Liu *et al. Financial Innovation* (2024) 10:27
https://doi.org/10.1186/s40854-023-00529-8

Financial Innovation

RESEARCH Open Access

Crowdfunding innovative but risky new ventures: the importance of less ambiguous tone

Ye Liu[1], Ke Zhang[1*], Weili Xue[2] and Ziyu Zhou[3]

*Correspondence:
kezhang@nju.edu.cn

[1] School of Management and Engineering, Nanjing University, No. 5 Pingcangxiang, Gulou District, Nanjing 210093, Jiangsu, China
[2] School of Economics and Management, Southeast University, No. 2 Sipailou, Jiangning District, Nanjing 210096, Jiangsu, China
[3] Ningbo Branch, the Import-Export Bank of China, No. 268 Andong Road, Yinzhou District, Ningbo 315040, Zhejiang, China

Abstract

Crowdfunding provides a novel and potential way for innovative but risky new ventures to fund their new product development (NPD) projects. To help potential investors evaluate the projects and enhance the credibility of disclosure, founders are struggling with how to phrase the project description. The rapidly growing cleantech crowdfunding projects provide an ideal context to study this issue. We collected information on cleantech crowdfunding projects and matched non-cleantech crowdfunding projects from Kickstarter. The sample period extends from January 2013 to October 2018. Using signaling research as a theoretical lens and a dictionary-based, computerized text mining method, we found that founders of high-quality cleantech crowdfunding projects could create a reliable signal of quality by providing a project description with a less ambiguous tone and thus boost the success of crowdfunding. Moreover, the signaling effectiveness of a less ambiguous tone is more pronounced in cleantech crowdfunding than in matched non-cleantech crowdfunding, suggesting that the marginal benefit of using a less ambiguous tone is larger when the industry information environment is noisier. Further evidence shows that the signaling effectiveness of a less ambiguous tone in cleantech crowdfunding could be strengthened by backers' endorsements. Our findings imply that tone ambiguity in project descriptions is related to founders' information-concealing behavior. Potential investors could search ambiguous words in project descriptions and just allocate their limited attention into projects with a low percentage of ambiguous words to avoid information overload. Founders of high-quality projects could boost crowdfunding success by using a less ambiguous tone to describe their projects. The marginal effect is larger when there is greater uncertainty about project prospects.

Keywords: Innovative new ventures, Cleantech, Crowdfunding success, Tone ambiguity

Introduction

Innovative new ventures have been widely recognized as one of the most important drivers of sustained economic growth. They are germane to the creation, development and growth of new technologies, industries and markets (Lee et al. 2015). However, few of them can cross the early-stage capital gap (the so-called "valley of death"). Since

the innovative process is inherently risky and the return from the innovative process is highly skewed, important frictions are introduced into the financing process (Bellavitis et al. 2017). These frictions lead to an undersupply of funding from traditional financing channels, such as venture capital and angel financing (Kerr and Nanda 2014). Under this background, in recent years, crowdfunding via the internet (hereafter referred to as crowdfunding) has attracted increasing attention. Unlike venture capital and other traditional sources of early-stage capital, crowdfunding enables the entrepreneurs of new ventures to fund their new product development (NPD) projects by drawing on relatively small contributions from a relatively large number of individuals (Mollick 2014; Zhang and Khan 2022).[1] According to the statistic of Rau (2020), the growth of crowdfunding volume has been one of the fastest of any type of financial innovation documented in recent history. From approximately $0.5 billion of funding crowdfunded in 2011, the volume grew to over $305 billion in 2018, a growth rate of over 125% per annum (Ziegler et al. 2020).

Since money is raised at the stage that the product is still to be developed, the founders of crowdfunding (referring to the entrepreneurs raising crowdfunding for their NPD project) need to help potential investors evaluate the project quality and convince them to support the project (Mollick 2014; Courtney et al. 2017). To this end, the founders disclose information through a project description on the homepage of their crowdfunding. The project description provides a text description of the founders' creative ideas, the main risks of the product, team experiences and the project plan, etc. (Courtney et al. 2017; Scheaf et al. 2018). The description is qualitative, difficult to verify and vulnerable to being considered "cheap talk" (Cascino et al. 2019). Thus, just as the director of Kickstarter's design and technology team said,[2] founders must carefully phrase the project description to enhance the credibility of information disclosure to boost the success of crowdfunding. However, our knowledge on how the way in which founders describe their projects (how something is said) affects the credibility of information disclosure is limited (Costello and Lee 2022; Mendes-da-Silva et al. 2022; Yin et al. 2022), since the majority of existing research on crowdfunding has focused on the importance of the content of project descriptions (what one said) (Courtney et al. 2017).

We note that prior literature on mature markets has reported that linguistic tone greatly influences investors' perception and interpretation of information. An ambiguous tone (a high percentage of ambiguous words, such as "*contingency*", "*uncertain*", "*might*", "*possible*" and "*approximate*") is often perceived as hoarding information and thus undermines the credibility of disclosure (Loughran and Mcdonald 2011; Ertugrul et al. 2017). A natural question is whether a similar result holds for crowdfunding. The answer is not intuitive, since crowdfunding takes place in a virtual setting (online), there is a lack of explicit disclosure requirements and clear regulations, and potential investors cannot contemporaneously verify the credibility of founders' expressions (Mollick

[1] This paper focuses on the reward-based crowdfunding, under which the investors will receive the product as a reward if the NPD project succeeds. Reward-based crowdfunding is the most common crowdfunding model for NPD projects. In addition to reward-based crowdfunding, there are other types of crowdfunding model: patronage crowdfunding, equity crowdfunding and debt crowdfunding. We do not examine other types of crowdfunding in this paper.

[2] In May 2020, a crowdfunding marketing agency *Gadget Labs* invited the director of Kickstarter's design and technology team, Heather Swift Hunt, to have a conversation with users of the Chinese biggest question-and answer website *Zhihu*. See https://zhuanlan.zhihu.com/p/376151835.

2014; Cascino et al. 2019). In particular, since the underlying technologies of the promised product are often at an early stage of development with high uncertainty, it is difficult for founders of innovative but risky crowdfunding projects to describe the project with a less ambiguous tone (Park and Patel 2015; Cumming et al. 2017). Whether an ambiguous tone in innovative but risky crowdfunding would just be viewed as falling short in "plain English" or generate more uncertainty about future outcomes and impair perceived trustworthiness? This paper aims to investigate whether and how founders could enhance the credibility of information disclosure by making efforts to provide a project description with a less ambiguous tone and thus boost the success of crowdfunding.[3] Such research is critical, as it provides insights into the mechanism of information disclosure in innovative but risky crowdfunding and decision implications for founders.

The exponentially growing cleantech crowdfunding projects, which aim to give rise to disruptions in traditional industries related to energy, provide an ideal context for use to investigate this research issue. In recent years, the increasing deterioration of the environment has created a high demand for clean technology solutions, which refer to providing a product, service, or process that delivers value using limited or zero non-renewable resources and/or creates significantly less waste than conventional offerings (Pernick and Wilder 2007; Khan et al. 2022). Since cleantech is characterized as having high risks in terms of becoming quickly obsolete, having higher costs of consumer adoption and easily being disrupted by policy changes, new cleantech ventures have been recognized as typical innovative but risky firms (Bjornali and Ellingsen 2014).[4] Moreover, as demonstrated by Cumming et al. (2017), information asymmetries are more severe in cleantech investment than in non-cleantech investment since cleantech investment needs to evaluate not only the science underlying cleantech but also the market opportunities and policy uncertainty. Over the last decade, as many venture capitalists have experienced great losses in cleantech investments and exited from the market, crowdfunding has become the most important alternative financing channel for new cleantech ventures worldwide, including the United States, Australian, and European Union member states, etc. (Cumming et al. 2017). We seek to answer three specific questions:

(1) We examine whether founders of cleantech crowdfunding could create a reliable signal of quality by providing a project description with a less ambiguous tone and thus boost the success of crowdfunding. The signal production cost has been the primary focus of traditional signaling research, while an emerging stream of signaling research has identified the importance of the consequence costs (e.g., reputa-

[3] For example, a crowdfunding project using ambiguous tone would describe the feature of its product as follows: "Possible future features we've considered include AC input capability for the charging of batteries using grid supplied AC electricity" (See https://www.kickstarter.com/projects/sunraiden/sunraiden-solar-inverter-charger-for-off-grid-powe). Here, "possible" is an ambiguous word, indicating a lack of confidence. A less ambiguous tone would go as follows: "The feature of our product will include AC input capability for the charging of batteries using grid supplied AC electricity".

[4] In previous crowdfunding literature, the category of design & technology is usually considered as more innovative than other categories. The design & technology category covers multiple industries. Choosing a random sample from a single industry is a widely used approach to correct endogeneity biases resulting from the need to control for industry variations (Kyriakopoulos and Ruyter 2004), whereas there isn't an explicit industry classification rules on Kickstarter. We used Cumming et al. (2017)'s method to identify cleantech crowdfunding projects from the category of design & technology, which enables us to build a sample from a single industry to control for industry variations. But we also used a matched non-cleantech sample to make a comparison.

tion cost) (Connelly et al. 2011). We use this emerging stream of signaling research as a theoretical lens to analyze the signaling effectiveness of tone ambiguity.

(2) We investigate whether and how the signaling effectiveness of tone ambiguity varies with the industry information environment by examining whether the association between a less ambiguous tone and crowdfunding success is more or less pronounced in cleantech crowdfunding than in matched non-cleantech crowdfunding. The difference between the information environment of cleantech crowdfunding and that of non-cleantech crowdfunding offers a good opportunity to examine this question (Cumming et al. 2017; Crescenzo et al. 2020).

(3) We further examine whether the signaling effectiveness of a less ambiguous tone in cleantech crowdfunding could be strengthened by backers' endorsements (third-party endorsements).

We use a WebCrawler-type technology to collect cleantech crowdfunding projects and matched non-cleantech crowdfunding projects from the world's largest reward-based crowdfunding platform, Kickstarter, and apply a dictionary-based, computerized text mining method to measure the tone ambiguity of project descriptions.

This paper contributes to the literature in four respects. First, this is the first study that formally examines the association between tone ambiguity and crowdfunding success. Prior literature on the role of information disclosure in crowdfunding has predominantly focused on the content of project descriptions (what one said) (Courtney et al. 2017; Moradi and Badrinarayanan 2021; Deng et al. 2022). A growing body of literature has begun to investigate the tone of project descriptions. However, almost all of them have focused on whether a positive tone (or a negative tone) could boost the success of crowdfunding (Anglin et al. 2018; Du 2022; Mendes-da-Silva et al. 2022; Zhang et al. 2022). None of them examined whether a less ambiguous tone could boost crowdfunding success, which nevertheless is important for innovative but risky crowdfunding. Our research aimed to address this gap. Second, it extends previous studies that deal with signals in crowdfunding. Previous studies have found three types of important signals, including signals of project quality, signals of entrepreneurs' credibility, and signals sent by third-party. This paper adds to the first stream of signaling studies by investigating the role of tone ambiguity in project descriptions. It also extends the first and the third stream of signaling studies by investigating the simultaneous interaction of tone ambiguity and third-party endorsements. Third, it also adds to the general literature on the role of tone ambiguity in information disclosure. Previous research on the role of tone ambiguity in information disclosure has focused on mature markets, where there are rigorous disclosure requirements and professional participants such as financial analysts and institutional investors (Loughran and Mcdonald 2011; Wu et al. 2021). We extended the literature by exploring whether tone ambiguity impairs the credibility of information disclosure in a nascent market that takes place in a virtual setting (online crowdfunding), lacks explicit disclosure norms and clear regulations, and is combined with the inexperience of investors. Forth, it extends the literature on the determinants of cleantech crowdfunding success. Cumming et al. (2017) presented the first study in this field. They documented that investors in cleantech crowdfunding

perceived higher information asymmetry than those in non-cleantech crowdfunding. Following Cumming et al. (2017), several recent works have examined whether longer project descriptions, more accurate spelling, more video pitches and gallery items could signal the quality of cleantech crowdfunding projects (Lu et al. 2018; Crescenzo et al. 2020; Slimane and Rousseau 2020). We extended this field by investigating how the tone ambiguity of the project description affects the success of cleantech crowdfunding.

