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**Article — Published Version**

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Small Business Economics

**Provided in Cooperation with:**

Springer Nature

*Suggested Citation:* Herold, Patrick-Peter; Schlichte, Franziska; Junge, Sebastian (2025) : Green signals of new ventures: investigating the impact of environmental orientation on funding and the moderating role of lead venture capitalists, Small Business Economics, ISSN 1573-0913, Springer US, New York, NY, Vol. 65, Iss. 3, pp. 1791-1810, <https://doi.org/10.1007/s11187-025-01072-9>

This Version is available at:

<https://hdl.handle.net/10419/335138>

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# Green signals of new ventures: investigating the impact of environmental orientation on funding and the moderating role of lead venture capitalists

Verena Hossnofsky · Patrick-Peter Herold · Franziska Schlichte · Sebastian Junge

Accepted: 28 May 2025 / Published online: 25 June 2025  
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**Abstract** Drawing on signaling theory, this study investigates whether the environmental orientation of new ventures serves as an important signal related to funding outcomes. Analyzing a dataset of 2003 funding rounds completed in the U.S. during 2022, our findings reveal that the environmental orientation of a new venture positively influences pre-IPO funding outcomes. Furthermore, this effect is positively moderated by the prominence of lead venture capital investors. Our post hoc analysis offers a valuable temporal perspective and suggests that our findings generalize across both early-stage and late-stage funding rounds, but not seed funding. This study contributes to the literature on financial resource acquisition and signaling theory, and also offers valuable implications for practitioners, helping them navigate the competitive funding environment more effectively.

**Plain English Summary** Environmental-oriented new ventures secure more funding, particularly when backed by prominent venture capital. This study analyzes the influence of new ventures' environmental orientation on funding amounts across 2003 funding

rounds in 2022. Furthermore, we investigate the reinforcement of this influence by the presence of lead investors who have either a strong environmental orientation or high prominence. Our findings indicate that the environmental orientation of a new venture positively affects the financing received, and this effect is amplified when prominent lead investors participate in the funding round. Accordingly, environmentally oriented entrepreneurs should prioritize attracting prominent lead investors, as their networks, expertise, and reputation enhance visibility and funding potential, making them more valuable than investors with solely strong environmental credentials. Additionally, entrepreneurs should adopt a stage-specific approach: while an environmental orientation is generally beneficial in early-stage and late-stage funding rounds, clearer and more credible signals may be more effective than green signals in seed funding stages.

**Keywords** Entrepreneurs · Funding · New ventures

**JEL Classification** L26 · G24 · M13 · Q56

**Supplementary Information** The online version contains supplementary material available at <https://doi.org/10.1007/s11187-025-01072-9>.

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## 1 Introduction

The number of green new ventures has been steadily increasing worldwide, driven by many entrepreneurs' intrinsic motivation to contribute positively to the planet through environmentally friendly

business practices (Criscuolo & Menon, 2015; Demirel et al., 2019). Additionally, during periods of increased scrutiny on climate change by key legitimacy providers—such as regulators, media, customers, and investors—new ventures may find it tempting to include green signals, i.e., adopt an environmental orientation to enhance their legitimacy and signal distinctiveness (Fisher et al., 2017; Navis & Glynn, 2011; Schaltegger & Hörisch, 2017).

At the same time, the field of environmental sustainability is still evolving, which means corporations endorsing environmental orientation may face greater uncertainty (Criscuolo & Menon, 2015). Historically, securing external funding for green new ventures has been deemed challenging (Demirel et al., 2019; Penz et al., 2022). Access to external financial capital is decisive for any new venture to sustain and grow their business (Gilbert et al., 2006), yet green new ventures often face unique barriers. They are frequently perceived as bearing higher political and technological risks, offering lower scalability, and requiring longer pay-back periods, which makes them generally less attractive to investors (Mrkajic et al., 2019; Petkova et al., 2014). Nonetheless, the funding landscape has evolved, with sustainable investing emerging (Marti et al., 2023). Even growth-oriented financiers, who traditionally solely focus on economic returns, may increasingly recognize the value of investing in for-profit new ventures with an environmental orientation (Marti et al., 2023; Toschi et al., 2023).

However, it remains largely unclear whether new ventures' environmental orientation, as a green signal, helps or hinders acquiring external funding in this changed funding landscape. Besides the limited exploration from a signaling perspective, previous research on environmental orientation has primarily focused on crowdfunding and angel investment, revealing a predominantly positive effect of new ventures' environmental orientation (Calic & Mosakowski, 2016; Hörisch, 2015; Shahid et al., 2024; Truong & Nagy, 2021). But there has been limited exploration of the effectiveness of environmental orientation and related green signals in acquiring funding from venture capital (VC) firms. For instance, Mrkajic and colleagues (2019) found that green signals do not increase access to the VC market for Italian high-tech start-ups unless the venture is effectively positioned within the green sector. This

finding contrasts with the results of studies conducted in crowdfunding and angel investing settings (e.g., Calic & Mosakowski, 2016; Truong & Nagy, 2021). Accordingly, we ask: How does the environmental orientation of new ventures influence pre-IPO funding outcomes?

In this study, we address this research question by first outlining the key attributes of green signals (Bafera & Kleinert, 2023; Spence, 1973) and then arguing that, despite their potentially ambiguous nature, green signals can effectively reduce information asymmetries in the current funding landscape, thereby positively affecting new venture funding. Furthermore, we propose that the green signaling effect is magnified by the presence of VCs as lead investors. Specifically, we investigate the environmental orientation and prominence of VCs to shed light on signal portfolios (e.g., Colombo, 2021; Drover et al., 2017).

We test our hypotheses using a sample of 2003 funding rounds over multiple stages completed in the U.S. during 2022, drawn from a unique dataset combining multiple sources. The results indicate that the environmental orientation of a new venture positively influences funding outcomes. Aligned with our hypothesis, this effect is positively moderated by the prominence of lead VC investors. However, contrary to our hypothesis, we find no significant moderating effect of the environmental orientation of the lead investor. This means that the presence of green lead investors does not influence the attraction of other investors and thus does not significantly influence the total funding amount. Our post hoc analysis suggests that our findings generalize across both early-stage and late-stage funding rounds but not seed funding.

