*** (496.38)	1818.637** (599.23)	1593.844*** (456.38)	1834.025*** (514.00)	1354.673*** (289.31)
Log(Creativity _{t-1}) ²	-214.361*** (58.28)	-171.276*** (39.79)	-205.734*** (54.96)	-201.362** (66.38)	-176.557*** (50.53)	-203.303*** (56.92)	-149.946*** (32.05)	-205.333*** (50.74)
Technology Screen features			1.166*** (0.08)					0.957*** (0.07)
Technology Size features			-0.101 (0.06)					0.014 (0.08)
Technology Memory and connectivity			0.002 (0.03)					0.084+ (0.05)
Firm strategy: Log(Avg price of devices)						3.850*** (1.04)		2.780** (1.08)
Log(Avg price of devices) ²						-0.400*** (0.10)		-0.298** (0.10)
Log(Devices Mention) _{t-1}							0.146*** (0.04)	-0.011 (0.04)
Label Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Dummies	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes
Syllables Dummies	No	Yes	No	No	No	No	No	Yes
Form Factor Controls	No	No	No	Yes	No	No	No	Yes
Producer Controls	No	No	No	No	Yes	No	No	Yes
Log(α)	0.813*** (0.10)	0.678*** (0.09)	0.293** (0.10)	0.720*** (0.10)	0.505*** (0.13)	0.537*** (0.10)	0.783*** (0.10)	-0.357* (0.17)
Pseudo R ²	0.116	0.137	0.206	0.133	0.148	0.150	0.120	0.273
N	1900	1900	1900	1900	1900	1900	1900	1900

Notes: Negative Binomial Regression with standard errors clustered at the Label Level. “Label Controls” are: *Derivation, Trademark, Generation, “Enabled” suffix, Lifestyle, Spatially Unified Compound, Operating System* dummy variables, *Age, Number of Characters* and a set of dummy variables for the number of words. “Year Dummies” are a set of dummy variables for years from 2000 until 2010. “Form Factors Controls” are a set of dummies for the phones with a specific form factor using a certain label in a given year. “Producer Controls” are a set of dummies for whether one of the major producers (Apple, Motorola, Nokia, RIM, and Samsung) used a certain label in a certain year. Unit of analysis is label-year. Significance levels: + $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

FAMILIARITY AND CREATIVITY IN CATEGORY LABELS: RESULTS FROM TWO ONLINE EXPERIMENTS

In order to fine-tune our identification of familiarity and creativity, extend our results to other types of stakeholders beyond producers, broaden the scope of our industry beyond smartphones, and address any remaining endogeneity concerns in our field data, we designed and ran two online experiments. One experiment was designed to portray a generic hypothetical technology industry, which helped avoid the influence that a known technology, such as smartphones, could have on participants' adoption of specific labels (Grodal et al. 2015). The other experiment investigated differences in label adoption according to the degree of radicalness of the technology, by asking participants to consider two scenarios: radical versus incremental technology.

The experiments also allowed us to mitigate remaining concerns about two sources of bias in our field data analysis: measurement errors and omitted variables (Wooldridge 2010). Regarding measurement errors, we computed our measures based on a specific set of newspapers, but these may not perfectly represent the English language. For example, in our sample of newspaper articles, the word "potato" appears 8,960 times in 2014, whereas the word "dividend" appears 98,126 times in the same period. Nevertheless, it is quite likely that more people would rate the word "potato" as more familiar than the word "dividend." This potential bias in our regression analysis is minimized in our experiment because we directly asked the subjects to evaluate the perceived familiarity and creativity of specific labels. As for possible omitted variables, the word combinations that constitute a label chosen by producers are not random, and their relative suitability to describe a new category could be due to unobserved heterogeneity associated with both the dependent and the explanatory variables. In a randomized experiment, these problems are eliminated.

