Founder Education and Start-Up Funds Raised

—Stefano Franco
Luiss Business School, Luiss University, 00197 Roma, Italy

—Francesco Cappa
Department of Engineering, Campus Bio-Medico University, 00128 Roma, Italy
Luiss Business School, Luiss University, 00197 Roma, Italy

—Michele Pinelli
Faculty of Economics and Management, Free University of Bozen, 39100 Bolzano, Italy

(Corresponding author: Stefano Franco.)

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***Abstract*—*Start-ups need investor funding to overcome the early stages of their life, during which they are more vulnerable and exposed to failure. They need to convince investors to fund their business ideas by signaling the potential success of their entrepreneurial venture, through a demonstration of cohesion, shared views, and determination. The educational background of the founders of start-ups can be a strong driver of start-up performance, as it is a visible signal for investors. However, education is composed of two different dimensions (i.e., its depth and its heterogeneity), and their configurations should be carefully considered. To clarify this aspect, in this article, we discuss the impact that these two education dimensions have on funds raised by start-ups in the early stages of their life. Results show that highly educated cofounders have improved access to external funding as long as they do not have highly heterogeneous educational backgrounds; in a parallel fashion, cofounders educated in different disciplines also have improved access to funding, as long as they have less advanced levels of education. These findings are relevant to start-up founders and indicate the best team configurations to guarantee better access to capital in the initial stages of their life.*

Key words: Education, educational heterogeneity, educational level, fund raising, start-up

I. Introduction

START-UPS are among the most prominent sources of innovation and technological development, and they have contributed to economic growth and delivered value to consumers more than any other economic activity since the Industrial Revolution [1], [2]. Start-ups are a global phenomenon, as they are rapidly growing not only in Europe but in the U.S. and Asia as well [3]. Although COVID-19 is having a negative impact on the rise of new entrepreneurial ventures and will require new models of innovation [4], the start-up economy is still thriving, and it is now worth $3 trillion [5], with high-tech ventures in the fields of blockchain, cybersecurity, and gaming likely to be the most resilient to this crisis [6]. However, for each successful start-up, there are still nine that fail [7]. Start-up growth and success, indeed, depend crucially on their ability to raise funds in the early stages of their life, when they lack cash-flows to sustain costs and investments. Airbnb's history is a clear example of this. In the initial phases of its life, Airbnb's business model was not considered capable of disrupting the market or of making significant profits, and so it received several funding rejections. However, an investment of $20 000 from the accelerator Y Combinator gave its founders the opportunity to develop product and customer relationships, and the results of this became obvious months later when the venture capital firm Sequoia invested $600 000 in it, allowing the start-up to embark on a process which, after ten years, has led the company to have an estimated market value of over $18 billion [8]. This story shows why

start-ups need and seek investors to fund their businesses. In 2019, venture capitalists invested a total of $300 billion in new ventures [5], although this figure alone is hardly sufficient to frame the phenomenon, since several other categories of start-up investors exist, such as friends and family, business angels, corporate investors, banks, accelerators, incubators, and dispersed individuals. In particular, incubators and accelerators are among the most diffused kind of investors. Differently from the others, they provide workspace and competences for startups, allowing them to grow, not just financially, but also at the capability level [9], [10].

For their part, investors fund start-ups for three main reasons: making profits, nurturing innovations in the sectors, and developing projects in which they believe. Organizations like incubators and venture capitals invest in start-ups that they believe can rapidly become profitable and guarantee good returns on investment, evaluating market potential, uniqueness of product and service, and human resources [11], [12]. In contrast, corporate investors or large corporations invest in start-ups because they constitute possible sources of innovation for their business. Indeed, start-ups have "promising ideas, organizational agility, the willingness to take risk, and aspirations of rapid growth" that are missing in corporations [9, p. 66]. Finally, friends, family, and crowd backers can also be motivated by the willingness to support projects they consider worthy [14].

However, investing in early stage start-ups is extremely risky for any kind of funder due to the absence of a credible track record of past organizational results and financial information [1]. So, what drives an investor to fund a start-up? Investors must rely on signals of organizational qualities that are associated with future business success [15]–[19]. Such signals have to overcome existing information asymmetries between start-ups and investors [20] while convincing the latter that the former are worth investing in. Examples of effective signals can be affiliations with prestigious companies, consistent business plans, governance characteristics that improve start-up reputation and reliability [20], and convince investors that the business idea is valid and very likely to be commercialized. Among these factors, human capital is also important in instilling confidence and trustworthiness. The knowledge possessed by a start-up's founders is, in fact, the basis for its technological capabilities and so is fundamental for its future development [21]. Such knowledge is the result of skills acquired through education and experience. However, skills acquired through experience are defined as tacit, because they are difficult to recognize for investors, who, in contrast, may easily access information about founders' codified skills, i.e., the ones attained through education [22]. For this reason, a founder's education is one of the most significant factors in signaling the future success of start-ups to potential investors. Education may be decomposed into two dimensions: education level and the degree of its heterogeneity. In order to have a comprehensive view of the phenomenon, this article seeks to analyze the impact of both dimensions on the funds raised by start-ups in the early stages of their life. In this manner, we clarify the best conditions to increase the funds raised by a start-up, an outcome relevant to both the founders of entrepreneurial ventures and to investors.