Our study makes several key contributions to signaling theory in the context of entrepreneurial finance (Colombo, 2021). Specifically, we advance the limited understanding of signal portfolios, as frequently studies focus on a single signal and do not investigate how multiple signals work in concert with one another (Bafera & Kleinert, 2023). Additionally, we enhance the literature on identity similarity in signaling environments (Bafera & Kleinert, 2023) by uncovering how in-group preferences among investors can create barriers for diverse investors, thereby deepening our understanding of the relational dynamics in funding decisions. Finally, we contribute to the debate on signal credibility (Kleinert, 2024) by demonstrating that green signals are less effective in seed

funding rounds due to their ambiguous and non-costly nature, underscoring the need for a stage-dependent and temporal perspective in signaling research (e.g., Anglin et al., 2018).

## 2 Theory and hypotheses

### 2.1 New venture funding and signaling

Acquiring external financial capital represents a major accomplishment for recently founded ventures and may be decisive for future success and survival (Gilbert et al., 2006). Entrepreneurs gain access to financial resources when they can show that their venture can generate future superior economic returns compared to others (Fisher et al., 2017). But the expectations of resource providers about future returns are associated with a great deal of uncertainty, as any new venture's future is largely unknown particularly at an early stage (Ko & McKelvie, 2018). Thus, quite regularly efforts to convince external resource providers fail due to the inherent information asymmetries between entrepreneurs and prospective investors regarding both the entrepreneurs themselves and the quality of their ventures (Amit et al., 1990). These efforts are impeded by the fact that new ventures lack established, objective evidence, such as track records, regarding the venture's quality (Nagy et al., 2012; Stinchcombe, 1965). Therefore, potential investors may rely on subjective, unverifiable statements made by the entrepreneurs until more reliable reputation or market-related information becomes accessible (Colombo, 2021). One approach to mitigate information asymmetries and attracting potential resource providers is the use of signals to communicate about a venture's unobservable quality and convince resource providers of their capabilities (Bafera & Kleinert, 2023).

Signaling theory (Spence, 1973, 2002) is an appropriate lens to explain the phenomenon of provisioning resources to new ventures and is especially useful for new ventures in new or emerging industries, where established business models or key success factors are not known (Aldrich & Fiol, 1994). Signalers use private information to create informative signals for outsiders, such as potential investors, who lack access to this information (Spence, 1973). Originating in economics, the theory thus has several core tenets

(Bafera & Kleinert, 2023): First, the signal needs to be alterable and observable. Second, and according to the original theory, the signal must be costly. Third, signalers outperform non-signaling firms over time. A venture can act as a signaler itself (i.e., internal signaler); however, third parties can also function as signalers (Bafera & Kleinert, 2023).

Many studies have adopted this traditional signaling perspective to understand which kinds of signal messages enable new ventures to reduce information asymmetries with resource providers (Colombo, 2021). Entrepreneurship studies have examined a variety of signals, such as patents and prototypes (e.g., Audretsch et al., 2012), the prominence of external partners (e.g., Stuart et al., 1999), entrepreneurs' rhetoric (e.g., Payne et al., 2013; Steigenberger & Wilhelm, 2018), and entrepreneurs' human or social capital (e.g., Backes-Gellner & Werner, 2007; Hsu, 2007). In the following, we focus on a relatively novel, but timely signal sent by the new venture itself: green signals.

### 2.2 Green signals and new venture funding

The number of green new ventures has been steadily increasing worldwide, driven by entrepreneurs' intrinsic motivation to improve the world through environmentally friendly business practices (Criscuolo & Menon, 2015; Demirel et al., 2019). In times of increased scrutiny on climate change by key legitimacy providers—such as regulators, media, customers, and investors—any kind of entrepreneur may find it tempting to include green signals to enhance their legitimacy and signal distinctiveness (Fisher et al., 2017; Navis & Glynn, 2011; Schaltegger & Hörisch, 2017). Following related studies (Criscuolo & Menon, 2015; Mrkajic et al., 2019), we define green signals generally as an environmentally friendly orientation adapted by new ventures in order to provide practical and innovative solutions to environmental problems.

We apply the above outlined three core tenets of signaling theory to green signals in order to get a more nuanced understanding on the nature of green signals and their potential effectiveness, as very few studies in this vein have explicitly adopted a signaling perspective (see Mrkajic et al., 2019; Shahid et al., 2024 for exceptions): First, green signals are observable choices by entrepreneurs and can be adjusted

throughout the life span accordingly. Second, these signals can be costly (e.g., for green patents or prototypes), but early-stage green ventures often rely on green rhetoric, which, despite being seemingly costless, may still effectively influence resource providers (Kleinert, 2024). Additionally, there may still be associated costs with seemingly costless signals (Payne et al., 2013). For example, if the signal turns out to be misleading, the new venture may incur costs due to a loss of reputation or legal costs (Anglin et al., 2018). Third, in the long run, those who utilize green signals may outperform non-signalers due to the growing legitimacy of green initiatives and the opportunities it presents for competitive advantages (Flammer, 2013; King & Pearce, 2010; Sine et al., 2007) and enhanced distinctiveness (Fisher et al., 2017; Navis & Glynn, 2011). Overall, green signals appear suitable to effectively reduce information asymmetries in the current signaling environment, thus facilitating the acquisition of resources. But due to the nascent stage of the environmental field, green signals can vary substantially and appear ambiguous, making them less universal than human or social capital-related signals, such as education (Colombo, 2021), despite their timeliness.

Besides the limited exploration from a signaling perspective, previous research on environmental orientation has primarily focused on crowdfunding and angel investment, revealing a predominantly positive effect of new ventures' environmental orientation (e.g., Calic & Mosakowski, 2016; Hörisch, 2015; Shahid et al., 2024; Truong & Nagy, 2021). However, there has been limited exploration of the effectiveness of environmental orientation and related green signals in acquiring funding from VC firms. For example, Mrkajic et al. (2019) found that green signals do not increase access to the VC market for Italian high-tech start-ups unless the venture is effectively positioned within the green sector. It is important to note that green high-tech ventures are often capital-intensive and technologically complex (Amore & Bennedsen, 2016). This heightens investment challenges for VCs, given the lower exit opportunities and longer investment durations associated with these ventures (Ghosh & Nanda, 2012; Knight, 2010; Petkova et al., 2011). In addition, the frameworks for evaluating the financial potential of environmentally oriented new ventures may differ and are not yet established, impeding

efforts to understand these businesses (Petkova et al., 2014).