Experiment 1: Category Label Adoption - General Technology

Design and Participants

We first constructed a pool of 400 random category labels. Based on linguistic research, we decided to focus on a particular structure, the commonly used “adjective-noun” form (Bisetto and Scalise 2005). We intersected two sets of 20 randomly selected adjectives and 20 randomly selected nouns from a large corpus of one syllable words.⁴⁶ In order to avoid confounding effects with verb-ing issues (Pinker 1994) common in the English language, we selected only words that univocally perform the specific noun function. Examples of our artificially generated labels are: “posh-waist,” “grum-bock,” and “dense-pear.” We then recruited a total of 328 American participants via Amazon Mechanical Turk, who completed an experiment online for a small fee. Our experiment follows a within-subject design, common in consumer research.

Procedure

Each subject completed an online task on Qualtrics by answering a call on the Amazon Mechanical Turk platform.⁴⁷ Each subject was presented with four pages and was required to complete one page before moving to the next. The first page contained brief instructions. A second page provided a short definition of “familiarity” as a construct, and then asked each respondent to score familiarity (assigning a value from 1 to 7) for a list of 50 category labels selected randomly from our 400 category-label pool. A third page provided a short definition of “creativity” as a construct and then asked each respondent to assign a value from 1 to 7 for another list of 50-word combinations. We took care to randomize the order in which the word combinations appeared on a page as well as to randomize the order in which the familiarity and creativity pages appeared as the respondent moved through the survey. After completing the pages for familiarity and creativity,

⁴⁶ The list of words was taken from <http://www.ashley-bovan.co.uk/words/partsofspeech.html>

⁴⁷ It is worth noting that our choice of online experiment through Amazon Mechanical Turk has been validated by previous studies in several fields, such as decision making (Paolacci et al. 2010), political science (Berinsky et al. 2012), and psychology (Buhrmester et al. 2011). These studies compared traditional controlled lab experiments with those run using Amazon Mechanical Turk and found no differences in the results. In strategy, previous studies used Amazon Mechanical Turk experiments jointly with regression analysis (Fonti et al. 2017).

subjects were asked the following question: “How likely are you to use each of the following word combinations to refer to a new technology you have never heard of before?” We purposely left a degree of ambiguity and provided little information to avoid cognitive biases towards particular technologies.

After we collected the data, we dropped subjects who marked the same answer for every single question because it might have been a sign they were not paying enough attention to the task. After these deletions, we retained 263 subjects and performed ordered logit regressions with label-subject as the unit of analysis. The dependent variable is the subjects’ rating of their likelihood of adoption and the explanatory variable is each subject’s rating of the label’s familiarity and creativity. As controls, we used compound head dummies and/or label dummies.

We tested the sensitivity of our results two ways. First, we calculated the familiarity and the creativity of the random word combinations based on Factiva counts, using the same methodology we used in the field data analysis of category labels, and as presented in the previous section of this paper. Second, because it is not possible to control for subjects’ fixed effects in ordered logistic regressions, we used individual mean conditional logit (IMCLOG) as suggested in the economics literature (Riedl and Geishecker 2014). This method estimates a conditional logit by constructing a binary dependent variable that takes the value of one if the preference of a subject is above their mean for all compounds, and zero otherwise.

Results

Table 6 reports descriptive statistics of the experiment data, using subject-label as the unit of analysis. On average, the familiarity of the category labels presented to the participants is low, 2.0 in the 1 to 7 scale. This result is reasonable if we recall that the words used for the category labels were drawn randomly from a dictionary. For the creativity of category labels, the average score in the experiment was 4.0 in the 1 to 7 scale. This higher score for creativity may reflect that words

were combined randomly to create novel category labels and are thus not likely to be found together in everyday usage. Finally, it is worth stressing that the scores for familiarity and creativity are not correlated in the experiment data (correlation score of -0.02). If familiarity and creativity were the opposite ends of a spectrum, they should be highly and negatively correlated. Although only descriptive evidence, this result tends to support our conceptualization of familiarity and creativity as two distinct constructs.

Table 6. Summary Statistics of the experimental evidence

Variable	N	Mean	S.D.	Max	Min	(1)	(2)	(3)
(1) Likelihood of adoption	13150	2.220	1.657	1	7	1		
(2) Familiarity	13150	2.008	1.523	1	7	0.310	1	
(3) Creativity	13150	4.022	1.869	1	7	0.118	-0.018	1

Note: Unit of observation is label-subject.