II. Start-Up Founder Education

A start-up's human capital of among its distinctive resources. Above all, during a start-up's early stage, human capital garners even more importance due to the absence of established performance, adequate financial resources, and evidence that the business idea could be effective. Knowledge, in particular, is a human capital dimension and it is recognized as a resource that is capable of generating a competitive advantage [23], [24]. It is composed of a tacit component and a codified component. While tacit knowledge is hard to recognize, codified knowledge may be signaled by the education of the start-up's founders. As a result, education can be considered an indicator of founder knowledge and, in turn, human capital. Consequently, the founders' education is likely to be evaluated and to function as a signal, whereas investors are less likely to perceive and reward the tacit value of human capital.

Education, indeed, is considered the most crucial investment to improve a start-up's knowledge base [1]. Data show that most start-ups are founded by highly educated groups of people. On average, in the EU, in the 2017–2018 period, 53% of founders had completed a master's degree or equivalent, 19.3% a bachelor's degree, and 12.6% a doctoral degree [25]. Thus, a total of 84.9% of start-up founders had attended and completed a higher education program. In addition, previous studies have shown that higher levels of education are associated with a higher likelihood of developing and improving products and business models, detecting business opportunities, and obtaining financial resources [26].

Level of education, however, is only one side of the coin when considering the knowledge capital of a start-up. Education, indeed, may also be thought of as the number of different fields of expertise in which one person has achieved a certified, i.e.,

codified, amount of knowledge. Such diversity is known as education heterogeneity. Higher education heterogeneity manifests itself when founders are specialized in the areas of expertise that are different from each other, and the degree of startup heterogeneity corresponds to the set of heterogeneity brought by each founder. For example, a start-up operating in the biotech industry may have founders educated in biotechnology and others educated in business studies. Such start-ups present a higher degree of education heterogeneity compared to a counterpart having all founders with a biotechnology background. The joint presence of different fields of expertise characterizing the group of start-up founders can have positive or negative impacts on a start-up's success [27]. On the one hand, it improves problem-solving capabilities, learning potential, dynamic capabilities, and diversified perspectives. On the other hand, the coexistence of very different areas of knowledge may also be detrimental in the early stages of a start-up's life, causing misunderstandings and conflicts, lack of cohesion, poor coordination, and low-quality decision-making. These aspects may negatively impact the efficiency and effectiveness of organizational performance, thus communicating negative signs to investors.

In other words, it is not automatic that higher levels of education and a high degree of education heterogeneity are positive for a start-up's ability to raise funds, and we believe that it is worth investigating the topic further by considering the joint effect of the two dimensions of education on the amount of start-up funds raised. In this vein, some of the questions that this article tries to address are the following: Which education configurations are associated with the most successful start-ups? Does a high level of education improve or worsen conflicts caused by a high degree of heterogeneity? Does a high degree of education heterogeneity favor founder teams with a lower level of education?

III. Methodology

To provide answers to these questions, we analyzed a sample of 1078 start-ups—corresponding to a total number of 1725 founders—founded in the U.S. between 2012 and 2016. Greater details on the analyses conducted are reported here [28]. The database Crunch Base gave us access to several sets of information, such as the funds raised by each start-up, the level of education of each of start-up's founders (e.g., high school, bachelor's degree, Ph.D., etc.), the number and the fields of expertise in which they were specialized when they founded the start-up (e.g., social sciences, humanities, hard sciences, etc.), and their previous entrepreneurial experiences. Through econometric analyses, we assessed the impact that the level of education and the amount of education heterogeneity have on the financial resources start-ups collected in their first round of fundraising. In particular, we run an OLS regression setting the funds raised by startup at the first round of fundraising, and the level of education and education heterogeneity as independent variables. Moreover, to avoid endogeneity problems, we included several controls in the analysis. Finally, to measure the interaction between the two dimensions of education, we performed a mediation model that allowed us to understand how different configurations of level of education and education heterogeneity determine startup access to funds.

IV. Results. Cognitive Rigidity and Cognitive Distance: The Best Sets of Start-Up Founders

Results show that both education dimensions have a positive impact on funds raised if considered separately. This means that the higher the level of education of the founders, the higher the amount of financial resources collected. In the same way, a higher degree of educational heterogeneity is associated with higher funds raised. However, these results do not consider the joint effect of the two dimensions. Indeed, when considering the simultaneous effect of level of education and heterogeneity, results show tensions between the two. Such tensions, in turn, bear upon on the ability of start-ups to raise funds.