However, the signaling environment, influenced by increased media attention, regulatory interventions, social movements, and heightened customer awareness, has shifted the funding landscape in favor of green signals (Flammer, 2013; King & Pearce, 2010; Sine et al., 2007). Legislative measures, such as the 2022 U.S. Inflation Reduction Act, have allocated significant funds to energy and climate change programs, facilitating green investments (Omeokwe & Hughes, 2022). Such developments have encouraged investors to consider environmental issues in their investment decisions (Amir & Serafeim, 2018). Consequently, sustainable investing has emerged, with some VCs adopting a broader stakeholder view than traditional investment modes (Marti et al., 2023; Toschi et al., 2023). These investors are believed to value the green signals conveyed by new ventures.

Besides dedicated sustainable investors, green signals may appeal to a broader investor audience for various ideological, emotional, or trend-related reasons. Despite conducting formal due diligence, investors often rely on their intuition and gut feeling as part of the decision-making process (Huang & Pearce, 2015; Zacharakis & Shepherd, 2001). Gompers and colleagues (2020) report that nearly half of the VCs, particularly early-stage ones, admit to often making gut-based investment decisions. Given the overwhelming volume of investment solicitations, investors rely on intuitive screening and cognitive cues to identify promising ventures, making signaling mechanisms especially effective in new venture evaluation (Ko & McKelvie, 2018). Green signals may enable new ventures to distinguish themselves from others and stand out in the due diligence process of VCs, where only one in 100 companies, on average, is offered a deal (Gompers et al., 2020). Given this evolving signaling environment, we argue that external financiers appreciate green signals and consequently invest larger amounts in new ventures with an environmental orientation. Thus, we propose the following hypothesis:

**Hypothesis 1 (H1):** The environmental orientation of a new venture is positively related to the new venture's funding amount.

### 2.3 Signal interactions and the role of green and prominent lead investors

Recent literature has highlighted that signals do not occur in isolation, but different signals may act in concert (Ko & McKelvie, 2018). For instance, strong signals might enhance the effectiveness of weaker signals (Plummer et al., 2016). In this context, studies emphasize the strong signaling role of third-party signalers, such as affiliations with prominent VCs, because these signalers are unlikely to associate with low-quality firms, as doing so could harm their own reputation (Pollock et al., 2010; Stuart et al., 1999). This association helps new ventures overcome the challenge of building their own reputation (Bafera & Kleinert, 2023). We apply this logic to our setting, as we identified green signals to be potentially ambiguous. Ambiguous signals may benefit particularly from strong third-party signals to unlock their value (Plummer et al., 2016). Thus, in the following, we investigate whether green signals interact with strong, costly third-party signals, such as the presence of green or prominent VCs as lead investors.

VCs play a crucial role in fostering business growth by accelerating the development of new ventures, increasing value creation, and promoting employment and innovation (Bocken, 2015; Keuschnigg, 2004). They commonly invest in more “risky” ventures, providing financial support to new ventures while leveraging their expertise and networks (Bocken, 2015). VC firms often collaborate closely with the ventures they invest in, offering guidance and value beyond just capital (Quas et al., 2021; Sørensen, 2007). VCs as lead investors play a distinct role within the group of investors, as they typically take the lead in identifying the new venture they want to invest in, selecting and organizing investor partners, and closely monitoring the new venture (Plagmann & Lutz, 2019). VCs perform more thorough due diligence to gather private information about a new venture’s economic potential (Shafi et al., 2020). The involvement of a lead VC is generally seen by subsequent investors as a signal of the venture’s quality (de Lange & Valliere, 2020; Fisher et al., 2016). If a lead VC enters a venture, others are more likely to follow suit, drawn by the credibility and strategic

judgment demonstrated by the initial investment (de Lange & Valliere, 2020).

However, as green initiatives are still nascent, there is neither a solid track record for green VC investments nor an established framework for assessing the potential of environmentally oriented new ventures (Mrkajic et al., 2019; Petkova et al., 2014). The majority of VCs have less extensive experience regarding the peculiarities of environmental-oriented new ventures and, therefore, are less confident in their expert judgment (de Lange & Valliere, 2020). At the same time, and as noted above, the funding landscape has changed and green VCs have emerged (Randjelovic et al., 2020). In contrast to traditional VCs, green VCs are familiar with the requirements of environmental-oriented new ventures and can help them grow efficiently from the outset (Randjelovic et al., 2020). Green VCs can support the development of green businesses by integrating traditional management consulting with specialized sustainable practices (Bocken, 2015). Moreover, they are especially useful for forming credible collaborations through the use of their networks (Bocken, 2015). On a broader level, similarity among signalers and recipients may speed up the formation of trust and promote a productive working relationship (Claes & Vissa, 2020), yielding more positive interpretations (Bafera & Kleinert, 2023). Moreover, lead VCs with industry experience can more easily form syndicates with multiple investors (Hopp, 2010; Hopp & Lukas, 2014). In relation to new ventures with an environmental orientation, the expertise of green investors in these industries could contribute to attracting additional investors. Building on these arguments, the presence of green lead VCs therefore may act as a signal to other investors that the environmental-oriented new venture will thrive and become a successful business. We argue that the presence of green lead VCs leads to higher overall funding amounts for the new venture. Thus, we hypothesize:

**Hypothesis 2a (H2a):** The environmental orientation of a lead investor positively moderates the relationship between a new venture’s environmental orientation and funding amount.

Nonetheless, green VC still represents only a niche market in the broad area of VC investments (Randjelovic et al., 2020). In contrast, large and prominent individual VCs have more market share and a larger investment volume (Elango et al., 1995; Plagmann & Lutz, 2019). While they do not possess the expertise of green VCs to meet the specific needs of environmental-oriented new businesses, they have remarkable track records of investment success (de Lange & Valliere, 2020; Gompers, 1996). Support from VCs with stronger reputations<sup>1</sup> is associated with more favorable exits, often resulting in higher share prices compared to companies without prominent VC backing (Drover et al., 2017; Nahata, 2008). VCs with higher reputations find it easier to secure funds, make superior deal selections, and achieve greater investment success, and backing by such VCs is associated with more favorable exits and higher share prices compared to non-VC-backed companies (Gompers et al., 1998; Hsu, 2004; Krishnan et al., 2011; Nahata, 2008; Plagmann & Lutz, 2019).