Table 7 provides a regression analysis of the experimental data at the label-subject unit of analysis. Model 1 is the baseline analysis, where only familiarity and creativity enter the regression in both linear and quadratic terms. In Model 2, we control for the head-noun as we did in our earlier field data analysis, while in Model 3 we control for label fixed effects. Controlling for head-nouns and category labels minimizes the problem that ratings for specific words in the category label may be driving the results, rather than the compound itself. In Model 4, we apply IMCLOG to control for subject fixed effects. Models 5 and 6 are a sensitivity analysis where we compute familiarity and creativity of the randomly drawn category labels based on Factiva counts, following the same procedure we used in our field data analysis. Model 5 replicates the baseline model and Model 6 replicates the IMCLOG model to control for the possibility that the subjects' individual characteristics could drive results.

For all models, the coefficients for familiarity and creativity are significant at least at the 1% level and have the expected sign. We also conducted further analysis of the inverted U-shaped relationship and we determined that the inflection point falls within the data range for all models. These results once again confirm and lend support to our main hypotheses.

Table 7. Experimental Evidence: Likelihood to adopt

	(1)	(2)	(3)	(4)	(5)	(6)
DV:	Likely to adopt	Likely to adopt	Likely to adopt	Likely to adopt	Likely to adopt	Likely to adopt
Method:	Ord. Logit Baseline	Ord. Logit Head FE	Ord. Logit Label FE	IMCLOG Subject FE	Ord. Logit Alternative	IMCLOG Subj. FE Alternative
Familiarity	0.926*** (0.047)	0.928*** (0.048)	0.955*** (0.049)	0.360*** (0.07)	5.136*** (1.067)	6.161*** (1.37)
Familiarity ²	-0.087*** (0.007)	-0.087*** (0.007)	-0.090*** (0.008)	-0.031** (0.01)	-7.254*** (1.618)	-8.681*** (2.08)
Creativity	0.772*** (0.045)	0.772*** (0.045)	0.766*** (0.045)	0.241*** (0.07)	2.103* (0.850)	2.883** (1.10)
Creativity ²	-0.082*** (0.005)	-0.082*** (0.005)	-0.081*** (0.006)	-0.022** (0.01)	-2.604** (0.866)	-3.875*** (1.12)
Pseudo- R ²	0.051	0.052	0.064	-	0.001	-
<i>Familiarity</i>						
<i>Slope at min</i>	0.752***	0.754***	0.776***	0.298***	5.136***	6.160***
<i>Slope at max</i>	-0.292***	-0.290***	-0.300***	-0.723	-4.920***	-5.873***
<i>Inflection point within the range</i>	Yes	Yes	Yes	Yes	Yes	Yes
<i>Creativity</i>						
<i>Slope at min</i>	0.609***	0.609***	0.603***	0.197***	2.103*	2.883**
<i>Slope at max</i>	-0.369***	-0.369**	-0.372***	-0.071	-1.506***	-2.489***
<i>Inflection point within the range</i>	Yes	Yes	Yes	Yes	Yes	Yes
<i>N</i>	13150	13150	13150	13150	13150	13150
<i>N Subjects</i>	263	263	263	263	263	263
<i>N Labels</i>	400	400	400	400	400	400

Note: Robust standard error in parenthesis. IMCLOG stands for individual mean conditional logit as in Riedl and Geishecker (2014) the DV is an indicator variable for higher than individual's average score of likelihood to adopt. Significance level + $p < 0.1$ * $p < 0.05$ ** $p < 0.01$ *** $p < 0.001$

To summarize, facing a choice among random word combinations, subjects chose category labels for a hypothetical new technology whose familiarity and creativity scores were not at either extreme of the respective distributions. The low correlation between the two constructs (Table 5) further supports our conceptualization of familiarity and creativity as two different constructs and

not as opposite ends of the same spectrum.⁴⁸ Overall, the results from the experiment are highly consistent with our hypotheses and corroborate the findings from the archival data analysis.