The disciplines of cognitive and social psychology suggest that highly educated people develop a so-called *cognitive rigidity*; that is to say, an individual who has studied a given discipline for a long time, thereby achieving a high-level qualification in that topic, develops a mindset that brings him or her to approach issues using the dominant logic of that particular discipline. In other words, cognitive rigidity reduces an individual's openness to different forms of logic [29]. Founders who possess a high level of education in one discipline tend to pursue business success with more determination, to develop better products and processes, and to be better at recognizing and exploiting business opportunities. But when they interact with cofounders educated in different disciplines, they may run into conflicts and misunderstandings due to cognitive rigidity that may prevent them from taking full advantage of their advanced knowledge.

Cognitive and social psychology also suggest that education heterogeneity is a driver of *cognitive distance*; that is, two individuals with different backgrounds and kinds of education develop different mindsets, languages, and priorities over time [30] that make communication more difficult between them and, in turn,

this stiffens organizational performance. This is detrimental for early stage start-ups that, on the contrary, need great flexibility and quick choices.

The findings of our analyses suggest that different combinations of level of education (cognitive rigidity) and education heterogeneity (cognitive distance) have different effects on the funds a start-up raises. Start-ups whose groups of founders present high levels of education and high degrees of education heterogeneity are characterized by a mix of cognitive distance and cognitive rigidity that is detrimental for early-stage start-ups. Teams of cofounders with thorough education in different disciplines present a higher chance of negative group dynamics preventing them from taking full advantage of their advanced knowledge and of the benefits of their diversified skill sets. This mechanism is a threat to start-ups' prospects because it may hinder the founders' ability to realize the innovation and technological potential of their start-ups as well as their ability to communicate the start-ups' value to investors, who consequently perceive negative signs and are less willing to provide funding. Of course, teams of founders characterized by the joint presence of low levels of education and a low degree of heterogeneity are even less likely to raise funds, since these start-ups do not show established and verified expertise, thus signaling low potential success to investors. Education, indeed, remains a very important factor for a start-up's success and consequently for investor returns. This insight is highlighted by findings on mixing high levels of education with a low degree of education heterogeneity, and vice versa. In fact, teams of highly educated founders specialized in similar areas of knowledge are very likely to receive funds. These start-ups, indeed, are able to improve products and processes without wasting time, and they find shared solutions to problems. In other words, the cognitive rigidity of the founders does not clash with different educational backgrounds.

Finally, start-ups whose founders present different areas of expertise, but with a low level of depth, are also very likely to receive high funds. Indeed, their cognitive distance does not collide with the cognitive rigidity that would prevent them from finding a shared solution to any problems that occur. On the contrary, a diverse set of knowledge fields ensures that they easily find solutions coming from a multidisciplinary approach that founders are more willing to accept due to their low cognitive rigidity.

V. Discussion, Implications, and Conclusions

The start-up economy is still thriving, despite the slowdown imposed by the COVID-19 pandemic. Start-ups need investors' funds to survive and overcome the initial stages of their life, in order to ensure prosperity and success for their business ideas. Start-up founders, thus, need to convince investors to finance their entrepreneurial ventures by signaling potential success. Among other factors, founder education is one of the most influential signals when pursuing this goal, and this article advances the understanding of its impact for scholars and

		Level of education – Cognitive rigidity	
		Low	**High**
Education heterogeneity – Cognitive distance	**Low**	*Less likely to receive funds*	*More likely to receive funds*
	High	*More likely to receive funds*	*Less likely to receive funds*

Figure 1. Combinations of level of education and education heterogeneity and their effects on start-up funds raised (source: authors elaboration on Pinelli *et al.*, 2021).

practitioners. Indeed, it has been highlighted that high levels of education and exposure to different fields of knowledge guarantee positive outcomes for firms. However, in the early stages of a start-up's life, their joint presence may stand in the way of success due to a clash between cognitive rigidity and cognitive distance within the team of founders, which hinders effective decision-making and organizational performance. Such a result has relevant practical implications that can affect start-up success in raising funds. Indeed, at the beginning of their venture's life, a start-up's founders should build a team that can easily take effective decisions by choosing one of two routes: selecting people highly educated in the same subject or selecting intermediate educated people that mix different education backgrounds. These results are relevant for entrepreneurs and start-up founders because they highlight which conditions are more likely to communicate potential success to investors assessing young ventures in the early stages of their life, and, in turn, to raise more funds that guarantee prosperity and success for their business ideas (see Figure 1). Indeed, although we agree that both high levels of education and high degrees of education heterogeneity are powerful tools for each company, we demonstrate that in the initial phases of their life—when they are more vulnerable and exposed to failure—start-ups need to carefully manage their team compositions so as to avoid risks related to the joint presence of high cognitive rigidity and cognitive distance. Although the above-mentioned outcomes are already of immediate applicability, future research can enrich the understanding of how such dynamics could change in the subsequent stages of a start-up's life.