A high reputation enhances the attractiveness for other investors, as they aim to access the valuable resources and expertise of the reputable partner through collaborating in syndicates (Gu & Lu, 2014; Meuleman et al., 2009; Plagmann & Lutz, 2019). Due to their track record, prominent investors are assumed to have more experience in evaluating new ventures and are more familiar with the due diligence process (Stuart et al., 1999). Other investors may thus believe that prominent investors conduct more thorough due diligence, which reduces risk and enhances the attractiveness of the investment (Ko & McKelvie, 2018). Their excellent reputation can therefore serve as an endorsement for new ventures and can send a strong signal of legitimacy to other investors (Colombo, 2021; Hsu & Ziedonis, 2013; Ko & McKelvie, 2018). The presence of a prominent investor can attract additional investors, resulting in higher overall funding amounts for the new venture. This can be particularly relevant for new ventures with an environmental orientation taken into account the potential ambiguity of green signals. Thus, we hypothesize:

**Hypothesis 2b (H2b):** The prominence of a lead investor positively moderates the relationship between a new venture's environmental orientation and funding amount.

### 3 Method

To evaluate the influence of a new venture's environmental orientation on its funding success, we analyzed individual funding rounds (Alexy et al., 2012; Bellavitis et al., 2022) across different funding stages in 2022, i.e., seed rounds, early-stage and late-stage funding rounds. We used computer-aided textual analysis to measure the environmental orientation of new ventures, our independent variable. To assess the impact of environmental orientation on our dependent variable, the funding amount, we employed multiple linear regression models.

#### 3.1 Sample and data sources

To create our sample and to acquire the needed data, we used Crunchbase and LinkedIn. In the first step, data pertaining to funding rounds was systematically gathered from Crunchbase. Crunchbase is frequently used as a database in finance and entrepreneurship literature, given its detailed information on funding rounds and new ventures (Alexy et al., 2012; Block et al., 2022; Homburg et al., 2014; Ter Wal et al., 2016; X. Wang et al., 2024). For our sample, we included equity funding rounds with an announcement date in 2022. To ensure that only funding rounds of new ventures were included, we limited the sample to funding rounds of organizations that were no more than 10 years old at the time of the funding round. A maximum age of 10 years is regularly used in the literature to define new ventures (Beckman et al., 2007; Danso et al., 2022; Winkler et al., 2020). In addition, we only incorporated companies from the USA that were still active and had not been acquired or taken public. Furthermore, all rounds with missing information were excluded, and the sample was limited to funding rounds with at least one VC lead investor. After the exclusion of rounds with missing data, our first sample consisted of 2690 rounds.

In the second step, we accumulated further data on LinkedIn. We collected the companies' descriptions on LinkedIn of all new ventures and all lead investors.

<sup>1</sup> Reputation is an economic concept that refers to the "perceived or actual quality or merit that generate earned, performance-based rewards" (Washington & Zajac 2005, p. 283).

To analyze the descriptions with the text analysis software Linguistic Inquiry and Word Count (LIWC), we excluded all cases in which the company description on LinkedIn was less than 50 words long (Block et al., 2022; Fisch & Block, 2021). To control for founders' human capital in the analysis, we collected further data on the founders from LinkedIn. The final sample consists of 2003 funding rounds.

### 3.2 Dependent variable

*Funding amount.* The main goal of a company in a funding round is to acquire sufficient funding (Bauer et al., 2023). Based on previous research (Alexy et al., 2012; Ko & McKelvie, 2018; Mansouri & Momtaz, 2022), we used the funding amount of each funding round as a measure of the success of the funding round and the valuation of the company by investors

### 3.3 Independent variables

*Environmental orientation.* We used computer-aided textual analysis (CATA) to analyze new ventures' environmental orientation as a proxy for green signals. Due to the explicit nature of our construct, we employed a dictionary-based approach for the measurement (Short et al., 2010). The underlying assumption of this measurement approach is that words or phrases "that are frequently used are cognitively central and reflect what is most on the user's mind" (Cho & Hambrick, 2006, p. 459). Aligned with similar and most recent work (Maldonado-Bautista et al., 2023), we used ventures' profiles ("about us" pages). More specifically, we crawled companies' descriptions on LinkedIn, a platform frequently used as data source in research on new ventures and funding (Ko & McKelvie, 2018; Piva & Rossi-Lamastra, 2018; Reese et al., 2021). In the context of new ventures, one can argue that the information provided on a company's social media profiles is particularly suitable for capturing the firm's intentions and attitudes towards specific subjects (e.g., their environmental orientation), since the founders have significant influence over this content (Olanrewaju et al., 2020). To analyze the companies' descriptions, CATA is particularly suitable as it ensures consistent and accurate assessment of textual data over time (Short et al., 2010). Furthermore, as the word order in our analyzed companies' descriptions does not matter, we used the frequency of words

as the measure for our dictionary-based analysis (Humphreys & Wang, 2018).

Following the multi-step CATA dictionary development process recommended by Short et al. (2010), we systematically developed and validated our measurement. Due to significant contextual differences, we were not able to draw on a previously validated dictionary such as the one of Moss and colleagues (2018). We therefore conducted a detailed deductive and inductive process followed by a thorough validation. The comprehensive description of the procedure is presented in Appendix A1. Our final list of words included a total of 81 words or word roots as presented in Table 1. We then used the LIWC software for computerized text analysis to apply our dictionary on the companies' descriptions (Pennebaker et al., 2001). The software calculates the frequency of the keywords as a percentage of words from the dictionary in relation to the total number of words in the text. We used this score in our analysis to measure the ventures' environmental orientation. Table 2 provides exemplary company descriptions of our sample and their respective measurements of environmental orientation.

*Lead investor's (LI) environmental orientation.* To test for the moderating effect, we used the same approach and analyzed the companies' descriptions of the lead investors on LinkedIn. In instances where a funding round featured multiple lead investors, we selected the score of the lead investor with the highest rating to represent the score for the variable in our analysis.

*Lead investor's (LI) prominence.* To measure the prominence of the investors, we applied the approach of Bellavitis and colleagues (2022) by using the Crunchbase rank of the lead investors. The Crunchbase rank measures the prominence of all entities on the Crunchbase platform by using an algorithm that "takes many signals into account, including the number of connections a profile has, the level of community engagement, funding events, news articles and acquisitions" (Crunchbase, 2023). For funding rounds with more than one lead investor, we used the Crunchbase rank of the most prominent lead investor. Since the investor with the lowest rank on Crunchbase is the most prominent investor, we inverted the variable for better interpretation (Bellavitis et al., 2022). For the calculation of the moderations, the

**Table 1** Environmental orientation keywords included in dictionary

	Environmental orientation keywords	
air	e-mobility	photovoltaic
biodegrad*	energy	planet
biodivers*	environmental*	plant-based
biofertilizer*	erod*	plastic
biofuel*/bio-fuel*	erosion	pollut*
biogas*	externalit*	preservation
carbon	fertilis*	preservational
carbon-negative	fertiliz*	preservationist
circular	footprint	re-charge*
clean	global warming	recycl*
cleaned	GMO (genetically modified organism)	regenerative
cleaner	GMO-free	regrow
clean-up	green	renewab*
climate*	greener	reus*/re-us*
CO2	greenhouse	seascape
compostable	greenlife	solar
conservation	habitat	sustainab*
conserve	HACCP (hazard analysis and critical control points)	thermal
conserved	harmful*	toxic
conserves	hydrogen	trees
conserving	ISO14001	unpollut*
decarboni*	naturalize	unspoil*
eco	nature	waste
eco-activis*	non invasive	water
ecofriendly/eco-friendly	nontoxic/non-toxic	wind
ecolog*	organic*	zero-carbon
emission*	ozone	zero-emissions

independent variable and the moderator variables were centered.