The remainder of the paper is organized as follows: Sect. "Literature review" reviews the related literature. Sect. "Research hypothesis" presents the research hypotheses. Sect. "Data" outlines the data and steps to collect them. Sect. "Methodology" introduces key variables and the regression model. Sect. "Empirical results and analysis" reports the summary statistics and regression results. Sect. "Conclusions and implications" presents conclusions and implications.

Literature review

PRISMA method

This paper is related to three streams of literature: the role of information disclosure in crowdfunding; the role of tone ambiguity in information disclosure; cleantech crowdfunding (or crowdfunding in energy industry). We used the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) method to investigate the related studies (Moher et al. 2009). We conduct the process as follows:

First, we searched literature in the online database Science Direct, Emerald, and Taylor & Francis. We used the following combinations of keywords: "information disclosure" AND "crowdfunding"; ("signal" OR "signaling") AND "crowdfunding"; "tone" AND "crowdfunding"; "tone" AND "ambigu*" AND "information disclosure"; ("cleantech" OR "energy industry" OR "energy sector") AND "crowdfunding"; "new venture" AND "financing" AND "energy". We collected papers that have one of the above combinations of keywords in the full paper (including title, abstract, keywords and text).

Second, we performed an additional search through Google Scholar. The above search with broad keywords achieved a good coverage of the literature, while an additional search with more specific keywords could be a helpful supplement (Bartels, 2013). For this reason, we proceeded to perform an additional research through Google Scholar with the following combinations of specific keywords: "tone" AND "information disclosure" AND "crowdfunding"; "tone ambiguity" AND "crowdfunding"; "ambiguous tone" AND "crowdfunding".

Third, we collected papers that published between 2013 and 2022. Beyond the chronological range, there was no other restriction. After removing duplications, we got N = 2605 papers. We used Zotero, an open-source Chrome extension and reference management tool, to collect these papers. We reviewed the title and abstract of these N = 2605 papers. Among them, only N = 23 papers related to role of tone in crowdfunding, and all most of them investigated the role of positive tone (or a negative tone). None of them (N = 0) examined the role of tone ambiguity in crowdfunding. In the following section, we reviewed the most relevant empirical studies, even when they do not consider the tone of project descriptions.

Review results

The majority of existing research on the role of information disclosure in crowdfunding has focused on the importance of the content of the project description (e.g. the human capital of the team and the social capital of the entrepreneur) (Mollick 2014; Courtney et al. 2017; Moradi and Badrinarayanan 2021; Deng et al. 2022). Recently, a growing body of literature (N = 23) have begun to examine the effect of the tone in which founders describe their projects on crowdfunding success. Most of them (N = 18) focused on whether a positive tone (or a negative tone) in project description leads to better fundraising performance (e.g. Anglin et al. 2018; Allison et al 2017; Du 2022; Mendes-da-Silva et al. 2022; Zhang et al. 2022; Li et al. 2022). There are only several exceptions: Two papers examined the role of a personal tone (by mentioning the founder's name or using second-person pronouns) in project descriptions (Gafni et al. 2019; Zhu 2022); Four papers investigated the usage of concrete words (articles, prepositions and quantifiers (e.g. "a lot", "few")), which affects the tone of communication (Parhankangas and Renko 2017; Abdullah 2019; Zhu 2022; Jin et al. 2022). None of them (N = 0) examined the role of tone ambiguity, which nevertheless is important for innovative but risky crowdfunding. Our research aimed to address this gap.

This paper extends the studies that deal with signals in crowdfunding. Numerous previous studies applied signaling theory to understand the determinants of crowdfunding success. They have found three types of important signals: (1) signals of project quality, including the use of media (Cumming et al. 2017; Huang et al. 2022), the length of the project description (Cascino et al. 2019), a positive tone in the project description (Li et al. 2022; Mendes-da-Silva et al. 2022), the presence of quick updates (Deng et al. 2022), etc. (2) signals of entrepreneurs' credibility, including entrepreneurs' social networks (Deng et al. 2022) and experience (Huang et al. 2022; Madsen and McMullin 2020). (3) signals sent by third-party, including backers' endorsements (Courtney et al. 2017; Bukhari et al. 2020) and being featured by the platform (Mollick 2014). This paper adds to the first stream of signaling studies by investigating the role of tone ambiguity in the project description. It also extends the first and the third stream of signaling studies by investigating the simultaneous interaction of tone ambiguity and third-party endorsements.

This paper also relates to the general literature on the role of tone ambiguity in information disclosure. Loughran and Mcdonald (2011) compiled categories of word lists to measure the tone in financial documents. Using Loughran and Mcdonald (2011)'s word lists, many studies found that an ambiguous tone in listed companies' financial statements is positively related to stock return volatility, key initial public offering (IPO) performance metrics (initial return, absolute price revisions and subsequent volatility), cost of debt and stock price cash risk (Loughran and Mcdonald 2013; Ertugrul et al. 2017; Wu et al. 2021). Their findings indicate that an ambiguous tone is related to managerial information hoarding and thus reduces the credibility of disclosure. However, they all focused on mature markets and listed companies, and whether a similar result holds for crowdfunding is unstudied. We extended the literature by exploring whether tone ambiguity impairs the credibility of information disclosure in a nascent market that takes place in a virtual setting (online crowdfunding), lacks explicit disclosure norms and clear regulations, and is combined with the inexperience of investors.

This paper also adds to the literature on the determinants of cleantech crowdfunding success. Prior works on energy finance have mostly focused on examining commodity markets and environmental mutual funds (Henderson et al. 2015). Cumming et al. (2017) presented the first empirical analysis of cleantech crowdfunding. They documented that investors of cleantech crowdfunding perceived higher information asymmetry than those in non-cleantech crowdfunding. From then on, a growing but still sparse literature, such as Lu et al. (2018), Crescenzo et al. (2020) and Slimane and Rousseau (2020), found that longer project descriptions, more accurate spelling, more video pitches and gallery items could signal the high quality of cleantech projects. However, more research on the mechanisms by which founders of cleantech crowdfunding mitigate the information asymmetry problem, thus boosting crowdfunding success, is urgently needed. We extended this field by investigating whether the founders could boost the success of cleantech crowdfunding by providing project descriptions with a less ambiguous tone.

Research hypothesis

Research context and analysis framework

In crowdfunding, founders present the NPD project to be funded on online platforms to raise external financing from the crowd. An essential part of any crowdfunding proposal is the project description. Taking the Kickstarter platform as an example, a project description includes two main parts: "story" and "risk and challenge". The "story" section shows details of the project to potential investors, such as the founders' creative ideas, the product development process, team experiences, a series of new and high technology the project used, market prospects, etc. The "risk and challenge" section describes the potential risks and challenges of the project and the founders' plan to address the risks and challenges. Since money is raised at the stage that the product is still to be developed, the project description provides mainly a qualitative textual description. Founders struggle with how to phrase the project description to enhance the credibility of information descriptions and thus boost the success of crowdfunding (Loughran and Mcdonald 2011; Baginski 2016).

Previous literature on mature markets has reported that an ambiguous description (with a high percentage of ambiguous words, such as "*contingency*", "*uncertain*", "*might*", "*possible*" and "*approximate*") is often perceived as information hoarding and undermines the credibility of disclosure (Loughran and Mcdonald 2011; Ertugrul et al. 2017). However, whether this is also true for crowdfunding is unclear, since the crowdfunding market is a nascent market, lacks explicit disclosure norms and clear regulation mechanisms and is combined with the inexperience of investors (Cascino et al. 2019). Moreover, it is difficult for the founders of cleantech crowdfunding to describe the projects clearly. This is because cleantech is usually in "gray" areas of development and characterized as high uncertainty (Cumming et al. 2017). Some founders themselves may not know much about the prospects and risk factors of the projects. Even if founders have a clear understanding of their projects, whether they are capable of describing the project clearly is largely contingent upon their effort put into writing (Allison et al. 2017). A high percentage of ambiguous words in the project description makes it difficult for potential investors to distinguish high-quality projects from low-quality projects (Loughran and Mcdonald 2011; Ertugrul et al. 2017). This issue becomes more severe when low-quality

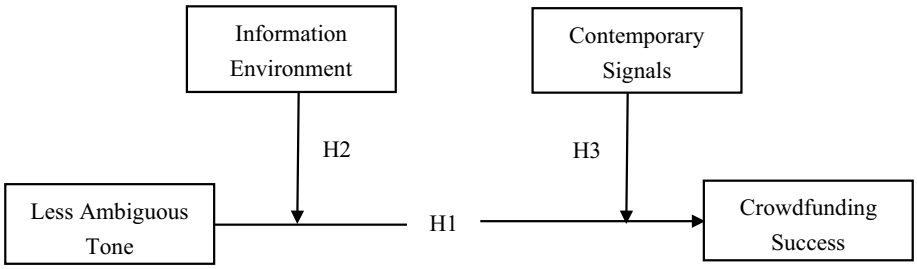

Fig. 1 Analysis framework

projects strategically use an ambiguous tone to transmit less accurate information and muddy potential investors' evaluation (Doran 2011).

This paper examines whether founders of high-quality projects could create a reliable signal of quality by providing project descriptions with a less ambiguous tone. Signaling theory predicts that the signal is effective when senders with low quality cannot transmit the same signal considering the costs associated (Bergh et al. 2014). The signal production cost has been the primary focus of signaling research, while an emerging stream of signaling research has identified another kind of cost associated with signaling: consequence costs, e.g., reputation costs, and negative social influence (Connelly et al. 2011). Consequence costs are entailed through potential consequences. When the signal production cost is cheap but consequence costs are high, high-quality signalers can still differentiate themselves from low-quality signalers. We use the lens of this emerging stream of signaling research to develop our analysis. Figure 1 depicts the analysis framework. The rest of this section discusses each of the three hypotheses in Fig. 1 in detail.

The association between tone ambiguity and crowdfunding success

Based on signaling theory, we argue that founders of high-quality cleantech crowdfunding projects could create a reliable signal of quality by providing project descriptions with a less ambiguous tone. There are two scenarios.

First, when founders describe the finished part of the products and achievements with a less ambiguous tone (i.e., sending a signal), the signal production cost helps differentiate high-quality projects from low-quality projects. Specifically, Kickstarter has taken strict control of submitted projects to fight fraud since 2012. For example, they provided the following rules of information disclosure every project must follow.