References

[1] D. Ratzinger, K. Amess, A. Greenman, and S. Mosey, "The impact of digital start-up founders' higher education on reaching equity investment milestones," *J. Technol. Transfer*, vol. 43, no. 3, pp. 760–778, 2018.

[2] M. A. Carree and A. R. Thurik, "The impact of entrepreneurship on economic growth," in *Handbook of Entrepreneurship Research*. Berlin, Germany: Springer, 2010.

[3] D. Stangler, "The global startup economy is growing, but who is left out?," *Forbes*, May 9, 2019.

[4] J. Sarkis, "Managing in a Post-COVID-19 World," *IEEE Eng. Manag. Rev.*, vol. 48, no. 3, pp. 6–12, Sep. 2020.

[5] B. Herrmann, M. Marmer, E. Dogrultan, and D. Haltschke, "The Global Startup Ecosystem Report," *Startup Genome*, pp. 1–221, 2020.

[6] T. Daim, K. K. Lai, H. Yalcin, F. Alsoubie, and V. Kumar, "Forecasting technological positioning through technology knowledge redundancy: Patent citation analysis of IoT, cybersecurity, and blockchain," *Technol. Forecasting Soc. Change*, vol. 161, 2020, Art. no. 120329.

[7] N. Patel, "90% of startups fail: Here's what you need to know about the 10%," *Forbes*, Jan. 16, 2015.

[8] K. Warren, "Meet Airbnb CEO Brian Chesky, who cofounded the company in 2008 to help pay his San Francisco rent and now may be taking his $18 billion business public," *Bus. Insider*, Aug. 20, 2020.

[9] G. Elia, A. Margherita, and C. Petti, "An operational model to develop technology entrepreneurship 'EGO-System,'" *Int. J. Innovation Technol. Manag.*, vol. 13, no. 5, 2016, Art. no. 1640008.

[10] B. Aulet, *Disciplined Entrepreneurship: 24 Steps to a Successful Start-Up*. Hoboken, NJ, USA: Wiley, 2013.

[11] Monika and A. K. Sharma, "Venture capitalists' investment decision criteria for new ventures: A review," *Procedia -Soc. Behav. Sci.*, vol. 189, pp. 465–470, 2015.

[12] E. Hudson and M. Evans, "A Review of Research into Venture Capitalists 'Decision Making: Implications for Entrepreneurs, Venture Capitalists and Researchers A Review of Research into Venture Capitalists 'Decision Making," *J. Econ. Soc. Policy*, vol. 10, no. 1, pp. 45–63, 2005.

[13] T. Weiblen and H. W. Chesbrough, "Engaging with startups to enhance corporate innovation," *California Manage. Rev.*, vol. 57, no. 2, pp. 66–90, 2015.
[14] F. Cappa, M. Pinelli, R. Maiolini, and M. Isabella Leone, "'Pledge' me your ears! The role of narratives and narrator experience in explaining crowdfunding success," *Small Bus. Econ.*, to be published, doi: 10.1007/s11187-020-00334-y.
[15] L. A. Plummer, T. H. Allison, and B. L. Connelly, "Better together? Signaling interactions in new venture pursuit of initial external capital," *Acad. Manag. J.*, vol. 59, no. 5, pp. 1585–1604, 2016.
[16] M. S. Cardon, R. Sudek, and C. Mitteness, "The impact of perceived entrepreneurial passion on angel investing," *Frontiers Entrepreneurship Res.*, vol. 29, no. 2, pp. 1–15, 2009.
[17] W. R. Kerr, J. Lerner, and A. Schoar, "The consequences of entrepreneurial finance: Evidence from angel financings," *Rev. Financial Stud.*, vol. 27, no. 1, pp. 20–55, 2014.
[18] S. J. Chang, "Venture capital financing, strategic alliances, and the initial public offerings of Internet startups," *J. Bus. Venturing*, vol. 19, no. 5, pp. 721–741, 2004.
[19] M. Pinelli, F. Cappa, E. Peruffo, and R. Oriani, "Acquisitions of non-controlling equity stakes: Agency conflicts and profitability," *Strategic Org.*, 2020.
[20] M. Islam, A. Fremeth, and A. Marcus, "Signaling by early stage startups: US government research grants and venture capital funding," *J. Bus. Venturing*, vol. 33, no. 1, pp. 35–51, 2018.
[21] M. G. Colombo, and L. Grilli, "Founders human capital and the growth of new technology-based firms: A competence-based view," *Res. Policy*, vol. 34, no. 6, pp. 795–816, 2005.
[22] J. A. C. Baum, and B. S. Silverman, "Picking winners or building them? Alliance, intellectual, and human capital as selection criteria in venture financing and performance of biotechnology startups," *J. Bus. Venturing*, vol. 19, no. 3, pp. 411–436, 2004.
[23] D. P. Dimov and D. A. Shepherd, "Human capital theory and venture capital firms: Exploring 'home runs' and 'strike outs,'" *J. Bus. Venturing*, vol. 20, no. 1, pp. 1–21, 2005.
[24] J. Barney, "Firm resources and sustained competitive advantage," *J. Manage.*, vol. 17, no. 1, pp. 99–120, 1991.
[25] A. Makowska *et al.*, "Annual Report on European SMEs 2017/2018," European Commission, Brussels, Belgium, 2018.
[26] J. M. Millán, E. Congregado, C. Román, M. Van Praag, and A. Van Stel, "The value of an educated population for an individual's entrepreneurship success," *J. Bus. Venturing*, vol. 29, no. 5, pp. 612–632, 2014.
[27] D. Henneke and C. Lüthje, "Interdisciplinary heterogeneity as a catalyst for product innovativeness of entrepreneurial teams," *Creativity Innov. Manag.*, vol. 16, no. 2, pp. 121–132, 2007.
[28] M. Pinelli, F. Cappa, S. Franco, E. Peruffo, and R. Oriani, "Too much of two good things: Effects of founders' educationale level and heterogeneity on start-up funds raised," *IEEE Trans. Eng. Manag.*, to be published.
[29] D. Lei, M. A. Hitt, and R. Bettis, "Dynamic core competences through meta-learning and strategic context," *J. Manage.*, vol. 22, no. 4, pp. 549–569, 1996.
[30] P. Chattopadhyay, W. H. Glick, C. C. Miller, and G. P. Huber, "Determinants of executive beliefs: Comparing functional conditioning and social influence," *Strategic Manag. J.*, vol. 20, no. 8, pp. 763–790, 1999.