Experiment 2: Category Label Adoption - Incremental versus Radical Technologies

Design and Participants

The design for Experiment 2 follows Experiment 1, with an added randomization between subjects. One random subset of participants answered the question about category label adoption in a setting where they were asked to consider a new, hypothetical product based on a radical technology. A second random subset of participants answered the same question but was asked to consider category label adoption in a setting where a new, hypothetical product was based on an incremental technology. Radical technology was defined as a “new technology that represents a major departure from existing products.” Incremental technology was defined as a “new technology that represents only a minor improvement over existing products.” We recruited 400 American participants on Amazon Mechanical Turk in exchange for a small fee.

Procedure

The procedure was the same as in Experiment 1, with an additional manipulation check to eliminate respondents who did not pass the attention test showing they understood the technology setting to which they had been assigned. We also removed those respondents whose answers suggested lack of attention, i.e. by always choosing the same score for each item. Out of 400 subjects, 202 subjects provided consistent answers.

Results

Table 8 reports the results of Experiment 2. Model 1 tests the baseline specification. Model 2 adds label fixed effects as controls, while Model 3 includes subjects’ fixed effects. Interestingly, the results for Models 1 and 2 shows that familiarity has a positive but linear effect when subjects

⁴⁸ Additionally, we regressed creativity on familiarity, and found no significant association.

perceive the technology as radical, suggesting that for higher degrees of technology radicalness additional familiarity is always associated with higher adoption.⁴⁹ Regarding creativity, we observe no substantial departures in the size and significance of coefficients.

Table 8. Experimental Evidence: Degree of radicalness and Likelihood to adopt

	(1.inc)	(1.rad)	(2.inc)	(2.rad)	(3.inc)	(3.rad)
DV:	Likely to adopt	Likely to adopt	Likely to adopt	Likely to adopt	Likely to adopt	Likely to adopt
Method:	Ord. Logit Incremental	Ord. Logit Radical	Ord. Logit Incremental Label FE	Ord. Logit Radical Label FE	IMCLOG Incremental Subj. FE	IMCLOG Radical Subj. FE
Familiarity	0.822*** (0.074)	0.259*** (0.076)	0.839*** (0.075)	0.241** (0.077)	0.536*** (0.146)	0.446** (0.088)
Familiarity ²	-0.094*** (0.009)	0.0004 (0.009)	-0.097*** (0.009)	0.003 (0.009)	-0.058** (0.018)	-0.028+ (0.016)
Creativity	0.963*** (0.070)	0.912*** (0.066)	0.976*** (0.071)	0.938*** (0.067)	0.400* (0.183)	0.541*** (0.138)
Creativity ²	-0.075*** (0.0103)	-0.083*** (0.010)	-0.075*** (0.010)	-0.083*** (0.010)	-0.035* (0.023)	-0.055** (0.183)
Pseudo- R ²	0.073	0.050	0.082	0.060	0.013	0.023
<i>N</i>	4750	5350	4750	5350	4750	5350
<i>N Subjects</i>	95	107	95	107	95	107
<i>N Labels</i>	400	400	400	400	400	400

Note: Robust standard errors for models 1 and 2, and subject clustered standard errors for model 3. IMCLOG stands for individual mean conditional logit as in Riedl and Geishecker (2014) the DV is an indicator variable for higher than individual's average score of likelihood to adopt.

Significance level: + $p < 0.1$ * $p < 0.05$ ** $p < 0.01$ *** $p < 0.001$

DISCUSSION

We began this paper by asking which characteristics drive the adoption of category labels in emerging industries. Category labels play an important role in shaping stakeholders' understanding of technology products (Porac et al. 2001, Jones et al. 2012, Cattani et al. 2017). We build on existing research (Quillian 1969, Rosch 1978) to conceptualize semantic networks along three dimensions: the hierarchy embedded in the taxonomy of language, the density of the network that

⁴⁹ Consistent with this result, in Model 3 that controls for subjects' fixed effects, we find an inverted U-shaped whose inflection point falls beyond the range of familiarity, suggesting that more familiarity is always beneficial within the score range.

emerges from the co-occurrence of words, and the degree of overlap in the semantic connections between words. Category labels get their meaning from the semantic network associated with their component words (Bingham and Kahl 2013). The semantic network associated with a focal label conveys notions of familiarity and creativity, which ultimately determines how stakeholders perceive a new technology product (Clark 1985).