### 3.4 Control variables

We controlled for several variables that were previously identified in relevant articles as determinants of new venture funding. First, we controlled for *firm age*, as the age of a company can influence the valuation (Naiki & Ogane, 2022; Schmidt et al., 2018; Sigmund et al., 2015) and firm age is also related to firms' legitimacy (Stam & Elfring, 2008). We applied the natural logarithm of firm age (Justo et al., 2015). Second, research shows that *firm size* influences new ventures financial performance (Sigmund et al., 2015). We controlled for firm size, captured as the number of employees (Naiki & Ogane, 2022). Because

Crunchbase uses intervals of employee counts, we coded the given intervals as consecutive numbers (Schlichte et al., 2019). Third, we controlled for the total *number of funding rounds* of the company as receiving several rounds of funding is a signal of a new venture's success that is considered by investors (Ter Wal et al., 2016). We included *industry* dummies (Nahata et al., 2014), as the industry influences the capital requirements of companies and their valuation (Schmidt et al., 2018). We used industry groups to control for the industry of the company. Since there was a high correlation between some of the Crunchbase's industry groups, we used the approach of Block and colleagues (2022) and clustered Crunchbase's 47 industry groups into 16 broader industry groups. Based on the companies' descriptions, we assigned a primary industry group to each new venture and used

**Table 2** Exemplary company descriptions and respective measurements of environmental orientation

Company descriptions	Environmental orientation (LIWC score)
<i>Company A</i> is the leading decarbonization platform for consumer companies to combat climate change. Its proprietary database makes it easy for brands to measure and reduce their carbon emissions. Leveraging one of the largest Life Cycle Analysis database for agricultural production systems, <i>Company A</i> provides consumer companies with the most granular insight into their emissions. <i>Company A</i> has robust Scope 3 emissions modeling capabilities, making it the best solution in the market for consumer brands to decarbonize, where 90% + of emissions come from their supply chain	12.79
<i>Company C</i> exists to bring energy to ideas. We are the pioneers of clean computing infrastructure that reduces both the costs and the environmental impact of the world's expanding digital economy. By unlocking stranded sources of energy to power cloud and data center services, we are creating the climate-aligned future of compute-intensive innovation that reduces rather than adds to emissions. The world's appetite for computation, energy, and progress will never stop growing. <i>Company C</i> is here to bring energy to ideas in ways that are aligned with the needs of our climate	10.00
Batteries have a big role to play in tackling the climate crisis, and it's essential to make sure that they're safe and reliable to operate. At <i>Company D</i> , we build cutting-edge software solutions that empower companies to deeply understand their batteries, both in design and deployment. It's all part of our work to enable a renewable energy revolution, powered by safer batteries, at a lower cost, with less waste	5.88
<i>Company E</i> is a leading technology platform for property managers and owners of single-family rental homes. Steady offers a suite of tailored financial and insurance products that are designed to reduce risk for the owners generate ancillary revenue for our property manager partners. Steady's technology provides property managers with products that benefit their owners, while also giving them competitive differentiation to grow their businesses	0.00

these as dummy variables. Since the location of a new venture could influence the funding outcome (Block et al., 2022; Ko & McKelvie, 2018), we included *location* dummies representing the state in which the company's headquarter is located (Wang et al., 2022). Furthermore, research shows that the founding team influences new venture funding (Gimmon & Levie, 2010; Ko & McKelvie, 2018). Therefore, we controlled for the *number of founders* of a company, as the number of founders and the team composition can influence the financing of companies (Block et al., 2022; Ughetto, 2016). In addition, we controlled for *gender* of the founders (Robb & Watson, 2012) and *previous founding experience* as a dummy variable that takes the value of "1" if one of the founders has founded a company before (Ko & McKelvie, 2018; Naiki & Ogane, 2022). Since we included various funding rounds with diverse conditions, we also considered funding round-specific control variables. We controlled for the *funding stage* of the funding round (i.e., seed, early-stage and late-stage) using dummy variables based on the funding stage provided by Crunchbase (Bellavitis et al., 2022). In addition, we

controlled for the *number of investors* in the funding round (Alexy et al., 2012; Block et al., 2022). Due to the skewness of the variable and outliers, we applied the natural logarithm and winsorized<sup>2</sup> at the 1% level. Finally, we controlled for general cyclical effects that could affect the provision of capital (Alexy et al., 2012). We included dummy variables for each *quarter* of the year.

## 4 Results

### 4.1 Main results

Table 3 reports descriptive statistics and Pearson's correlations. The highest correlation among the independent and control variables is between firm age and the number of funding rounds (0.54), which can be explained by the fact that older companies have had

<sup>2</sup> Winsorization can be used to reduce the influence of outliers (Barnett & Lewis, 1994). Values that lie outside a defined boundary are replaced by the most extreme value within this boundary (Wilcox, 2003).

more time to conduct funding rounds than younger companies. Overall, the correlations are below the limit of 0.7, which is often seen as a critical threshold for multicollinearity (Junge et al., 2023; Kalnins, 2018). Furthermore, we analyzed the VIFs for each model and find the average VIF ranging from 1.72 to 1.81, with no VIF higher than 5.45. Given these VIFs and correlations, we conclude that multicollinearity is unlikely to distort our results (Justo et al., 2015; O’Brien, 2007).

Table 4 shows the results of the linear regression analyses. Model 1 displays the effect of the control variables on the funding amount in the funding round. We find firm size, firm age, number of investors, industry, gender, previous founding experience, funding stage, and the timing of the funding round to have a significant impact on the funding amount.