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Francesco Cappa received the Ph.D. degree in management from Luiss University, Rome, Italy in 2018. He is currently an Assistant Professor of Innovation at the Campus Bio-medico University, Rome, Italy, and an Adjunct Professor at Luiss Guido Carli University, Rome, Italy. He has been a Visiting Researcher at the New York University Tandon School of Engineering, New York, NY, USA, and Pace University Seidenberg School of Computer Science, New York, NY, USA. His papers have appeared in prestigious international refereed journals such as *Research Policy, Journal of Product Innovation Management, Small Business Economics, Strategic Organization,* IEEE TRANSACTIONS ON ENGINEERING MANAGEMENT, *Business Horizons, Journal of Environmental Management, Computers in Human Behavior, Information Technology for Development, Quarterly Review of Economics and Management, Journal of Strategy and Management*, and *Digital Business*. His main research interests are in the areas of the areas of innovation and sustainability.

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Faculty of Economics and Management, Free University of Bozen, 39100 Bolzano, Italy

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Level of education, however, is only one side of the coin when considering the knowledge capital of a start-up. Education, indeed, may also be thought of as the number of different fields of expertise in which one person has achieved a certified, i.e.,

codified, amount of knowledge. Such diversity is known as education heterogeneity. Higher education heterogeneity manifests itself when founders are specialized in the areas of expertise that are different from each other, and the degree of startup heterogeneity corresponds to the set of heterogeneity brought by each founder. For example, a start-up operating in the biotech industry may have founders educated in biotechnology and others educated in business studies. Such start-ups present a higher degree of education heterogeneity compared to a counterpart having all founders with a biotechnology background. The joint presence of different fields of expertise characterizing the group of start-up founders can have positive or negative impacts on a start-up's success [27]. On the one hand, it improves problem-solving capabilities, learning potential, dynamic capabilities, and diversified perspectives. On the other hand, the coexistence of very different areas of knowledge may also be detrimental in the early stages of a start-up's life, causing misunderstandings and conflicts, lack of cohesion, poor coordination, and low-quality decision-making. These aspects may negatively impact the efficiency and effectiveness of organizational performance, thus communicating negative signs to investors.

In other words, it is not automatic that higher levels of education and a high degree of education heterogeneity are positive for a start-up's ability to raise funds, and we believe that it is worth investigating the topic further by considering the joint effect of the two dimensions of education on the amount of start-up funds raised. In this vein, some of the questions that this article tries to address are the following: Which education configurations are associated with the most successful start-ups? Does a high level of education improve or worsen conflicts caused by a high degree of heterogeneity? Does a high degree of education heterogeneity favor founder teams with a lower level of education?