We theorize an inverted U-shaped relationship between label adoption and the degree of familiarity and creativity emanating from the label's semantic network. Two opposing mechanisms account for this non-linear pattern. In the case of familiarity, the opposing mechanisms are the benefits of increased comprehension and the cost of increased obviousness. In the case of creativity, these mechanisms are the benefits of arousing curiosity and the cost of increased dissonance. The implication of our theorizing is that for both familiarity and creativity, there is an optimal level—a “sweet spot”—that maximizes the probability of label adoption. Our hypotheses received strong support from both the archival data analysis and two online experiments; furthermore, our models withstood several robustness tests (e.g. Haans et al. 2016) that ruled out alternative explanations.

Our study contributes to the industry evolution literature by expanding our understanding of the socio-cognitive dimensions of an emerging industry (Clark 1985). This literature emphasizes how the physical characteristics of new technology products convey familiarity and creativity, which in turn are important for adoption (Hargadon and Douglas 2001). For instance, Rindova and Petkova (2007, p. 220) propose “an optimal level of product novelty” in product form that would lead to higher adoption. Our work here shows that this optimal level might not only depend on the physical characteristics of the product, but also on the notions of familiarity and creativity conveyed by the semantic network of the category label. In so doing, we expand on existing understandings of industry evolution to include how the category label can elicit a larger meaning system surrounding the new technology.

Our results also point to how familiarity and creativity affect adoption differently. Our robustness tests suggest that as the industry matures, familiarity and creativity have a decreasing role in shaping adoption. The industry evolution literature has long documented that the mature stage of an industry is associated with a significant decrease in the entry of firms and with a greater standardization in the industry products (Abernathy and Utterback 1978, Anderson and Tushman 1990), which should result in less heterogeneity in category labels (Rosa et al. 2005). In addition, mature industries are likely to coalesce on a dominant category (Suarez et al. 2015), which ends the contestation that is typically observed in young industries. In mature industries, the semantic network associated with the industry stabilizes, and thus the influence of the creativity and familiarity of the category labels is likely to play a lesser role. Future research might expand on this exploratory finding by studying category labels' adoption during different phases of the industry life cycle.

Similarly, our findings point to different roles of familiarity and creativity when it comes to incremental and radical technologies. When technology products are based on radical technologies, the relationship between the familiarity of a category label and its adoption appears to be linear, i.e. more familiarity is always beneficial. The literature on industry evolution has emphasized the benefits of technological radicalness (Schumpeter 1939, Abernathy and Utterback 1978, Utterback 1994). However, recent research has suggested that many radical products are not adopted due to a lack of congruence with existing schemas (Hargadon and Douglas 2001, Rindova and Petkova 2007). In these settings, the marginal benefit of comprehension always dominates the marginal cost of obviousness because the technology departs significantly from existing understandings. Future research could compare settings in which the technologies differ in degree of radicalness.

By showing that familiarity and creativity lead to different adoption patterns depending on the stage of the industry and the radicalness of the technology, we deepen our understanding of how these two constructs differ and enter analysis of industry evolution. Most of the existing

research has posited that familiarity and creativity are opposite ends of the same spectrum (Bingham and Kahl 2013), thus emphasizing a tradeoff between the two. In contrast, our results suggest that familiarity and creativity are distinct constructs. Our empirical evidence on this point is substantial, given that we corroborated the findings from our archival analysis—which measured creativity and familiarity in the actual labels used in the smartphone industry—with an experiment designed for this purpose. Our theorizing here is consistent with more recent research (Zuckerman 2016, Dalpiaz and Di Stefano 2018). For instance, Zuckerman (2016) has also conceptualized the two constructs as separate by proposing a two-stage model for how stakeholders evaluate products and firms. This framework shares with ours the distinctiveness of the constructs, and it can be considered complementary to our approach as it emphasizes a temporal dimension and focuses on sociopolitical legitimacy. Dalpiaz and Di Stefano’s (2018) work on narrative practices also suggests a similar distinction between familiarity and creativity. Future research can build on these and our insights here by jointly exploring familiarity and creativity from both cognitive and sociopolitical perspectives. Future studies can also extend and test this theorizing in other contexts, using constructs other than category labels, such as narratives or product form.