In Model 2, we test Hypothesis 1, examining the influence of the new venture’s environmental orientation on the funding amount. The results reveal a positive ( $\beta = 1637.61$ ) and significant ( $p < 0.01$ ) relationship. This finding supports Hypothesis 1, demonstrating that a company’s environmental orientation positively influences the amount of capital it receives in a funding round.

In Model 3, we assess Hypothesis 2a, which proposes that the environmental orientation of lead investors has a positive moderating effect on the relationship between the new venture’s environmental orientation and the funding amount. While the baseline effect remains positive and significant, we find a positive, but not significant ( $p = 0.493$ ) moderating effect of the lead investors’ environmental orientation. Therefore, Hypothesis 2a is not confirmed.

In Model 4, we investigate the moderating effect of the lead investor’s prominence. While we find our baseline relationship to remain positive and significant, we also find the moderating effect of lead investor’s prominence to positively ( $\beta = 0.07$ ) and significantly ( $p < 0.05$ ) influence our dependent variable. For a better interpretation, Fig. 1 illustrates this moderating effect. These results confirm Hypotheses 2b and underline that a high lead investor’s prominence strengthens the influence of a company’s environmental focus on funding amounts.

**Table 3** Descriptive statistics and correlations

Variables	Mean	Std. Dev	Min	Max	1	2	3	4	5	6	7	8	9
1 Funding amount (in thousand USD)	27,618.52	56,888.97	20.00	1,480,000.00	1.00								
2 Firm age (log)	1.44	0.57	0.00	2.40	0.20*	1.00							
3 Firm size	2.35	1.24	1.00	7.00	0.52*	0.43*	1.00						
4 Number of founders	2.15	1.02	1.00	9.00	0.13*	0.05*	0.15*	1.00					
5 Number of funding rounds	3.59	2.38	1.00	17.00	0.29*	0.54*	0.47*	0.18*	1.00				
6 Number of investors (log)	1.37	0.76	0.00	2.30	0.23*	0.05	0.18*	0.15*	0.19*	1.00			
7 Environmental orientation	0.47	1.62	0.00	20.00	0.05*	0.08*	0.00	0.01	0.10*	0.00	1.00		
8 Lead investor’s environmental orientation	0.25	1.01	0.00	12.70	0.03	0.08*	0.06*	0.00	0.08*	0.05*	0.35*	1.00	
9 Lead investor’s prominence	261,417.91	13,655.03	108,525.00	273,184.00	0.05*	-0.14*	0.00	0.01	-0.06*	0.11*	0.01	0.02	1.00

$n = 2,003$ ; \* $p < 0.05$

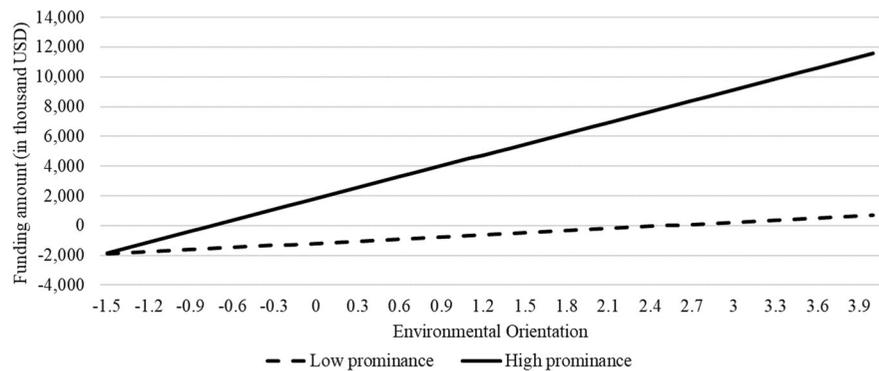
**Table 4** Linear regression models to predict funding amount

Funding amount (in thousand USD)	Model 1	Model 2	Model 3	Model 4
Firm age (log)	-9,929.16*** (-5.43)	-9,873.03*** (-5.41)	-9,780.43*** (-5.38)	-9,567.27*** (-5.04)
Firm size	14,621.88*** (7.02)	14,719.62*** (7.07)	14,783.44*** (7.07)	14,719.04*** (7.06)
Number of founders	1,292.96 (0.82)	1,249.73 (0.79)	1,211.13 (0.77)	1,250.38 (0.79)
Number of funding rounds	-229.27 (-0.49)	-286.51 (-0.61)	-304.88 (-0.65)	-254.69 (-0.55)
Number of investors (log)	7,290.25*** (6.45)	7,303.57*** (6.47)	7,426.62*** (6.52)	7,169.42*** (6.34)
Funding stage (early-stage as reference)				
Seed	-10,951.77*** (-4.50)	-10,903.99*** (-4.47)	-10,927.34*** (-4.47)	-10,707.18*** (-4.45)
Late-stage	57,583.27*** (7.98)	57,541.33*** (7.98)	57,613.10*** (8.00)	57,482.71*** (7.97)
Gender (male as reference)				
Female	-465.10 (-0.16)	-1,085.50 (-0.37)	-984.34 (-0.34)	-912.08 (-0.31)
Mixed	-4,774.32* (-2.23)	-4,992.66* (-2.34)	-4,874.61* (-2.30)	-4,955.20* (-2.33)
Previous founding experience	4,593.94* (2.11)	4,672.35* (2.15)	4,753.82* (2.20)	4,498.88* (2.06)
Industry dummies	Yes	Yes	Yes	Yes
Quarter dummies	Yes	Yes	Yes	Yes
State dummies	Yes	Yes	Yes	Yes
Environmental orientation		1,637.61** (2.63)	1,867.04* (2.51)	1,250.17* (2.12)
Lead investor's environmental orientation			-3,029.89 (-1.96)	
Environmental orientation X Lead investor's environmental orientation			176.56 (0.69)	
Lead investor's prominence				0.11* (2.22)
Environmental orientation X Lead investor's prominence				0.07* (2.04)
Constant	-15,722.26 (-1.54)	-16,042.76 (-1.58)	-16,163.74 (-1.54)	-15,699.69 (-1.55)
R-squared	0.410	0.411	0.413	0.412
Adjusted R-squared	0.399	0.400	0.401	0.401
F-statistic	26.993***	26.392***	25.238***	25.704***

$n = 2,003$ ;  $t$  statistics in parentheses

\* $p < 0.05$ , \*\* $p < 0.01$ , \*\*\* $p < 0.001$

**Fig. 1** Moderating effects of lead investor's prominence



#### 4.2 Robustness tests

We conducted additional tests to ensure the robustness of our findings. Regarding our independent variable, environmental orientation, we performed two additional robustness tests. First, we only included words with an ambiguity score of less than 0.3 from the KWIC analysis (see Appendix A1) to ensure that words with an ambiguity score close to 0.5 did not drive the effect. Second, we used a dummy variable representing a high environmental orientation ( $> 3.5$ ). In both robustness tests, we found a positive and comparable significant effect ( $p < 0.1$ ;  $p < 0.01$ ) of Model 2, which again confirms Hypothesis 1.