III. Methodology

To provide answers to these questions, we analyzed a sample of 1078 start-ups—corresponding to a total number of 1725 founders—founded in the U.S. between 2012 and 2016. Greater details on the analyses conducted are reported here [28]. The database Crunch Base gave us access to several sets of information, such as the funds raised by each start-up, the level of education of each of start-up's founders (e.g., high school, bachelor's degree, Ph.D., etc.), the number and the fields of expertise in which they were specialized when they founded the start-up (e.g., social sciences, humanities, hard sciences, etc.), and their previous entrepreneurial experiences. Through econometric analyses, we assessed the impact that the level of education and the amount of education heterogeneity have on the financial resources start-ups collected in their first round of fundraising. In particular, we run an OLS regression setting the funds raised by startup at the first round of fundraising, and the level of education and education heterogeneity as independent variables. Moreover, to avoid endogeneity problems, we included several controls in the analysis. Finally, to measure the interaction between the two dimensions of education, we performed a mediation model that allowed us to understand how different configurations of level of education and education heterogeneity determine startup access to funds.

IV. Results. Cognitive Rigidity and Cognitive Distance: The Best Sets of Start-Up Founders

Results show that both education dimensions have a positive impact on funds raised if considered separately. This means that the higher the level of education of the founders, the higher the amount of financial resources collected. In the same way, a higher degree of educational heterogeneity is associated with higher funds raised. However, these results do not consider the joint effect of the two dimensions. Indeed, when considering the simultaneous effect of level of education and heterogeneity, results show tensions between the two. Such tensions, in turn, bear upon on the ability of start-ups to raise funds.

The disciplines of cognitive and social psychology suggest that highly educated people develop a so-called *cognitive rigidity*; that is to say, an individual who has studied a given discipline for a long time, thereby achieving a high-level qualification in that topic, develops a mindset that brings him or her to approach issues using the dominant logic of that particular discipline. In other words, cognitive rigidity reduces an individual's openness to different forms of logic [29]. Founders who possess a high level of education in one discipline tend to pursue business success with more determination, to develop better products and processes, and to be better at recognizing and exploiting business opportunities. But when they interact with cofounders educated in different disciplines, they may run into conflicts and misunderstandings due to cognitive rigidity that may prevent them from taking full advantage of their advanced knowledge.

Cognitive and social psychology also suggest that education heterogeneity is a driver of *cognitive distance*; that is, two individuals with different backgrounds and kinds of education develop different mindsets, languages, and priorities over time [30] that make communication more difficult between them and, in turn,

this stiffens organizational performance. This is detrimental for early stage start-ups that, on the contrary, need great flexibility and quick choices.

The findings of our analyses suggest that different combinations of level of education (cognitive rigidity) and education heterogeneity (cognitive distance) have different effects on the funds a start-up raises. Start-ups whose groups of founders present high levels of education and high degrees of education heterogeneity are characterized by a mix of cognitive distance and cognitive rigidity that is detrimental for early-stage start-ups. Teams of cofounders with thorough education in different disciplines present a higher chance of negative group dynamics preventing them from taking full advantage of their advanced knowledge and of the benefits of their diversified skill sets. This mechanism is a threat to start-ups' prospects because it may hinder the founders' ability to realize the innovation and technological potential of their start-ups as well as their ability to communicate the start-ups' value to investors, who consequently perceive negative signs and are less willing to provide funding. Of course, teams of founders characterized by the joint presence of low levels of education and a low degree of heterogeneity are even less likely to raise funds, since these start-ups do not show established and verified expertise, thus signaling low potential success to investors. Education, indeed, remains a very important factor for a start-up's success and consequently for investor returns. This insight is highlighted by findings on mixing high levels of education with a low degree of education heterogeneity, and vice versa. In fact, teams of highly educated founders specialized in similar areas of knowledge are very likely to receive funds. These start-ups, indeed, are able to improve products and processes without wasting time, and they find shared solutions to problems. In other words, the cognitive rigidity of the founders does not clash with different educational backgrounds.

Finally, start-ups whose founders present different areas of expertise, but with a low level of depth, are also very likely to receive high funds. Indeed, their cognitive distance does not collide with the cognitive rigidity that would prevent them from finding a shared solution to any problems that occur. On the contrary, a diverse set of knowledge fields ensures that they easily find solutions coming from a multidisciplinary approach that founders are more willing to accept due to their low cognitive rigidity.

V. Discussion, Implications, and Conclusions

The start-up economy is still thriving, despite the slowdown imposed by the COVID-19 pandemic. Start-ups need investors' funds to survive and overcome the initial stages of their life, in order to ensure prosperity and success for their business ideas. Start-up founders, thus, need to convince investors to finance their entrepreneurial ventures by signaling potential success. Among other factors, founder education is one of the most influential signals when pursuing this goal, and this article advances the understanding of its impact for scholars and

		Level of education – Cognitive rigidity	
		Low	**High**
Education heterogeneity – Cognitive distance	**Low**	*Less likely to receive funds*	*More likely to receive funds*
	High	*More likely to receive funds*	*Less likely to receive funds*

Figure 1. Combinations of level of education and education heterogeneity and their effects on start-up funds raised (source: authors elaboration on Pinelli *et al.*, 2021).