> *When a project involves manufacturing and distributing something complex, like a gadget, we require projects to show backers a prototype of what they're making, and we prohibit the use of misleading imagery. Prototype demonstration should reflect a product's current state and should not include any computer-generated imagery (CGI) or special effects to demonstrate functionality that does not yet exist. Misleading imagery includes photorealistic renderings and heavily edited or manipulated images or videos. These rules are not solely recommendations. Violation of these rules can result in a range of actions depending on the severity of your failure to be transparent, ranging from your project being ineligible for promotion to account restriction or even project suspension. (See https://www.kickstarter.com/rules?ref=global-footer)*

If low-quality projects try to mislead investors by imitating high-quality projects, it will be difficult for them to show more details to backers, such as a prototype of what he (she) is making. Thus, they run a high risk of failing to bypass the strict control of submitted projects on Kickstarter (Herve and Schwienbacher 2018). Take, for example, on the Kickstarter platform, a cleantech project that produces a portable wind turbine describes the finished part of its product as follows: "Trinity folds together into a 12-inch cylinder that you can carry with you wherever you go…To open the three blades you simply pull out the 11-inch aluminum legs and arrange them in either a tripod configuration or laid flat depending on your circumstances".[5] At the same time, the founder shows several pictures of the finished part of the product on the webpage. Compared to using ambiguous tone, such as "We *believe* our product is the easiest to carry among likewise products", the project's description clearly shows how portable the wind turbine is and helps potential investors evaluate the portability of the wind turbine.

Second, if founders describe plans and goals with a low proportion of ambiguous words (and thereby send a signal), the signal production cost is relatively cheap, but the consequence costs (mainly reputational costs) may be high. Although the crowdfunding market is a nascent market that lacks rigorous legal regulation, few crowdfunding projects give up on delivering the promised product (Mollick 2014). This is because reputation concerns, from future careers, social networks, ex post sales and subsequent funding, motivate founders to fulfill their obligation (Ellman and Hurkens 2019). More specifically, in addition to raising money, crowdfunding has also been used to demonstrate managerial competencies, create interest in new products at the early stages of development and secure subsequent funding from professional investors. When founders' obligation to deliver the promised product is not fulfilled, they face serious reputation consequences. For our research purpose, it is noteworthy that the usage of ambiguous words is related to ill-informed expectations about product quality and thus generates a high risk of failing to meet the expectation (failing to deliver the promised product). However, the risk is lower for high-quality projects than for low-quality projects because the probability of failing to fulfill the promised product is lower for high-quality projects.

Collectively, we believe that founders of high-quality cleantech crowdfunding projects could create a reliable signal of quality by providing project descriptions with a less ambiguous tone. This means that crowdfunding projects with a less ambiguous description of their quality would be favorably treated in the market compared with others with ambiguous descriptions. As a result, we expect that cleantech crowdfunding projects with less ambiguous descriptions will be more likely to succeed and raise more money.

Hypothesis 1 Tone ambiguity in the project description is negatively associated with cleantech crowdfunding success.

The moderating effect of industry information environment

Next, we explore whether and how the signaling effectiveness of tone ambiguity varies with the industry information environment by examining whether the impact of

[5] See https://www.kickstarter.com/projects/skajaquoda/trinity-the-portable-wind-turbine-power-station.

tone ambiguity on crowdfunding success is more or less pronounced in cleantech crowdfunding than in non-cleantech crowdfunding. Similar to cleantech crowdfunding, non-cleantech crowdfunding relies on qualitative information to communicate with potential investors (Liberti and Petersen 2019). However, as Cumming et al. (2017) demonstrated in their seminal work, the information asymmetries between founders and potential investors are more severe in cleantech crowdfunding projects than in non-cleantech crowdfunding projects. This is because, on the one hand, the science underlying cleantech is vulnerable to becoming quickly obsolete. On the other hand, given that cleantech projects are characterized as encompassing a public good, the cost of consumer adoption is high, and cleantech investments may be disrupted by policy violations. Potential investors in cleantech crowdfunding projects face severe information asymmetries with respect to evaluating not only the science underlying cleantech but also the market opportunities and policy uncertainty of cleantech investments (Cumming et al. 2017; Crescenzo et al. 2020). This means that the information environment of cleantech crowdfunding is much noisier than that of non-cleantech crowdfunding. Signaling theory suggests that a noisy information environment affects recipients' perception and interpretation of signals, thus influencing signals' effectiveness (Janney and Folta 2006; Park and Patel 2015).

However, it is hard to say whether the signaling effectiveness of a less ambiguous tone of a project description is more pronounced in cleantech crowdfunding than in non-cleantech crowdfunding. On the one hand, because the information environment of cleantech crowdfunding is much noisier, potential investors severely lack information about cleantech projects (Connelly et al. 2011; Park and Patel 2015). In such situations, potential investors may pay more attention to the signals sent by founders, which can increase their perceptions of project quality and make a better decision (Janney and Folta 2006). This suggests that a less ambiguous tone is more likely to be perceived in a noisier information environment, and thus, the signaling effectiveness of a less ambiguous tone will be more pronounced in cleantech crowdfunding than in non-cleantech crowdfunding. On the other hand, we notice that a noisy information environment may also decrease the accuracy of potential investors' interpretation of information. Specifically, Park and Patel (2015) found that when the information environment is much noisier, it is difficult for potential investors to isolate firm-versus-industry effects in discerning ambiguous signals. In this situation, the ambiguous tone of the project description may be viewed as an industry risk rather than the low quality of the project. If this is true, tone ambiguity will not lead to a greater penalty from potential investors. In summary, we posit the following two hypotheses:

Hypothesis 2a The negative relationship between the tone ambiguity in the project description and crowdfunding success is stronger for the cleantech sample than for the non-cleantech sample.

Hypothesis 2b The negative relationship between the tone ambiguity in the project description and crowdfunding success is not stronger for the cleantech sample than for the non-cleantech sample.

The interaction between tone ambiguity and backers' endorsements

The analysis above shows that a less ambiguous tone of the project description can help potential investors better understand a cleantech project and accurately assess its quality. However, the premise is that potential investors believe that the description is genuine. In cleantech crowdfunding, it is difficult for potential investors to directly verify the credibility of founders' expressions because of the noisy information environment (Mollick 2014; Anglin et al. 2018). We explored whether the association between tone ambiguity and crowdfunding success can be strengthened by backers' endorsements (third-party endorsements in the context of crowdfunding).

Previous research has shown that endorsements in the form of online comments by early investors contain information that helps other potential investors make a better decision by ascertaining the quality of projects (Courtney et al. 2017). Specifically, positive comments indicate backers' sentiments/feelings about the project, and the number of comments demonstrates how much attention the project has obtained from backers (Courtney et al. 2017; Wang et al. 2018). Courtney et al. (2017) argued that backers' endorsements can validate and complement founder-originated signals. First, sentiments and attention underlying backers' comments are external to the new venture. Backers are cognizant of different founder-originated signals before making comments on the project, and their comments can be observed by other potential backers. Second, backers can source information from other channels, such as social networks and internet search. Backers' endorsements are outcomes of information sourced from various channels and can complement the information from founders, provided that the information is consistent across different channels. Courtney et al. (2017)'s arguments imply that the presence of high value of comment quantity and positive backer sentiments can validate and complement the signal conveyed by tone ambiguity, thus increasing the credibility of information in a clear description.

On the other hand, it is worthy to note that signaling from backers' endorsements may also substitute/offset the signal conveyed through tone ambiguity. Whether potential investors will integrate the information conveyed through tone ambiguity and that from backers' endorsements to paint a more complete picture of the project is an empirical issue (Scheaf et al. 2018). Thus, we posit the following alternative hypotheses:

Hypothesis 3a High value of comment quantity will strengthen the negative relationship between tone ambiguity and cleantech crowdfunding success.

Hypothesis 3b High value of comment quantity will weaken the negative relationship between tone ambiguity and cleantech crowdfunding success.

Hypothesis 4a Positive backer sentiments will strengthen the negative relationship between tone ambiguity and cleantech crowdfunding success.

Hypothesis 4b Positive backer sentiments will weaken the negative relationship between tone ambiguity and cleantech crowdfunding success.

Data

We used data from the world's largest reward-based crowdfunding platform, Kickstarter, which was launched in 2009 in the United States. The number of crowdfunding projects launched on Kickstarter is more than twice as large as that in Indiegogo, the second-largest reward-based crowdfunding platform. One of the differences between Kickstarter and Indiegogo is whether founders can choose between a fixed funding mechanism (so-called "all-or-nothing") and a flexible funding mechanism (so-called "keep-it-all"). Under the fixed funding mechanism ("all-or-nothing"), the founder only receives the pledges if the minimum goal of funding is achieved. Under the flexible funding mechanism ("keep-it-all"), the founder keeps the entire amount that the crowd has pledged even if the minimum goal is not achieved (Cumming, et al. 2017). On Kickstarter, only the fixed mechanism is possible, whereas on Indiegogo, both the fixed mechanism and flexible mechanism are possible. Under the fixed mechanism, founders bear more risks of failure because they will lose the pledges if the minimum goal is not achieved (Mollick 2014; Cumming et al. 2017); thus, they have a stronger incentive to signal the quality of the project to potential investors. As Kickstarter is an international platform, the projects may originate from different countries. We focused on projects that originated from the United States to control the impact of institutional factors on the success of crowdfunding.

Our sample period extends from January 2013 to October 2018. The sample period starts in 2013 because in late 2012, Kickstarter claimed that each crowdfunding project must describe the potential risks of the project, which may influence the tone ambiguity of the project description. The original sample includes all finished crowdfunding projects in the category of design & technology, including successful and unsuccessful crowdfunding projects. In addition to design & technology, there are seven other categories of crowdfunding projects on Kickstarter: arts, comics & illustration, film, food & craft, games, music and publishing. However, they are not involved with cleantech. Figure 2 depicts the six steps we used to collect information about the original sample from Kickstarter using WebCrawler technology:

(1) Collect the uniform resource locators (URLs) of all crowdfunding projects belonging to the category of design & technology on Kickstarter, including crowdfunding projects that were successfully funded and underfunded. The URLs provide the internet address of each crowdfunding project's exhibition webpage, update webpage, comment webpage and founder's personal information webpage on Kickstarter.
(2) Collect the characteristic information of crowdfunding from the exhibition webpage, including launch date, funding goal, category of crowdfunding, reward structure, and project description, etc.
(3) Collect the founder's personal information, including biography, location, links to the founder's social network homepages and the number of previous crowdfunding projects launched by the founder.
(4) Collect the update information posted by the founder. Updates are information posted by the founder to show the progress of the project and attract investors dur-

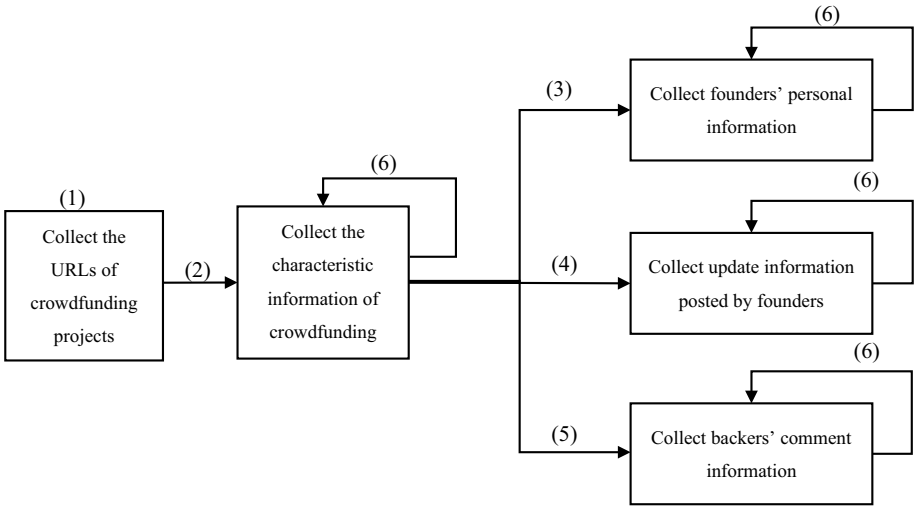

Fig. 2 The procedure of data collection

ing the period of crowdfunding. We gathered the content and publishing date of each update.