We contribute to the literature on categories (Negro et al. 2010) by bringing together the literature on the categorical imperative (Zuckerman 1999, Zuckerman 2000, Negro and Leung 2013) with the literature on the distinction between familiarity and creativity (Hargadon and Douglas 2001). While the literature on the categorical imperative has shown the penalties of attempting category spanning and recombination (Hsu et al. 2009, Carnabuci et al. 2015, Montauti and Wezel 2016), the literature on familiarity and creativity has emphasized how such recombination might be beneficial (Bingham and Kahl 2013). By focusing on how category labels are formed through word recombination, our study can help bridge these two literatures. For instance, we show that there is an optimal level of creativity that is beneficial, but too much creativity becomes detrimental; in other words, some recombination of category labels might be

beneficial for adoption. Furthermore, our results lend support to the findings of Ruef and Patterson (2009) and Pontikes (2012) suggesting that creativity is beneficial in the early stages of an industry but can be detrimental in later stages.

We also expand the current literature on categories by introducing the notion of semantic networks (Quillian 1969, Collins and Loftus 1975). Drawing on semantic networks enables us to develop mechanisms that explain the relationship between familiarity, creativity, and a category label's adoption. Understanding categories and category labels from the point of view of semantic networks has been an underappreciated perspective within the study of the socio-cognitive dimensions of technologies, and more generally in the categorization literature. The mechanisms we theorize help explain why the effect of familiarity and creativity is not linear but follows an inverted U-shape. By spelling out how different density levels of a label's semantic network creates costs and benefits associated with familiarity and creativity, we provide a parsimonious explanation for the optimal levels of these constructs that lead to greater traction in the market. By theorizing and testing the role of semantic networks in the study of category labels, we contribute to the literature by identifying some of the key characteristics that make certain category labels gain traction and leave others behind (Kennedy and Fiss 2013, Lo and Kennedy 2014).

Our research has implications for firms' agency and strategizing. Although categorical labels are socially constructed through the actions of users, critics, producers, and other stakeholders (Jones et al. 2012, Grodal et al. 2015), producers should think carefully about their labeling strategies when introducing new technology products into an emerging market. It is likely that firms, when introducing their products, may not be fully aware of the socio-cognitive dynamics that take place in their emergent industry, let alone their consequences. As existing research has shown (Zuckerman 1999, Pontikes 2012), choosing a categorical positioning inconsistent with what stakeholders have begun to accept as the major categories in an industry can have important consequences for the success of the firm's products and its overall performance. We show that

managing the familiarity and creativity of category labels is important for adoption and requires a nuanced understanding of the stage of the industry and the degree of technological radicalness of the different technology products.

There are several boundary conditions to our findings. There might be situations in which a powerful stakeholder plays a major role in the creation of an emerging market, which might shape the strength of the mechanisms that drive the adoption of new categories labels (Mazzucato 2015). For instance, Dobbin and Dowd (2000) document how the government, through the enforcement of antitrust regulation and an active intervention in the early railroad industry, influenced the prevailing business model and the number of competitors in that nascent industry, thus altering the intensity and duration of category label dynamics. Similarly, Russo (2001, p. 60) documents how the enactment of the Public Utilities Regulatory Policies Act of 1978, “generated an entrepreneurial opportunity that was not envisioned by its authors: building new facilities for the sole purpose of producing electricity for sale to utilities” (p. 60), forming what came to be known as the “co-generators” category. In some countries the government may also directly decide on the category label that will be used for a new technology. For example, in 2003, a French decree stated that the category label “courriel” should be used in all official communications to refer to “email.”⁵⁰ If a public actor were to actively interfere in an industry, we would need additional empirical tests to determine whether familiarity and creativity would still drive category labels’ adoption.