Third, we winsorized all variables at a 1% level to control for potential data outliers (Hossnofsky & Junge, 2019). We found positive and significant ( $p < 0.01$ ;  $p < 0.05$ ) results, similar to our main models. These results further confirm that outliers do not significantly influence the observed effect, thereby providing additional support for Hypotheses 1 and 2b.

Fourth, in Model 4, we used the value of the lead investor with the highest Crunchbase rank in the funding round as a moderator. However, it could be argued that the prominence of the entire lead investor team might be relevant. To ensure the robustness of our findings, we tested Model 4 with an average value of investors' prominence for the entire lead investor team. The results reveal a significant ( $p < 0.1$ ) positive moderating effect of the lead investors' average prominence, and therefore, support our model.

#### 4.3 Post hoc analysis

Many studies on signal effectiveness have focused on single events, such as an IPO, or on specific investor

types, such as crowdfunding (e.g., Calic & Mosakowski, 2016) or angel investors (e.g., Truong & Nagy, 2021). Our study instead investigates the effectiveness of green signals on pre-IPO funding outcomes overall. This enables us to distinguish between different funding stages and test the generalizability of our findings in a supplemental analysis, where we examine whether the identified signals (i.e., green signals and prominence of lead investors) are equally effective across different pre-IPO funding stages. This is important, because recent findings in the signaling literature indicate that different types of signals hold varying levels of importance over time in the context of new venture resource acquisition (Anglin et al., 2018; Ko & McKelvie, 2018; Plummer et al., 2016). Signals' effectiveness differs between early- and late-stage ventures, not only because information asymmetries reduce over time (Kleinert et al., 2020) but also because late-stage investors, like IPO investors, look for different signals compared to early-stage investors (Bafera & Kleinert, 2023). Therefore, some signals may be of persistent nature, whereas others are only temporarily efficient. For example, Ko and McKelvie (2018) found that founder human capital has the greatest effect for acquiring first-round funding. Anglin et al. (2018) demonstrated that rhetorical signals conveying messages about psychological capital are effective during the early stages, such as crowdfunding, but do not influence more mature companies undergoing their IPO. In their recent review, Bafera and Kleinert (2023) called for more comparative research, which considers the maturity of a firm as a vital boundary condition.

We sought to examine this boundary condition by testing our Hypotheses 1 and 2b for different funding stages, i.e., differentiating between seed rounds

and early-stage and late-stage funding rounds. Our results confirm our hypotheses across both early-stage and late-stage funding rounds. However, our findings do not generalize to funding in seed rounds, i.e., the environmental orientation of new ventures does not have a significant impact on funding success in seed rounds. Additionally, our post hoc analysis reveals that the environmental orientation of new ventures and interacting lead investor prominence have a significant negative impact on the funding amount in seed rounds. We elaborate on these somehow unexpected findings in our discussion. A more detailed description of the post hoc analysis and the corresponding data can be found in Appendix A2. In summary, the post hoc analysis indicates that the significant positive effects proposed in Hypotheses 1 and 2b are only evident from early-stage funding rounds onwards.

## 5 Discussion

While green new ventures are on the rise, it remains largely unclear how the environmental orientation of new ventures affects funding outcomes. Our research aims to fill this gap by investigating whether a new venture's environmental orientation serves as an important signal related to their pre-IPO funding outcomes. Given the shifting funding landscape that increasingly favors green signals, we hypothesize that new venture financiers increasingly value green signals and consequently invest larger amounts in new ventures that signal an environmental orientation. Our results confirm that the environmental orientation of a new venture indeed positively influences funding outcomes and can therefore be seen as an effective signal for resource acquisition.

Moreover, this study sheds light on signal interactions and the influence of VCs as lead investors. Particularly, we investigate the environmental orientation and prominence of VCs. Aligned with our hypothesis that the presence of prominent lead VCs acts as a signal to other investors, we find that the prominence of lead VC investors positively moderates the relationship between a new venture's environmental orientation and funding amount. However, and against our hypothesis that the presence of green lead VCs act as a signal to other investors, we find no significant moderating effect of the environmental focus of the

lead investor, i.e., the presence of green lead investors does not influence the attraction of other investors, and hence does not significantly influence the total funding amount. A possible explanation might be that lead investors with a high environmental orientation are still an emergent group and thus lack a positive track record, which enables reputation (Petkova et al., 2014). Indeed, our sample shows that investors with high environmental orientation do not exhibit high levels of prominence. Moreover, the potential positive effects arising through the presence of green lead VCs, such as their industry experience and network (Bocken, 2015; Hopp, 2010; Hopp & Lukas, 2014; Randjelovic et al., 2020), do not appear to take effect. The same seems to apply to benefits arising through the similarity between lead investors and investees, instead in-group preferences may appear (e.g., Claes & Vissa, 2020); thus, we do not observe a significant positive effect on total funding. In contrast, if reputable VCs lead the entrepreneurial environmental endeavor, others follow.

Our post hoc analysis allows us to test the generalizability of our findings across different funding stages as recent research indicates that different types of signals hold varying levels of importance over time in the context of new venture resource acquisition (Anglin et al., 2018; Ko & McKelvie, 2018; Plummer et al., 2016). Interestingly, our findings reveal a positive signaling effect of new ventures' environmental orientation on early- and late-stage funding rounds, but no significant positive funding effect for green signals in seed rounds. We attribute this to the observation that, at this very early stage, when a venture lacks a track record and the uncertainty is highest, investors may tend to prioritize clearer and less ambiguous signals. For example, extant research suggest that signals related to founder human capital, such as experience, are particularly strong in first-round funding (Ko & McKelvie, 2018). Investors may perceive those types of signals as more credible due to the universal and clearly costly character of these signals (Colombo, 2021). Vice versa, green signals at this very early stage may mainly consist of green rhetoric and thus be perceived as less credible. This finding relates to very recent work on cheap talk, which is rather forward looking and may mainly rely on subjective, non-verifiable claims (Kleinert, 2024). In addition, we find a negative moderating effect of lead investor's prominence for seed funding rounds.