(5) Collect the comment information left by backers. During the duration of crowdfunding, both founders and backers can post comments. We identified comments posted by backers and then gathered the content and publishing date of each comment.

(6) If steps (2)–(5) encounter any errors or the information collected is incomplete, the program will repeat the above steps to ensure that no data are missing.

Starting with the original sample, we distinguished between cleantech and non-cleantech crowdfunding projects (both belonging to the category of design & technology). Following Cumming et al. (2017), we searched for the following key words in the project description to identify cleantech crowdfunding projects: "*cleantech*", "*green energy*", "*renewable energy*", "*sustainable*", "*environmental footprint*", "*green transport*", "*recycle*", "*solar power*", "*wind power*", "*biomass*", "*hydro-electric*", "*photovoltaic*", "*geotherm*", "*biofuel*", "*graywater*" and "*electric motor*". We also excluded projects with a funding goal below $5,000 USD, because those projects often target friends and family members (Mollick 2014; Cumming et al. 2017). After excluding crowdfunding projects with missing information on the project description, we had a sample of 1,172 cleantech crowdfunding projects and 26,209 non-cleantech crowdfunding projects. We will discuss the selection of matched non-cleantech crowdfunding projects for each cleantech crowdfunding project in the next section.

Methodology

Measuring crowdfunding success

In our study, we used two different measurements of crowdfunding success. Under the fixed funding mechanism on Kickstarter, founders receive pledges only if the pledged

funds meet or exceed the funding goal. Consequently, we used the dummy variable *Success* as the first measurement of crowdfunding success, which measures whether the founders received the pledges (Mollick 2014; Courtney et al. 2017; Anglin et al. 2018). The dummy variable takes the value 1 if the founders received the pledges and 0 otherwise. Once a project is funded successfully, it is more meaningful to use the amount of funds pledged as a measurement of crowdfunding success (Cumming et al. 2017; Anglin et al. 2018; Cascino et al. 2019). Therefore, we used the variable *Money pledged*, which is the natural logarithm of the dollar amount pledged, as the second measurement of crowdfunding success.

Measuring tone ambiguity

In previous studies, Loughran and McDonald (2011) noted that the word classifications derived for non-business disciplines do not suit measuring the tone of financial documents. They developed six sentiment word lists (uncertain, weak modal, negative, positive, legal and strong modal) to reflect the tone of financial documents. Among these word lists, the uncertain and weak modal word lists gauge the ambiguous tone (Loughran and McDonald 2013; Ertugrul et al. 2017). There are 285 words in the uncertain word list, including "*assume*", "*predict*", "*seems*", and "*unknown*", etc., which indicates imprecision. There are 27 words (e.g., "*could*", "*might*", "*perhaps*") in the weak modal word list, which mainly represents a lack of confidence.[6] Loughran and McDonald (2013) used these two lists to measure the tone ambiguity of IPO prospectuses. IPOs do not typically have a long history of tangible information. On this point, their context is similar to ours. According to the above analysis, we used the percentage of uncertain and weak modal words in the project description to measure the tone ambiguity in crowdfunding.

Specifically, following Loughran and McDonald (2011) and Ertugrul et al. (2017), we used two proxies, *Uncertain* and *Weak modal*, to measure tone ambiguity, and they were calculated as follows:

$$Uncertain = (UW/TW) \cdot 100 \tag{1}$$

$$Weak\ modal = (WMW/TW) \cdot 100 \tag{2}$$

where UW is the number of uncertain words in the project description, TW is the number of total words in the project description, and WMW is the number of weak modal words in the project description.

Regression model

To test Hypotheses 1 and 2, we considered the following regression equation:

$$Y = \beta_0 + \beta_1 \cdot X + \sum_i \varphi_i \cdot Controls^i + \omega \cdot Subcategory + \sum_j \gamma_j \cdot Year^j + \sum_k \delta_k \cdot Location^k + u \tag{3}$$

[6] It is worth noting that the weak modal word list is a subset of the uncertain word list, which represents both imprecision and less of confidence.

where the dependent variable Y represents one of the two measurements of crowdfunding success considered in the paper, including *Success* and *Money pledged*. The independent variable X represents the tone ambiguity in the project description, calculated by Eqs. (1) or (2).

Following prior literature, we included the following control variables: *Funding goal* is the natural logarithm of the capital goal set by the founders of crowdfunding. *Duration* is the natural logarithm of the number of funding days. *Rewards* is measured by the natural logarithm of 1 plus the number of different rewards offered (Courtney et al. 2017). *Quick updates* is a dummy variable equal to 1 if the founder posts at least one update (information about the progress of the project) within the first three days of the fundraising period and 0 otherwise (Mollick 2014). *Comment quantity* is the natural logarithm of 1 plus the number of backers' comments (Wang et al. 2018). In order to delete the comments that come too late to be processed by the crowd and acted upon, we only selected comments before the fundraising amount reached 90% and removed the comments from the founder. *Backer sentiment* is the measurement of positive sentiment override reflected in the backers' comments (Baginski 2016). It is defined as the difference between the number of backers' comments with a positive tone and the number of backers' comments with a negative tone scaled by the total number of backers' comments. We only selected comments before the fundraising amount reached 90% and removed the comments from the founder. We used the Loughran and McDonald (2011)'s dictionaries for capturing the positive and negative tone. *Featured* is equal to 1 when the crowdfunding was featured by Kickstarter on their home page (that is, it has been identified by the Kickstarter staff as a crowdfunding project they support) and 0 otherwise. Crowdfunding projects featured by Kickstarter are more likely to be successful (Mollick 2014). *Social network* is the number of categories of external links to the founder's social networks (including Facebook, Twitter, Instagram and YouTube) in the project description. *ARI* is designed to gauge the understandability of the project description. Following Cumming et al. (2017), we used the Automated Readability Index, which is expressed as a US grade level. *Total words* is the natural logarithm of the number of words in the project description. *Net Positive* is the measurement of positive sentiment override reflected in the project description (Baginski 2016). It is defined as is the difference between the number of positive words and the number of negative words scaled by the total number of words in the project description. *Risk Index* is designed to measure the risk of crowdfunding project. Madsen and McMullin (2020) constructed a comprehensive index to measure crowdfunding project risk. Following them, we used the comprehensive index, which is the sum of several indicators.[7] *Image* is the natural logarithm of 1 plus the number of images. *Video* is the natural logarithm of 1 plus the total length (seconds) of videos.

Our samples were all in the category of design & technology. This category includes two subcategories: product design and technology. We controlled for the subcategory

[7] The indicators include: *High Reward Tiers*, the number of reward tiers of the project is at the top 25%; *High Complexity*, the complexity words in the description of the project is at the top 25% (Madsen and McMullin 2020); *Prototype*, a project page that mentions the word "prototype"; *Short main description*, the length of the project's main descriptions is at the bottom 25%; *Inexperienced*, a creator who has never previously launched a project on Kickstarter; *Low Ability*, the ability-related words in the description of the project is at the bottom 25% (Madsen and McMullin 2020).

effect by introducing a dummy variable *Subcategory*, coded 1 for technology crowdfunding projects and 0 for product design crowdfunding projects. To control for the launch year effect, we included five dummy variables $Year^i$ for 2013, 2014, 2015, 2016 and 2017, with 2018 being the excluded dummy variable. Similarly, to control for the effect of geographic location on crowdfunding success, we included four dummy variables $Location^j$ for California, New York, Florida and Texas, which are the top four states by number of cleantech crowdfunding projects.

To test Hypothesis 1, we used the cleantech samples to estimate Eq. (3). First, we used the full cleantech sample (including successful and unsuccessful cleantech crowdfunding projects) to test the effect of tone ambiguity on our first dependent variable *Success*. Because *Success* is a dummy variable, we performed logistic regression. Second, we used the subsample of successful cleantech crowdfunding projects to test the effect of tone ambiguity on the other dependent variable *Money pledged*, since founders receive the pledges only if crowdfunding projects achieve success. Given that *Money pledged* is a continuous variable, we performed OLS regressions. If the coefficients on the variable *Uncertain* or *Weak modal* in the two regressions above are significantly negative, Hypothesis 1 is supported.

To test Hypotheses 2a and 2b, we used the propensity score matching (PSM) method to select matched non-cleantech crowdfunding projects for each cleantech crowdfunding project. Specifically, we matched, without replacement, a cleantech crowdfunding project with the nearest five non-cleantech crowdfunding projects that were launched in the same year, and belonged to the same subcategory (technology or product design). The matching covariates include *Funding goal*, *ARI*, *Total words*, *Net Positive*, *Risk index*, *Video* and *Image*. Then, we used the matched non-cleantech sample to re-estimate Eq. (3). If Hypothesis 2a is true, there should be a significant difference in the estimated coefficient (on the variable *Uncertain* or *Weak modal*) using the cleantech sample and that using the matched non-cleantech sample. Otherwise, hypothesis 2b is true.

To test Hypotheses 3 and 4, we added interaction terms to Eq. (3). The new equation is as follows:

$$Y = \beta_0+\beta_1\cdot X+\beta_2\cdot X\cdot Z+\sum_i \varphi_i\cdot Controls^i+\omega\cdot Subcategory+\sum_j \gamma_j\cdot Year^j+\sum_k \delta_k\cdot Location^k+u \tag{4}$$

We used the cleantech samples to estimate Eq. (4). When we tested Hypothesis 3, the variable Z represents the dummy variable *High comment quantity*, which equals 1 if the value of *Comment Quantity* ranked in the top 50% of the cleantech sample, 0 otherwise. When we tested Hypothesis 4, the variable Z represents the dummy variable *Positive backer sentiment*, which equals 1 if the value of *Backer sentiment* ranked in the top 50% of the cleantech sample, 0 otherwise. The definitions of the other variables are the same as those in Eq. (3). If Hypotheses 3a and 4a are true, then the estimated coefficients on the interaction terms would be significant and negative. Otherwise, Hypotheses 3b and 4b are true.