practitioners. Indeed, it has been highlighted that high levels of education and exposure to different fields of knowledge guarantee positive outcomes for firms. However, in the early stages of a start-up's life, their joint presence may stand in the way of success due to a clash between cognitive rigidity and cognitive distance within the team of founders, which hinders effective decision-making and organizational performance. Such a result has relevant practical implications that can affect start-up success in raising funds. Indeed, at the beginning of their venture's life, a start-up's founders should build a team that can easily take effective decisions by choosing one of two routes: selecting people highly educated in the same subject or selecting intermediate educated people that mix different education backgrounds. These results are relevant for entrepreneurs and start-up founders because they highlight which conditions are more likely to communicate potential success to investors assessing young ventures in the early stages of their life, and, in turn, to raise more funds that guarantee prosperity and success for their business ideas (see Figure 1). Indeed, although we agree that both high levels of education and high degrees of education heterogeneity are powerful tools for each company, we demonstrate that in the initial phases of their life—when they are more vulnerable and exposed to failure—start-ups need to carefully manage their team compositions so as to avoid risks related to the joint presence of high cognitive rigidity and cognitive distance. Although the above-mentioned outcomes are already of immediate applicability, future research can enrich the understanding of how such dynamics could change in the subsequent stages of a start-up's life.

References

[1] D. Ratzinger, K. Amess, A. Greenman, and S. Mosey, "The impact of digital start-up founders' higher education on reaching equity investment milestones," *J. Technol. Transfer*, vol. 43, no. 3, pp. 760–778, 2018.

[2] M. A. Carree and A. R. Thurik, "The impact of entrepreneurship on economic growth," in *Handbook of Entrepreneurship Research*. Berlin, Germany: Springer, 2010.

[3] D. Stangler, "The global startup economy is growing, but who is left out?," *Forbes*, May 9, 2019.

[4] J. Sarkis, "Managing in a Post-COVID-19 World," *IEEE Eng. Manag. Rev.*, vol. 48, no. 3, pp. 6–12, Sep. 2020.

[5] B. Herrmann, M. Marmer, E. Dogrultan, and D. Haltschke, "The Global Startup Ecosystem Report," *Startup Genome*, pp. 1–221, 2020.

[6] T. Daim, K. K. Lai, H. Yalcin, F. Alsoubie, and V. Kumar, "Forecasting technological positioning through technology knowledge redundancy: Patent citation analysis of IoT, cybersecurity, and blockchain," *Technol. Forecasting Soc. Change*, vol. 161, 2020, Art. no. 120329.

[7] N. Patel, "90% of startups fail: Here's what you need to know about the 10%," *Forbes*, Jan. 16, 2015.

[8] K. Warren, "Meet Airbnb CEO Brian Chesky, who cofounded the company in 2008 to help pay his San Francisco rent and now may be taking his $18 billion business public," *Bus. Insider*, Aug. 20, 2020.

[9] G. Elia, A. Margherita, and C. Petti, "An operational model to develop technology entrepreneurship 'EGO-System,'" *Int. J. Innovation Technol. Manag.*, vol. 13, no. 5, 2016, Art. no. 1640008.

[10] B. Aulet, *Disciplined Entrepreneurship: 24 Steps to a Successful Start-Up*. Hoboken, NJ, USA: Wiley, 2013.

[11] Monika and A. K. Sharma, "Venture capitalists' investment decision criteria for new ventures: A review," *Procedia -Soc. Behav. Sci.*, vol. 189, pp. 465–470, 2015.

[12] E. Hudson and M. Evans, "A Review of Research into Venture Capitalists 'Decision Making: Implications for Entrepreneurs, Venture Capitalists and Researchers A Review of Research into Venture Capitalists 'Decision Making," *J. Econ. Soc. Policy*, vol. 10, no. 1, pp. 45–63, 2005.