Factors other than the government may constrain the set of possible category labels in an emerging industry. For example, oppositional markets are defined as ideologically opposed to existing markets (Verhaal et al. 2015, p. 1466), as in “green energy,” which opposes the traditional polluting “brown” fuels (Sine et al. 2005). In such industries, the words used to create novel category labels are therefore chosen out of a limited set of words consistent with what the emerging industry is opposing. Similarly, some industries suffer from “categorical stigma” (Vergne 2012) in

⁵⁰ It actually replaced the term “courrier électronique” introduced also by decree in 1997.

that its organizations become targets of disapproval due to contentious businesses or practices (Piazza and Perretti 2015). In these industries producers try to avoid publicity (Durand and Vergne 2015) and stakeholders may use category labels to minimize the stigma associated with their activities. For example, when in 2015 Phillip Morris introduced a new product to replace traditional cigarettes (heating tobacco without burning it), they came out with new category labels for the products, such as “tobacco heating systems” and “tobacco heating technology” to distance the devices from the negative stigma of the “cigarette” category. The limitations on the set of feasible words and resulting label contestation brought about by oppositional markets or stigmatized industries might affect the relationship between familiarity and creativity on the adoption of category labels. Future research might address the interesting category dynamics that characterize these contexts.

Our study represents an important step to gaining a more in-depth understanding of how category labels are adopted in emerging industries. The contestation among different category labels in the early phase of industry evolution, and the resulting process of selection and retention, is thus far underexplored in the literature. We have strived to provide both careful theorizing and compelling empirical evidence regarding the adoption of category labels, and our study is among the first to offer experimental analyses in addition to an archival one. We hope that our paper will spark additional research that may confirm or extend our work along these lines.

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APPENDIX

Table A1. Principal component analysis

Component	Eigenvalue	Difference	Proportion	Cumulative
Comp1	4.218	1.709	0.3515	0.3515
Comp2	2.509	.822	0.2091	0.5606
Comp3	1.687	.695	0.1406	0.7012
Comp4	.991	.084	0.0826	0.7838
Comp5	.907	.229	0.0756	0.8594
Comp6	.679	.150	0.0565	0.9160
Comp7	.528	.153	0.0440	0.9600
Comp8	.375	.314	0.0313	0.9913
Comp9	.061	.020	0.0051	0.9964
Comp10	.041	.040	0.0034	0.9998
Comp11	.002	.001	0.0001	1.0000
Comp12	.0003	.	0.0000	1.0000
<i>N</i>	444			

Table A2. Rotated components loadings

Variable	Comp1	Comp2	Comp3	Unexplained
Memory (MB)		0.3683		.732
Display Size (inches)			0.5705	.382
Camera resolution (MP)			0.4570	.500
Height (mm)	0.5168			.074
Width (mm)	0.5164			.077
Depth (mm)	0.5093			.090
Weight (g)	0.4086			.454
Resolution (MP)			0.5657	.360
Touch		0.4603		.276
Camera		0.4644		.270
3G tech		0.5252		.215
Advanced 3g Tech		0.5248		.217

Note: Only loadings whose score is greater than 0.3 are reported

Table A3. Component rotation matrix

	Comp1	Comp2	Comp3
Comp1	0.7405	0.6547	0.1518
Comp2	-0.5991	0.5406	0.5906
Comp3	0.3046	-0.5283	0.7925

Table A4. Sentiment Analysis on Newspaper Articles mentioning the phones

	Mean	Median	Min	Max
Average Sentiment	0.116	0.118	-0.142	0.281
Share of Negatives	0.036	0.011	0.000	0.667

Notes: Sentiment scores range from -1 (absolutely negative sentiment) to 1 (absolutely positive sentiment). Sentiment analysis on each paragraph mentioning a smartphone using the R package AnalyzeSentiment.

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