Table 1 Descriptive statistics

Variable	Cleantech sample		Non-cleantech sample		Mean difference *t*-test	
	Mean	SD	Mean	SD	Diff	*t*-value
Success	0.370	0.483	0.276	0.447	0.094	6.542***
Money pledged	7.970	2.991	6.697	3.669	1.273	14.102***
Uncertain (%)	0.637	0.395	0.699	0.522	−0.062	−5.152***
Weak modal (%)	0.343	0.258	0.356	0.346	−0.013	−1.616***
Funding goal	10.177	1.086	10.088	1.093	0.089	2.747***
Duration	3.536	0.254	3.535	0.284	0.001	0.099
Rewards	2.215	0.558	2.004	0.621	0.211	12.618***
Quick updates	0.421	0.494	0.342	0.474	0.079	5.362***
Comment quantity	1.717	1.709	1.378	1.724	0.339	6.645***
Backer sentiment	0.523	0.451	0.371	0.459	0.152	11.278***
Featured	0.154	0.361	0.100	0.300	0.054	5.023***
Social network	0.460	0.906	0.348	0.813	0.112	4.141***
ARI	9.652	2.749	9.739	3.788	−0.087	−1.041
Total words	6.894	0.663	6.450	0.821	0.444	22.186***
Net positive	0.883	0.961	0.706	1.303	0.177	6.067***
Risk index	1.922	0.894	2.091	0.861	−0.169	−6.357***
Video	4.589	1.504	4.002	1.982	0.588	12.883***
Image	2.415	1.164	1.859	1.358	0.556	15.871***
Observations	1172		26,209			

This table provides descriptive statistics of all variables in our analysis. The sample period is from January 2013 to October 2018 and the sample covers 1172 cleantech crowdfunding projects launched on the Kickstarter platform. To make a comparison, this tale also provides descriptive statistics for the matched non-cleantech crowdfunding projects launched during the same period on the Kickstarter platform

Empirical results and analysis

Descriptive statistics and correlations

Table 1 reports the descriptive statistics of the samples. All continuous variables were winsorized at the 1st and 99th percentiles. The first two columns in Table 1 show the descriptive statistics of the full cleantech sample. Approximately 37% of the cleantech crowdfunding projects achieved success, and the mean of *Money Pledged* was 7.97. By calculation, we knew that the average amount of money pledged for a crowdfunding project was $35,000. The mean percentage of uncertain words in the project description was approximately 0.64% and that of weak modal words was approximately 0.34%. Although the percentage of uncertain (weak modal) words was not high, it makes sense in assessing the ambiguity tone of text information (Ertugrul et al. 2017). On average, the duration of crowdfunding projects was approximately 35.5 days (the mean of variable *Duration* was approximately 3.54). During this period, founders provided nearly 9 kinds of rewards for investors (the mean of variable *Rewards* was approximately 2.22). Approximately 42% of the founders provided updates within the first three days of the fundraising period, which was consistent with the findings of Mollick (2014). There were on average 29.44 comments provided by investors for each crowdfunding project (the mean of variable *Comment quantity* was approximately 1.72). As shown, 15.4% of crowdfunding projects were featured by Kickstarter on their home page.

Table 1 also reports the differences between the cleantech crowdfunding projects and the matched non-cleantech crowdfunding projects. The probability of success for

Table 2 Differences between the successful cleantech sample and the unsuccessful cleantech sample

Variable	Successful cleantech sample		Unsuccessful cleantech sample		Mean difference *t*-test	
	Mean	SD	Mean	SD	Diff	*t*-value
Success	1.000	0.000	0.000	0.000	–	–
Money pledged	10.618	1.188	6.413	2.613	4.205	37.601***
Uncertain (%)	0.594	0.336	0.663	0.424	−0.069	−3.067***
Weak modal (%)	0.317	0.217	0.359	0.278	−0.043	−2.913***
Funding goal	9.855	0.857	10.367	1.159	−0.512	−8.635***
Duration	3.529	0.233	3.539	0.266	−0.011	−0.723
Rewards	2.469	0.420	2.066	0.576	0.403	13.786***
Quick updates	0.654	0.476	0.283	0.451	0.371	13.142***
Comment quantity	3.196	1.593	0.847	1.051	2.349	27.407***
Backer sentiment	0.724	0.335	0.406	0.469	0.318	13.501***
Featured	0.339	0.474	0.045	0.207	0.294	12.258***
Social network	0.767	1.112	0.279	0.699	0.488	8.237***
ARI	9.669	2.258	9.641	3.002	0.028	0.183
Total words	7.063	0.525	6.795	0.714	0.268	7.376***
Net positive	1.120	0.801	0.744	1.019	0.376	7.004***
Risk index	1.888	0.811	1.979	0.824	−0.092	−1.762**
Video	4.911	0.909	4.400	1.736	0.512	6.612***
Image	2.865	0.914	2.150	1.214	0.714	11.409***
Observations	434		738			

cleantech crowdfunding projects is higher than that for non-cleantech crowdfunding projects. The mean of *Money pledged* in the non-cleantech sample is smaller than that in the cleantech sample, which is consistent with the fact that cleantech crowdfunding projects are more likely to have higher capital goals (the mean of *Funding goal* for the cleantech sample is significantly larger than that for the non-cleantech sample). We also found that the mean of *Uncertain* for the cleantech sample is smaller than that for the non-cleantech sample, and the mean of *Rewards*, *Quick updates*, *Total words*, *Video and Image* in the cleantech sample is larger than that for the non-cleantech sample. These findings suggest founders of cleantech crowdfunding projects put more effort to boost the success of the crowdfunding. In addition, cleantech crowdfunding projects had more comments provided by backers, and the comments were more positive on average than non-cleantech crowdfunding projects.

Table 2 indicates several differences between the successful cleantech sample and the unsuccessful cleantech sample. Specifically, there were 434 successful cleantech crowdfunding projects and 738 unsuccessful cleantech crowdfunding projects. The mean of *Money pledged* was approximately 10.62 for the successful cleantech sample and 6.41 for the unsuccessful cleantech sample, suggesting that successful cleantech crowdfunding projects raised more money than unsuccessful cleantech crowdfunding projects on average ($89,000 for successful cleantech crowdfunding projects and $4210 for unsuccessful cleantech crowdfunding projects). The mean of variable *Uncertain* in the successful cleantech sample was approximately 0.59, which was smaller than that in the unsuccessful cleantech sample (0.66). The two-sided mean difference *t* test and the one-sided mean

t test showed that the difference was significant at the 1% level. In general, the same was true for *Weak modal*. We also found that founders of successful cleantech crowdfunding projects were more likely to provide updates within the first three days of the fundraising period (65.4% of the successful cleantech crowdfunding projects versus 28.3% of the unsuccessful cleantech crowdfunding projects). Successful cleantech crowdfunding projects had more comments provided by backers, and the comments were more positive on average than unsuccessful cleantech crowdfunding projects. More specifically, the mean of *Comment quantity* (*Backer sentiment*) for the successful cleantech sample was approximately 3.20 (0.72) and 0.85 (0.41) for the unsuccessful cleantech sample. In addition, successful cleantech crowdfunding projects used more videos and images in the project description than unsuccessful cleantech crowdfunding projects.

Table 3 reports the correlation coefficients among the explanatory variables. We found a high correlation coefficient between *Uncertain* and *Weak modal*, approximately 0.76. This is consistent with the fact that the weak modal word list is a subset of the uncertain word list. Furthermore, correlations between other variables were generally low, suggesting that serious multicollinearity is not a concern.

The association between tone ambiguity and crowdfunding success

Table 4 reports the baseline results. Panel A in Table 4 reports the balance test results of the PSM. We found that the differences in the mean *t* tests between the cleantech and non-cleantech projects were significant for the unmatched samples, but no longer significant for the matched samples. These results suggest that there is adequate balance between the cleantech sample and the matched non-cleantech sample for matched variables, i.e., *Funding goal*, *ARI*, *Total words*, *Net positive*, *Risk index*, *Video*, and *Image*.

Panel B in Table 4 reports the regression results for Hypotheses 1 and 2. To test Hypothesis 1, we first used the full cleantech sample (including successful and unsuccessful cleantech crowdfunding projects) to estimate Eq. (3) and presented the results in columns (1) and (2). The dependent variable is *Success.* As shown in columns (1) and (2), the marginal effects of the independent variables *Uncertain* and *Weak modal* were both significantly negative at the 1% level, indicating that cleantech crowdfunding projects with a less ambiguous description are more likely to succeed. In terms of economic significance, a 1-standard deviation decrease in the percentage of uncertain words in the project description gave rise to a 5.65 percent points ($=0.143 \times 0.395$) increase in the probability of success. Since the average probability of success is 37% in the full cleantech sample, a 5.65 percent points increase is equivalent to an increase by 15.27%.[8] A 1-standard deviation decrease in the percentage of weak modal words in the project description gave rise to a 6.19 percent points ($=0.240 \times 0.258$) increase in the probability of success. Since the average probability of success is 37% in the full cleantech sample, a 6.19 percent points increase is equivalent to an increase by 16.73%.[9]

Then, we used the successful cleantech sample to re-estimate Eq. (3) and listed the results in columns (3) and (4) of Panel B in Table 4. The dependent variable in columns (3) and (4) is *Money pledged*. The results show that the independent variables *Uncertain*

[8] 15.27% = (37% + 5.65%)/37% -1.

[9] 16.73% = (37% + 6.19%)/37%-1.

Table 3 Correlation matrix

	Uncertain	Weak modal	Funding goal	Duration	Rewards	Quick updates	Comment quantity	Backer sentiment
Uncertain	1.000							
Weak modal	0.759***	1.000						
Funding goal	0.039	0.023	1.000					
Duration	0.001	0.007	0.133***	1.000				
Rewards	−0.090**	−0.041	−0.006	0.018	1.000			
Quick updates	−0.027	−0.025	−0.052	−0.043	0.251***	1.000		
Comment quantity	−0.012	0.018	−0.014	0.091**	0.378***	0.415***	1.000	
Backer sentiment	0.012	0.020	−0.023	0.046	0.316***	0.271***	0.556***	1.000
Featured	−0.016	−0.018	0.039	−0.012	0.243***	0.231***	0.368***	0.202***
Social network	−0.073*	−0.067*	−0.008	0.033	0.206***	0.128***	0.239***	0.156***
ARI	−0.041	−0.018	−0.021	0.008	0.033	0.008	0.054	0.057*
Total words	−0.054	0.020	0.186***	0.019	0.440***	0.142***	0.307***	0.240***
Net positive	−0.142***	−0.119***	−0.054	0.032	0.158***	0.099***	0.128***	0.089**
Risk index	−0.031	−0.052	0.000	−0.065*	0.206***	0.015	−0.016	−0.023
Video	−0.042	−0.052	0.044	−0.029	0.259***	0.102***	0.171***	0.157***
Image	−0.091**	−0.077**	−0.043	0.020	0.362***	0.165***	0.307***	0.226***

	Featured	Social network	ARI	Total words	Net positive	Risk	Video	Image
Uncertain								
Weak modal								
Funding goal								
Duration								
Rewards								
Quick updates								
Comment quantity								
Backer sentiment								
Featured	1.000							
Social network	0.110***	1.000						
ARI	0.001	0.004	1.000					
Total words	0.189***	0.191***	−0.027	1.000				
Net positive	0.111***	0.057*	−0.028	0.068*	1.000			
Risk index	0.040	0.017	0.046	−0.155***	0.053	1.000		
Video	0.088**	0.073*	0.023	0.181***	0.102***	−0.009	1.000	
Image	0.191***	0.232***	−0.002	0.355***	0.122***	−0.022	0.166***	1.000