[13] T. Weiblen and H. W. Chesbrough, "Engaging with startups to enhance corporate innovation," *California Manage. Rev.*, vol. 57, no. 2, pp. 66–90, 2015.
[14] F. Cappa, M. Pinelli, R. Maiolini, and M. Isabella Leone, "'Pledge' me your ears! The role of narratives and narrator experience in explaining crowdfunding success," *Small Bus. Econ.*, to be published, doi: 10.1007/s11187-020-00334-y.
[15] L. A. Plummer, T. H. Allison, and B. L. Connelly, "Better together? Signaling interactions in new venture pursuit of initial external capital," *Acad. Manag. J.*, vol. 59, no. 5, pp. 1585–1604, 2016.
[16] M. S. Cardon, R. Sudek, and C. Mitteness, "The impact of perceived entrepreneurial passion on angel investing," *Frontiers Entrepreneurship Res.*, vol. 29, no. 2, pp. 1–15, 2009.
[17] W. R. Kerr, J. Lerner, and A. Schoar, "The consequences of entrepreneurial finance: Evidence from angel financings," *Rev. Financial Stud.*, vol. 27, no. 1, pp. 20–55, 2014.
[18] S. J. Chang, "Venture capital financing, strategic alliances, and the initial public offerings of Internet startups," *J. Bus. Venturing*, vol. 19, no. 5, pp. 721–741, 2004.
[19] M. Pinelli, F. Cappa, E. Peruffo, and R. Oriani, "Acquisitions of non-controlling equity stakes: Agency conflicts and profitability," *Strategic Org.*, 2020.
[20] M. Islam, A. Fremeth, and A. Marcus, "Signaling by early stage startups: US government research grants and venture capital funding," *J. Bus. Venturing*, vol. 33, no. 1, pp. 35–51, 2018.
[21] M. G. Colombo, and L. Grilli, "Founders human capital and the growth of new technology-based firms: A competence-based view," *Res. Policy*, vol. 34, no. 6, pp. 795–816, 2005.
[22] J. A. C. Baum, and B. S. Silverman, "Picking winners or building them? Alliance, intellectual, and human capital as selection criteria in venture financing and performance of biotechnology startups," *J. Bus. Venturing*, vol. 19, no. 3, pp. 411–436, 2004.
[23] D. P. Dimov and D. A. Shepherd, "Human capital theory and venture capital firms: Exploring 'home runs' and 'strike outs,'" *J. Bus. Venturing*, vol. 20, no. 1, pp. 1–21, 2005.
[24] J. Barney, "Firm resources and sustained competitive advantage," *J. Manage.*, vol. 17, no. 1, pp. 99–120, 1991.
[25] A. Makowska *et al.*, "Annual Report on European SMEs 2017/2018," European Commission, Brussels, Belgium, 2018.
[26] J. M. Millán, E. Congregado, C. Román, M. Van Praag, and A. Van Stel, "The value of an educated population for an individual's entrepreneurship success," *J. Bus. Venturing*, vol. 29, no. 5, pp. 612–632, 2014.
[27] D. Henneke and C. Lüthje, "Interdisciplinary heterogeneity as a catalyst for product innovativeness of entrepreneurial teams," *Creativity Innov. Manag.*, vol. 16, no. 2, pp. 121–132, 2007.
[28] M. Pinelli, F. Cappa, S. Franco, E. Peruffo, and R. Oriani, "Too much of two good things: Effects of founders' educationale level and heterogeneity on start-up funds raised," *IEEE Trans. Eng. Manag.*, to be published.
[29] D. Lei, M. A. Hitt, and R. Bettis, "Dynamic core competences through meta-learning and strategic context," *J. Manage.*, vol. 22, no. 4, pp. 549–569, 1996.
[30] P. Chattopadhyay, W. H. Glick, C. C. Miller, and G. P. Huber, "Determinants of executive beliefs: Comparing functional conditioning and social influence," *Strategic Manag. J.*, vol. 20, no. 8, pp. 763–790, 1999.

Stefano Franco received the Ph.D. in Management from Luiss University, Rome, Italy in 2020. He is currently a Postdoctoral Researcher with Luiss Guido Carli University, Rome, Italy. He has been a Visiting Researcher with Rey Juan Carlos University, Madrid, Spain. His papers have appeared in international refereed journals, among others IEEE TRANSACTIONS ON ENGINEERING MANAGEMENT, *International Journal of Hospitality Management*, and *Journal of Cleaner Production*. His main research interests focus on the areas of sustainability and innovation.

Francesco Cappa received the Ph.D. degree in management from Luiss University, Rome, Italy in 2018. He is currently an Assistant Professor of Innovation at the Campus Bio-medico University, Rome, Italy, and an Adjunct Professor at Luiss Guido Carli University, Rome, Italy. He has been a Visiting Researcher at the New York University Tandon School of Engineering, New York, NY, USA, and Pace University Seidenberg School of Computer Science, New York, NY, USA. His papers have appeared in prestigious international refereed journals such as *Research Policy, Journal of Product Innovation Management, Small Business Economics, Strategic Organization,* IEEE TRANSACTIONS ON ENGINEERING MANAGEMENT, *Business Horizons, Journal of Environmental Management, Computers in Human Behavior, Information Technology for Development, Quarterly Review of Economics and Management, Journal of Strategy and Management*, and *Digital Business*. His main research interests are in the areas of the areas of innovation and sustainability.

Michele Pinelli received the Ph.D. degree in Business from Ca'Foscari University of Venice, Venice, Italy in 2015. He is currently an Assistant Professor with the Faculty of Economics and Management, Free University of Bozen-Bolzano, Bolzano, Italy, where he is also a Research Fellow with the Centre for Family Business Management. He is the author or coauthor of works published in prestigious outlets such as *Research Policy*, *Strategic Organization*, and *Small Business Economics*. His current research interests include strategy, entrepreneurship, and family business management.