This is contrary to extant notions that particularly less mature ventures depend on third-party signals due to their lack of own reputations (Kleinert et al., 2020). At the same time, the study by Hsu (2004) indicates that offers made by VC investors with high reputations are acquired at a substantial discount at this very early stage, which may explain the overall negative effect on seed funding amount. This effect may be magnified by the limited number of overall investors in seed funding rounds (see Table III of the Appendix).

### 5.1 Theoretical and practical implications

We make several contributions with our study. First, we contribute to signaling theory in the context of entrepreneurial finance (Colombo, 2021) by investigating the effectiveness of environmental orientation, a very timely signal, which has scarcely been explicitly studied through a signaling lens. We contribute to signaling theory by delineating core theoretical attributes (Bafera & Kleinert, 2023; Spence, 1973) of green signals and show that despite their potentially ambiguous nature, they can be effective in reducing information asymmetries in the current signaling environment, thus facilitating the acquisition of resources.

Second, this study contributes to the theoretical understanding of signal portfolios by addressing recent calls to deepen our grasp of how varied signals interact and not solely focusing on a signal construct (Bafera & Kleinert, 2023). By theorizing and testing signals from both internal and third-party sources, this research advances our understanding on the interactions between these diverse signals and their collective impact on funding outcomes.

Third, we contribute to the literature on identity similarity in signaling environments (Bafera & Kleinert, 2023), by advancing the theoretical understanding of how in-group dynamics influence funding decisions. By examining the alignment between new ventures and lead investors in terms of environmental orientation, we explore a critical but under-theorized aspect of similarity-based signaling. Our findings challenge the assumption that identity similarity inherently facilitates resource acquisition, suggesting instead that in-group preferences can limit funding opportunities from dissimilar investors. This

perspective enhances signaling theory by highlighting the potential trade-offs of identity alignment, where perceived affiliation may attract certain investors while also creating barriers for others, thus influencing access to diverse funding sources (Claes & Vissa, 2020).

Fourth, we contribute to the debate on the credibility of signals (Kleinert, 2024) by showing that green signals are less effective in seed funding rounds, likely due to their ambiguous and non-costly nature at this stage. Our work thus highlights how the effectiveness of signals varies by funding stage, emphasizing the need for a more nuanced view of stage-dependent signaling. This underscores the importance of a temporal perspective in signaling studies, in contrast to focusing on a single financing event as in most related research (Arthurs et al., 2009; Bafera & Kleinert, 2023).

Fifth, previous research on environmental orientation and related green signals has primarily concentrated on crowdfunding and angel investment (Calic & Mosakowski, 2016; Hörisch, 2015; Shahid et al., 2024; Truong & Nagy, 2021), with limited exploration of their effectiveness in attracting VCs. Our study addresses this gap by contributing to the literature on how new ventures secure financial resources from established, professional VCs. Additionally, our newly developed measurement tool offers valuable applications beyond the VC context. For instance, it can be utilized to assess company descriptions on crowdfunding platforms like Kickstarter, providing deeper insights into how environmental orientation influences entrepreneurs' success in attracting support through crowdfunding channels (see also Calic & Mosakowski, 2016).

From a practical point of view, we offer important insights particularly for entrepreneurs. While green signals generally enhance funding potential, success may depend on strategic alignment with prominent lead investors rather than focusing solely on investors with similar environmental orientations. By targeting prominent lead investors, entrepreneurs can benefit from these investors' networks, expertise, and reputation. These factors can significantly increase the venture's visibility in the eyes of other potential investors, facilitating easier access to additional funding. This strategic focus can help entrepreneurs navigate the competitive funding environment more effectively, ensuring that their environmentally

oriented ventures secure the financial support needed to thrive and make a substantial impact. Furthermore, by adopting a temporal perspective in their signaling strategy, entrepreneurs can adapt their green signals to be more effective at different stages of funding, thereby optimizing their chances of success across funding rounds. As we do not find that green signals have a significant positive funding effect in seed rounds, entrepreneurs should focus on signaling less ambiguous and more credible signals to investors at this stage.

## 5.2 Limitations and future research

Despite the contributions, our study faces limitations that may provide avenues for future research. First, as our sample is cross-sectional, we encourage studies with a longitudinal design. Second, we highlight the importance of investigating individual funding rounds, but acknowledge that we do not consider prior investor involvement, including different investor types and their composition (Demirel & Parris, 2015; Fisher et al., 2016). Third, we use companies' descriptions as the basis for measuring environmental orientation. It may be worthwhile to investigate other information sources, such as business pitches (Pollack et al., 2012), press releases and media reports (Pan et al., 2020), or further social media communications (Havakhor et al., 2023). Fourth, certain environmental issues may be more topical than others, and thus receive greater attention among investors; also the tone and style may influence funding consequences of green start-ups (Wöhler & Haase, 2022). Fifth, industry variations exist in how easily they can become green, with some industries like renewable energy and (organic) agriculture being more naturally aligned with environmental orientation than others, such as heavy manufacturing or chemical production, which face greater challenges. This disparity may affect investor interest and funding outcomes. Future research might study these industry-specific challenges and opportunities to better understand how different sectors can successfully adopt and benefit from green practices. Sixth, our measurement of environmental orientation is appropriate to capture green intents at various life cycle stages, but it also has its flaws. We discuss that our post hoc results may be caused by the non-verifiable, less costly claims that are less credible than when they are made at a later stage.

This assumption however requires further theorizing and testing. Different types of green signals could be investigated to understand how they interact over time. For example, examining green social media rhetoric or green patents could provide a more nuanced understanding of the effectiveness of green signals in the current environment. Additionally, it might be worthwhile to theorize and test other signal portfolios, such as how green signals interact with human capital related signals. For example, having prior experience in founding a venture with an environmental orientation could positively influence investors' perceptions and amplify the positive impact of green signals.

## 6 Conclusion

In conclusion, our research demonstrates that the environmental orientation of new ventures can serve as an important signal related to funding outcomes. Our results indicate that a new venture's environmental orientation positively influences the funding received, and this effect is amplified when prominent lead investors are involved in the funding round. Furthermore, adopting a stage-specific signaling strategy can help entrepreneurs optimize their chances of success by tailoring their approach to different funding stages. By expanding our understanding of these dynamics, we hope to contribute to more effective strategies for new ventures seeking to attract investment in an increasingly green-conscious market.

**Funding** Open Access funding enabled and organized by Projekt DEAL.

**Data Availability** The data that support the findings of this study are available from Crunchbase. Restrictions apply to the availability of these data, which were used under license for this study.

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