This table provides the correlations among independent variables

*, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively

Table 4 Baseline results

Variable	Unmatched (U) Matched (M)	Cleantech Mean	Non-cleantech Mean	mean diff. test *t*-value
Funding goal	U	10.529	10.121	1.95*
	M	10.529	10.633	−0.35
ARI	U	9.107	9.506	−0.69
	M	9.107	9.359	−0.35
Total words	U	6.780	6.380	2.70***
	M	6.780	6.768	0.07
Net positive	U	1.023	0.590	1.80*
	M	1.023	1.033	−0.05
Risk index	U	1.833	2.129	−1.98**
	M	1.833	1.753	0.43
Video	U	4.769	3.969	2.24**
	M	4.769	4.653	0.33
Image	U	2.537	1.753	3.00***
	M	2.537	2.499	0.11

	Cleantech sample				Matched non-cleantech sample			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Success	Success	Money pledged	Money pledged	Success	Success	Money pledged	Money pledged
Uncertain	−0.143***		−0.327***		−0.036**		−0.290***	
	(−4.51)		(−2.99)		(−2.10)		(−3.81)	
Weak modal		−0.240***		−0.765***		−0.034		−0.167*
		(−5.14)		(−4.23)		(−1.54)		(−1.87)
Funding goal	−0.119***	−0.124***	0.611***	0.593***	−0.116***	−0.116***	0.554***	0.551***
	(−10.61)	(−11.11)	(12.64)	(12.39)	(−22.96)	(−23.02)	(24.01)	(23.77)
Duration	−0.067*	−0.063	0.405***	0.387***	−0.009	−0.009	0.515***	0.525***
	(−1.69)	(−1.54)	(2.74)	(2.62)	(−0.49)	(−0.48)	(6.83)	(6.90)
Rewards	0.129***	0.130***	0.223**	0.239***	0.116***	0.116***	0.100**	0.106**
	(5.17)	(5.24)	(2.43)	(2.63)	(10.23)	(10.27)	(2.12)	(2.22)
Quick updates	0.088***	0.086***	0.162***	0.142**	0.107***	0.107***	0.266***	0.271***
	(4.68)	(4.57)	(2.61)	(2.28)	(12.30)	(12.37)	(7.51)	(7.62)
Comment quantity	0.086***	0.083***	0.327***	0.329***	0.048***	0.046***	0.146***	0.130***
	(13.18)	(13.51)	(14.73)	(15.30)	(23.55)	(29.95)	(18.59)	(19.91)
Backer sentiment	0.075***	0.073***	0.202***	0.199***	0.025***	0.025***	0.093***	0.095***
	(4.33)	(4.25)	(3.49)	(3.63)	(3.15)	(3.07)	(3.64)	(3.69)
Total words	0.011	0.025	0.029	0.057	0.066***	0.067***	0.100***	0.112***
	(0.54)	(1.23)	(0.45)	(0.92)	(7.21)	(7.48)	(2.81)	(3.14)
Featured	0.214***	0.210***	0.129*	0.131*	0.154***	0.155***	0.297***	0.302***
	(7.86)	(7.60)	(1.77)	(1.82)	(12.60)	(12.69)	(7.49)	(7.59)
Social network	0.034***	0.035***	0.009	0.015	0.012**	0.012**	0.003	0.002
	(3.20)	(3.22)	(0.34)	(0.56)	(2.38)	(2.39)	(0.19)	(0.13)
ARI	−0.003	−0.002	−0.017	−0.019	−0.001	−0.001	−0.011	−0.012*
	(−0.78)	(−0.43)	(−1.14)	(−1.26)	(−0.79)	(−0.81)	(−1.63)	(−1.79)

Table 4 (continued)

	Cleantech sample				Matched non-cleantech sample			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Success	Success	Money pledged	Money pledged	Success	Success	Money pledged	Money pledged
Net positive	0.032***	0.036***	0.082**	0.081**	0.020***	0.021***	0.023	0.029
	(3.09)	(3.40)	(2.32)	(2.29)	(4.14)	(4.32)	(1.13)	(1.45)
Risk index	−0.010	−0.012	−0.068	−0.071*	−0.011*	−0.011**	−0.028	−0.031
	(−0.82)	(−1.00)	(−1.59)	(−1.70)	(−1.94)	(−1.98)	(−1.35)	(−1.51)
Video	0.028***	0.029***	0.037	0.033	0.014***	0.014***	−0.002	−0.001
	(3.38)	(3.29)	(1.08)	(0.94)	(3.73)	(3.71)	(−0.15)	(−0.07)
Image	0.040***	0.037***	0.032	0.023	0.008**	0.009**	0.022	0.023
	(3.83)	(3.57)	(0.89)	(0.66)	(2.08)	(2.12)	(1.39)	(1.45)
Constant			1.401*	1.532**			1.633***	1.451***
			(1.85)	(2.03)			(3.92)	(3.48)
Subcategory control	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Location controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1172	1172	434	434	4798	4798	1800	1800
Adjusted R^2			0.734	0.737			0.689	0.686
Chi square	299.872	321.343			1162.676	1172.134		
SUEST test on the difference of the coefficients (Chi square)								
	(1)−(5)		(2)−(6)		(3)−(7)		(4)−(8)	
Uncertain	7.420**				0.824			
Weak modal			14.283***				9.264***	

Panel A: Balance test

This table shows the *t*-tests for equality of the means between the cleantech and non-cleantech projects samples before and after propensity score matching for matched variables (*Funding goal*, *ARI*, *Total words*, *Net positive*, *Risk index*, *Video*, *Image*).

*, **, *** indicate significance at the 10%, 5%, and 1% levels, respectively

Panel B: Regression using PSM samples

This table examines the relationship between tone ambiguity and crowdfunding success based on various samples. We perform 1:5 propensity score matching to select non-cleantech samples. In columns (1) and (4), we used the cleantech sample to estimate Eq. (3). Specifically, in columns (1) and (2), we used the full cleantech sample and the dependent variable is *Success*. We performed the logit regression and provided the marginal effect instead of the coefficients. In columns (3) and (4), we used the successful cleantech sample and the dependent variable is *Money pledged*. We performed the ordinary least squares (OLS) regression and provided the coefficients. In columns (5)–(8), we used the matched non-cleantech sample to re-estimate Eq. (3). Specifically, in columns (5) and (6), we used the full matched non-cleantech sample and performed the logit regression. In columns (7) and (8), we used the successful matched non-cleantech sample and performed the OLS regression. The *t* statistics adjusted for heteroscedasticity are reported in parentheses.

*, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively

and *Weak modal* were negatively associated with *Money pledged*, and the estimated coefficients were statistically significant. Regarding economic significance, a 1-standard deviation decrease in the percentage of uncertain words was associated with a 10.99% ($=0.327\times0.336$) rise in the average amount of money pledged. A 1-standard deviation decrease in the percentage of weak modal words gave rise to a 16.60% ($=0.765\times0.217$)

increase in the average amount of money pledged. These results suggest that a less ambiguous project description can not only increase the probability of success but also help founders raise more money. Overall, our results in columns (1)–(4) of Panel B in Table 4 provide compelling evidence for Hypothesis 1, implying that founders of high-quality cleantech crowdfunding could create a reliable signal of quality by providing less ambiguous project descriptions and thus boost the success of crowdfunding.

We also found some significant results for the control variables in columns (1)–(4) of Panel B in Table 4. Specifically, in the full cleantech sample (columns (1)–(2)), the variable *Funding goal* was negatively associated with *Success*, which is consistent with previous findings (Mollick 2014; Anglin et al. 2018). The results in columns (1) and (2) also indicate that the number of different kinds of rewards offered by founders was positively linked with the probability of success. Crowdfunding projects with quick updates, positive tone, more comments and positive backer sentiment were more likely to succeed. Meanwhile, if a crowdfunding project was featured by Kickstarter on their home page, then the probability of success would be approximately 21.4% higher. This result is consistent with the finding by Anglin et al. (2018), suggesting that being featured by Kickstarter is likely to help crowdfunding projects succeed. The size of social networks of founders was also positively associated with the probability of success, because it provided connections to potential investors as well as endorsements of crowdfunding project quality (Mollick 2014). The variables *Video* and *Image* were positively associated with *Success*, which is consistent with the early evidences from cleantech samples (Courtney et al. 2017; Cumming et al. 2017).

In the successful cleantech sample (columns (3) and (4)), the effects of control variables were generally consistent with those in columns (1) and (2), except for the results that the effect of *Social network* was insignificant when the dependent variable was *Money pledged*. We noted that *Funding goal* was positively associated with *Money pledged*, which is consistent with the findings of Cumming et al. (2017). The coefficients of the variable *Duration* were positive, suggesting that, ceteris paribus, long duration increased the money pledged to the crowdfunding project. The variables *Image* and *Video* don't have a significant relationship with *Money pledged*. One possible reason is that most of the successful cleantech crowdfunding projects have images or videos in project descriptions, which makes the effect of these two characteristics on crowdfunding success insignificant in the successful subsample.

The moderating effect of industry information environment

To test Hypothesis 2, we used the matched non-cleantech sample to re-estimate Eq. (3). The regression results are listed in columns (5)–(8) of Panel B in Table 4, which show that in the matched non-cleantech sample, crowdfunding success measured by various variables was also negatively associated with *Uncertain* and *Weak modal*, and these effects were generally significant. Regarding economic significance, a 1-standard deviation decrease in the percentage of uncertain (weak modal) words in the non-cleantech project description gave rise to a 1.68 percent points $= 0.036 \times 0.468$ ($1.02\% = 0.034 \times 0.299$) increase in the probability of success. A 1-standard deviation decrease in the percentage of uncertain (weak modal) words in the matched non-cleantech project description gave rise to a $12.12\% = 0.290 \times 0.418$ ($4.59\% = 0.167 \times 0.275$) increase in the average amount

of money pledged. The results of SUEST test show that the differences in the coefficient on *Uncertain* (*Weak model*) using the cleantech sample and that using the matched non-cleantech sample are significant. In summary, our results show that the signaling effectiveness of a less ambiguous tone is more pronounced in cleantech crowdfunding than in matched non-cleantech crowdfunding, which is consistent with Hypothesis 2a rather than Hypothesis 2b. As discussed before, this is because the information environment of cleantech crowdfunding is much noisier than that of non-cleantech crowdfunding. In a noisier information environment, potential investors will pay more attention to signals sent by founders (less ambiguous tone), which can help them increase perceptions of project quality and make better decisions.

Turning to the control variables in columns (5)–(8), we found that the sign and significance of coefficients on *Funding goal*, *Duration*, *Rewards*, *Quick updates*, *Comment quantity*, *Backer sentiment*, *Featured*, *Social network*, *ARI*, *Video*, and *Image* were generally consistent with those in the cleantech sample (columns (1)–(4)). For the other control variables, we noted that *Total Words* was positively associated with *Success* and *Money pledged*, consistent with the results obtained by previous literature based on non-cleantech samples (Courtney et al. 2017; Cumming et al. 2017). *Risk index* was negatively associated with *Success*, consistent with the results obtained by Madsen and McMullin (2020).

Robustness checks

Alternative measurement for crowdfunding success

In the baseline mode, we used the variable *Money pledged* as the second measurement for crowdfunding success. A legitimate concern is that the variable *Money pledged* might not be an ideal measurement, as larger projects can more easily collect higher amounts of funds. Take for example, there are two projects. The funding goal of project A and B is $1,000,000 and $100,000, respectively. The crowd pledged $1,000,000 to project A, while pledged $900,100 to project B. Although the amount of money pledged to project A is higher than that to project B, people may consider project A less successful than project B. This is because project A only barely achieves the minimum goal, while project B raised nine times more funds than the minimum goal. To mitigate this concern, we have controlled the variable *Funding goal* in the baseline model (Eq. (3)). To further mitigate this concern, we used the variable *Completion rat*io (=*Money pledged/Funding goal*) as an alternative measurement for crowdfunding success and reran the regressions in Table 4.[10]

The results are reported in Table 5. The estimated coefficients on *Uncertain* and *Weak modal* were all negative and significant in columns (1) and (2), indicating that ambiguous tone was negatively associated with the completion ratio of cleantech crowdfunding projects. As seen in columns (3) and (4), the estimated coefficients on the variables *Uncertain* and *Weak modal* using the non-cleantech sample were smaller than those using the cleantech sample. SUEST tests show that the differences were significant at 5% level. These findings are consistent with the results in Table 4, thus supporting Hypothesis 1

[10] Roma et al. (2017) argued that the amount of money pledged is a better measurement for crowdfunding success than the completion ratio, because the former better conveys the willingness to pay of consumers. In contrast, the latter may be strongly affected by the goal the founder set (Under the "all-or-nothing" mechanism adopted by Kickstarter, founders

and 2a. In addition, the sign of the coefficients on the control variables were consistent with expectation.

Alternative word lists for tone ambiguity

Measure error is a potential source of endogeneity in this paper. In the baseline analysis, we used uncertain and weal modal word lists compiled by Loughran and McDonald (2011) to measure tone ambiguity. Loughran and McDonald (2011)'s uncertain and weak modal word lists are widely adopted in the finance and accounting literature. However, Friberg and Seiler (2017) argued that uncertain and weak modal words associated with objective probabilities, such as "*variance*," "*volatility*" or "*frequently*," may not reflect ambiguity. They classified 74 such words as risk-related words (rather than ambiguity-related words). In this section, we excluded risk-related words to obtain new lists of uncertain and weak modal words. We defined the variable *Uncertain_R1* (*Weak modal_R1*) as the ratio of the number of new uncertain (weak modal) words to the total number of words in the project description. We used *Uncertain_R1* and *Weak modal_R1* as alternative measures of tone ambiguity and reran the regressions in Table 4.[11]

The results are reported in Table 6. The results in columns (1)–(4) indicate that ambiguous tone (measured by *Uncertain_R1* or *Weak modal_R1*) was negatively associated with cleantech crowdfunding success. In terms of economic significance, a 1-standard deviation decrease in the percentage of new uncertain words in the project description gave rise to a 7.44 percent points ($=0.151\times0.493$) increase in the probability of success. A 1-standard deviation decrease in the percentage of new weak modal words in the project description gave rise to a 7.05 percent points ($=0.211\times0.334$) increase in the probability of success. As seen in columns (5)–(8), the effects of *Uncertain_R1* and *Weak modal_R1* in the non-cleantech sample were smaller than those in the cleantech sample. SUEST tests show that the differences were significant at 1% level. These findings are consistent with the results in Table 4, thus supporting Hypothesis 1 and 2a. In addition, the sign and significance of the marginal effects/coefficients on the control variables were essentially unchanged from those in Table 4.

Using word counts to measure tone ambiguity

In the baseline mode, we used the ratio of the number of uncertain (weak modal) words over the total number of words in the project description to measure tone ambiguity. But the ratio may be affected too much by the length of project descriptions. To mitigate this concern, we have controlled the variable *Total words* in the baseline model (Eq. 3). To further mitigate this concern, we used the natural logarithm of the number of uncertain and weak modal words in the project descriptions as alternative measurements for tone ambiguity. We denoted the two alternative measurements as *Uncertain_R2* and *Weak modal_R2*, and reran the regressions in Table 4.

Footnote 10 (continued)

have incentive to lower the goal in order to increase the odds of receiving the money). For this reason, we used the variable *Money pledged* (rather than *Completion ration*) as our main dependent variable.

[11] Since Loughran and McDonald (2011)'s word lists are far more widely used than Friberg and Seiler (2017)'s word lists, we used Loughran and McDonald (2011)'s word lists in the baseline regressions.

Table 5 Regression using alternative measurement for crowdfunding success

	Cleantech sample		Matched non-cleantech sample	
	(1)	(2)	(3)	(4)
	Completion ratio	Completion ratio	Completion ratio	Completion ratio
Uncertain	−0.011***		−0.004***	
	(−4.80)		(−3.16)	
Weak modal		−0.013***		−0.001
		(−5.12)		(−0.48)
Funding goal	−0.004***	−0.004***	−0.003***	−0.003***
	(−6.27)	(−6.38)	(−9.54)	(−9.53)
Duration	0.005*	0.005*	0.008***	0.008***
	(1.73)	(1.78)	(5.64)	(5.73)
Rewards	0.002	0.003*	0.001	0.001
	(1.51)	(1.67)	(0.94)	(1.02)
Quick updates	0.004***	0.004***	0.002***	0.002***
	(3.36)	(3.47)	(3.32)	(3.55)
Comment quantity	0.009***	0.009***	0.003***	0.003***
	(11.82)	(11.61)	(14.82)	(16.89)
Backer sentiment	0.010***	0.010***	0.003***	0.003***
	(5.89)	(5.98)	(3.49)	(3.46)
Total words	0.002	0.002*	0.001**	0.002***
	(1.51)	(1.85)	(2.36)	(2.60)
Featured	0.007**	0.007**	0.005***	0.005***
	(2.44)	(2.44)	(3.17)	(3.30)
Social network	−0.001	−0.001	0.000	0.000
	(−1.31)	(−1.11)	(0.90)	(0.95)
ARI	−0.001*	−0.001*	−0.000	−0.000
	(−1.93)	(−1.71)	(−1.52)	(−1.58)
Net positive	0.000	0.001	0.000	0.000
	(0.66)	(0.95)	(0.08)	(0.56)
Risk index	0.000	−0.000	0.000	0.000
	(0.06)	(−0.05)	(0.75)	(0.73)
Video	0.000	0.000	−0.000	−0.000
	(0.15)	(0.06)	(−0.58)	(−0.59)
Image	−0.000	−0.000	−0.000	0.000
	(−0.58)	(−0.62)	(−0.09)	(0.00)
Constant	0.012	0.007	−0.009	−0.012*
	(0.93)	(0.57)	(−1.33)	(−1.84)
Subcategory control	Yes	Yes	Yes	Yes
Year controls	Yes	Yes	Yes	Yes
Location controls	Yes	Yes	Yes	Yes
Observations	1172	1172	4798	4798
Adjusted R^2	0.377	0.372	0.277	0.275
SUEST test on the difference of the coefficients (Chi square)				
	(1)−(3)		(2)−(4)	
Uncertain	5.730**			
Weak modal			17.543***	

This table provides the robustness test for the results in Table 4 by using the completion ratio as alternative dependent variable. Specifically, we defined a variable *Completion ratio* as the ratio of the money pledged over the funding goal. The left panel provides the results for the full cleantech sample. The right panel provides the results for the full matched non-cleantech sample. We performed the OLS regression and provided the coefficients. The *t* statistics adjusted for heteroscedasticity are reported in parentheses.

*, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively

Table 6 Regression using alternative word lists for tone ambiguity

	Cleantech sample				Matched non-cleantech sample			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Success	Success	Money pledged	Money pledged	Success	Success	Money pledged	Money pledged
Uncertain_R1	−0.151***		−0.452***		−0.013		−0.183***	
	(−5.86)		(−4.97)		(−1.51)		(−5.34)	
Weak modal_R1		−0.211***		−0.629***		−0.013**		−0.045***
		(−5.91)		(−5.05)		(−2.09)		(−2.78)
Funding goal	−0.117***	−0.121***	0.610***	0.591***	−0.115***	−0.116***	0.555***	0.549***
	(−10.51)	(−10.91)	(13.20)	(12.56)	(−22.91)	(−23.03)	(24.23)	(23.68)
Duration	−0.067*	−0.057	0.373**	0.421***	−0.009	−0.009	0.514***	0.524***
	(−1.69)	(−1.39)	(2.59)	(2.88)	(−0.47)	(−0.48)	(6.85)	(6.91)
Rewards	0.124***	0.124***	0.221**	0.228**	0.116***	0.116***	0.091*	0.105**
	(5.02)	(5.11)	(2.44)	(2.54)	(10.23)	(10.28)	(1.91)	(2.20)
Quick updates	0.080***	0.081***	0.121**	0.129**	0.107***	0.107***	0.265***	0.269***
	(4.25)	(4.28)	(1.97)	(2.08)	(12.37)	(12.26)	(7.46)	(7.56)
Comment quantity	0.082***	0.081***	0.333***	0.328***	0.047***	0.046***	0.146***	0.130***
	(14.08)	(13.86)	(14.97)	(15.13)	(26.83)	(34.45)	(21.41)	(23.08)
Backer sentiment	0.071***	0.068***	0.189***	0.187***	0.025***	0.024***	0.097***	0.095***
	(4.06)	(3.95)	(3.41)	(3.42)	(3.11)	(3.03)	(3.77)	(3.68)
Total words	0.015	0.026	0.043	0.080	0.067***	0.067***	0.117***	0.111***
	(0.78)	(1.35)	(0.70)	(1.30)	(7.43)	(7.48)	(3.31)	(3.13)
Featured	0.202***	0.200***	0.128*	0.130*	0.155***	0.155***	0.299***	0.303***
	(7.39)	(7.22)	(1.80)	(1.82)	(12.69)	(12.67)	(7.59)	(7.63)
Social network	0.032***	0.032***	0.005	0.009	0.012**	0.012**	0.004	0.001
	(3.03)	(3.00)	(0.18)	(0.32)	(2.39)	(2.39)	(0.23)	(0.09)
ARI	−0.003	−0.002	−0.013	−0.016	−0.002	−0.001	−0.011	−0.012*
	(−0.77)	(−0.46)	(−0.89)	(−1.08)	(−0.87)	(−0.82)	(−1.58)	(−1.81)
Net positive	0.029***	0.032***	0.070**	0.074**	0.020***	0.021***	0.023	0.029
	(2.77)	(3.05)	(2.04)	(2.08)	(4.21)	(4.33)	(1.14)	(1.44)
Risk index	−0.012	−0.011	−0.072*	−0.073*	−0.011**	−0.011**	−0.026	−0.029
	(−0.96)	(−0.93)	(−1.71)	(−1.75)	(−1.97)	(−1.96)	(−1.24)	(−1.41)
Video	0.027***	0.027***	0.028	0.028	0.014***	0.014***	−0.002	−0.001
	(3.24)	(3.11)	(0.80)	(0.80)	(3.75)	(3.75)	(−0.11)	(−0.05)
Image	0.038***	0.037***	0.028	0.029	0.008**	0.009**	0.019	0.023
	(3.69)	(3.55)	(0.80)	(0.83)	(2.08)	(2.12)	(1.24)	(1.47)
Constant			1.599**	1.325*			1.513***	1.453***
			(2.15)	(1.77)			(3.64)	(3.49)
Subcategory control	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Location controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table 6 (continued)

	Cleantech sample				Matched non-cleantech sample			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Success	Success	Money pledged	Money pledged	Success	Success	Money pledged	Money pledged
Observations	1172	1172	434	434	4798	4798	1800	1800
Adjusted R^2			0.743	0.741			0.690	0.687
Chi square	303.359	314.772			1172.397	1176.429		
SUEST test on the difference of the coefficients (Chi square)								
	(1)−(5)		(2)−(6)		(3)−(7)		(4)−(8)	
Uncertain	21.403***				8.088***			
Weak modal			26.376***				23.009***	

This table provides the robustness test for the results in Table 4 by using the alternative independent variables *Uncertain_R1* and *Weak modal_R1*. Specifically, we excluded risk related words to get new lists of uncertain (weak modal) words and defined variable *Uncertain_R1* (*Weak modal_R1*) as the ratio of the number of new uncertain (weak modal) words to the total number of words in project description. The left panel provides the results for the cleantech sample. The right panel provides the results for the matched non-cleantech sample. In columns (1) and (2) and (5) and (6), the dependent variable is *Success*. We performed the logit regression and provided the marginal effect instead of the coefficients. In columns (3) and (4) and (7)-(8), the dependent variable is *Money pledged*. We performed the OLS regression and provided the coefficients. The *t* statistics adjusted for heteroscedasticity are reported in parentheses.

*, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively

We reported the results in Table 7. The results in columns (1)–(4) show that ambiguous tone (measured by *Uncertain_R2* or *Weak modal_R2*) was negatively associated with cleantech crowdfunding success. In terms of economic significance, a 1-standard deviation decrease in the number of uncertain words in the project description gave rise to a 9.47 percent points ($=0.089 \times 1.064$) increase in the probability of success. A 1-standard deviation decrease in the number of weak modal words in the project description gave rise to a 5.92 percent points ($=0.038 \times 1.557$) increase in the probability of success. As seen in columns (5)–(8), the effects of *Uncertain_R2* and *Weak modal_R2* in the non-cleantech sample were smaller than those in the cleantech sample. SUEST tests show that the differences were significant at 5% level. These findings are consistent with the baseline results in Table 4, thus supporting Hypothesis 1 and 2a. In addition, the sign and significance of the marginal effects/coefficients on the control variables were essentially unchanged from those in Table 4.

Rectifying misspelled words

In the baseline analysis, we neglected misspelled ambiguous words. To investigate whether our results are robust to this issue, we matched the project descriptions against the list of the 4278 commonly misspelled English words and the list of the 350 most commonly misspelled English words from Wikipedia Typo team.[12] These word lists are widely used in the literature (Ahmed and Nürnberger 2009). We found that five uncertain words (two weak modal words) appear in the word lists. For example, "almost" may

[12] We collected the two word lists from http://en.wikipedia.org/wiki/Wikipedia:List_of_common_misspellings and https://en.wikipedia.org/wiki/Commonly_misspelled_English_words.

Table 7 Regression using word counts to measure tone ambiguity

	Cleantech sample				Matched non-cleantech sample			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Success	Success	Money pledged	Money pledged	Success	Success	Money pledged	Money pledged
Uncertain_R2	−0.089***		−0.162***		−0.005		−0.076***	
	(−5.58)		(−4.31)		(−1.38)		(−4.33)	
Weak modal_R2		−0.038***		−0.088***		−0.004		−0.024**
		(−4.85)		(−4.03)		(−1.54)		(−2.17)
Funding goal	−0.117***	−0.120***	0.618***	0.601***	−0.115***	−0.116***	0.551***	0.549***
	(−10.56)	(−10.62)	(13.43)	(12.74)	(−22.90)	(−23.08)	(23.77)	(23.52)
Duration	−0.070*	−0.063	0.400***	0.391***	−0.008	−0.009	0.526***	0.530***
	(−1.80)	(−1.56)	(2.78)	(2.67)	(−0.44)	(−0.46)	(6.99)	(6.97)
Rewards	0.127***	0.130***	0.206**	0.223**	0.118***	0.117***	0.098**	0.104**
	(4.99)	(5.20)	(2.28)	(2.48)	(10.37)	(10.35)	(2.07)	(2.19)
Quick updates	0.085***	0.091***	0.174***	0.172***	0.107***	0.107***	0.269***	0.269***
	(4.57)	(4.83)	(2.83)	(2.75)	(12.37)	(12.38)	(7.58)	(7.58)
Comment quantity	0.084***	0.079***	0.332***	0.324***	0.046***	0.046***	0.137***	0.128***
	(13.60)	(13.07)	(15.16)	(14.61)	(34.90)	(37.60)	(21.86)	(22.37)
Backer sentiment	0.071***	0.073***	0.172***	0.196***	0.024***	0.024***	0.093***	0.095***
	(4.03)	(4.09)	(3.06)	(3.53)	(3.04)	(3.02)	(3.64)	(3.67)
Total words	0.110***	0.076***	0.265***	0.207***	0.074***	0.074***	0.205***	0.153***
	(4.44)	(3.49)	(3.46)	(2.85)	(7.38)	(7.30)	(4.92)	(3.78)
Featured	0.207***	0.214***	0.126*	0.130*	0.155***	0.155***	0.299***	0.299***
	(7.67)	(7.71)	(1.75)	(1.79)	(12.70)	(12.70)	(7.56)	(7.54)
Social network	0.032***	0.034***	0.012	0.008	0.012**	0.012**	0.003	0.003
	(3.04)	(3.17)	(0.44)	(0.31)	(2.40)	(2.45)	(0.20)	(0.20)
ARI	−0.003	−0.002	−0.014	−0.018	−0.001	−0.001	−0.011*	−0.012*
	(−0.75)	(−0.51)	(−0.95)	(−1.18)	(−0.82)	(−0.82)	(−1.67)	(−1.74)
Net positive	0.029***	0.035***	0.074**	0.080**	0.020***	0.020***	0.026	0.028
	(2.80)	(3.37)	(2.09)	(2.22)	(4.22)	(4.29)	(1.32)	(1.41)
Risk index	−0.008	−0.010	−0.062	−0.071*	−0.012**	−0.012**	−0.030	−0.032
	(−0.68)	(−0.80)	(−1.48)	(−1.68)	(−2.09)	(−2.04)	(−1.48)	(−1.56)
Video	0.028***	0.028***	0.031	0.035	0.014***	0.014***	−0.002	−0.000
	(3.15)	(3.13)	(0.89)	(1.01)	(3.74)	(3.75)	(−0.16)	(−0.00)
Image	0.040***	0.040***	0.031	0.031	0.009**	0.009**	0.023	0.024
	(3.77)	(3.79)	(0.87)	(0.88)	(2.15)	(2.15)	(1.48)	(1.52)
Constant			0.547	0.621			1.215***	1.241***
			(0.75)	(0.82)			(2.92)	(2.95)
Subcategory control	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Location controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table 7 (continued)

	Cleantech sample				Matched non-cleantech sample			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Success	Success	Money pledged	Money pledged	Success	Success	Money pledged	Money pledged
Observations	1172	1172	434	434	4798	4798	1800	1800
Adjusted R^2			0.743	0.737			0.688	0.686
Chi square	309.386	321.063			1172.744	1173.057		
SUEST test on the difference of the coefficients (Chi square)								
	(1)−(5)		(2)−(6)		(3)−(7)		(4)−(8)	
Uncertain	23.377***				4.513**			
Weak modal			16.398***				7.025***	

This table provides the robustness test for the results in Table 4 by using the alternative independent variables *Uncertain_R2* and *Weak modal_R2*. Specifically, we defined variable *Uncertain_R2* (*Weak modal_R2*) as the logarithm of the number of uncertain (weak modal) words in project description. The left panel provides the results for the cleantech sample. The right panel provides the results for the matched non-cleantech sample. In columns (1) and (2) and (5) and (6), the dependent variable is *Success*. We performed the logit regression and provided the marginal effect instead of the coefficients. In columns (3) and (4) and (7) and (8), the dependent variable is *Money pledged*. We performed the OLS regression and provided the coefficients. The *t* statistics adjusted for heteroscedasticity are reported in parentheses.

*, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively

be misspelled as "allmost", "believe" may be misspelled as "beleive", and "occasionally" may be misspelled as "occasionaly" or "occassionally". We replaced misspelled uncertain (weak modal) words with their correct form and then recalculated the ratio of the number of uncertain (weak modal) words to the total number of words in the project description. We denoted these two ratios as *Uncertain_R3* and *Weak modal_R3*, respectively. Using *Uncertain_R3* and *Weak modal_R3* as alternative measurements of tone ambiguity, we reran the regressions in Table 4.

The results are reported in Table 8. The effects of *Uncertain_R3* and *Weak modal_R3* on crowdfunding success (measured by *Success* and *Money pledged*) were all negative and significant in columns (1)–(8), except in column (7). Moreover, the effects of *Uncertain_R3* and *Weak modal_R3* in the non-cleantech sample (columns (5)–(8)) were smaller than those in the cleantech sample (columns (1)–(4)), respectively. SUEST tests show that the differences were significant at 5% level. These findings are consistent with the results in Table 4, thus supporting Hypothesis 1 and 2a. The sign and significance of the marginal effects/coefficients on the control variables were essentially unchanged from those in Table 4.

The association between tone ambiguity and venture success

In this section, we further investigated whether tone ambiguity can also predict venture success/failure. Madsen and McMullin (2020) and Kim et al. (2022) argued that the most important outcome risk, from a backer's perspective, is that funded campaigns will not be able to fulfill their promised rewards. Due to the limited data

Table 8 Regression after rectifying misspelled words

	Cleantech sample				Matched non-cleantech sample			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Success	Success	Money pledged	Money pledged	Success	Success	Money pledged	Money pledged
Uncertain_R3	−0.157***		−0.556***		−0.021		−0.249***	
	(−4.62)		(−4.93)		(−1.60)		(−5.06)	
Weak modal_R3		−0.299***		−0.715***		−0.021**		−0.056***
		(−5.70)		(−4.12)		(−2.51)		(−2.60)
Funding goal	−0.120***	−0.123***	0.611***	0.595***	−0.116***	−0.116***	0.552***	0.549***
	(−10.67)	(−11.01)	(13.00)	(12.46)	(−22.91)	(−23.03)	(24.01)	(23.65)
Duration	−0.069*	−0.059	0.399***	0.396***	−0.008	−0.009	0.520***	0.525***
	(−1.72)	(−1.47)	(2.76)	(2.68)	(−0.45)	(−0.49)	(6.93)	(6.92)
Rewards	0.128***	0.127***	0.212**	0.243***	0.116***	0.116***	0.093**	0.105**
	(5.12)	(5.13)	(2.31)	(2.67)	(10.30)	(10.32)	(1.97)	(2.21)
Quick updates	0.086***	0.084***	0.148**	0.152**	0.107***	0.106***	0.267***	0.269***
	(4.56)	(4.43)	(2.42)	(2.45)	(12.36)	(12.23)	(7.54)	(7.57)
Comment quantity	0.085***	0.085***	0.338***	0.330***	0.047***	0.046***	0.147***	0.129***
	(13.29)	(13.77)	(15.07)	(15.09)	(24.76)	(34.56)	(20.44)	(22.90)
Backer sentiment	0.073***	0.068***	0.180***	0.186***	0.025***	0.024***	0.097***	0.095***
	(4.25)	(3.89)	(3.20)	(3.36)	(3.11)	(3.02)	(3.78)	(3.68)
Total words	0.011	0.022	0.009	0.066	0.066***	0.067***	0.111***	0.111***
	(0.54)	(1.10)	(0.14)	(1.07)	(7.33)	(7.48)	(3.14)	(3.11)
Featured	0.211***	0.206***	0.131*	0.129*	0.155***	0.155***	0.297***	0.302***
	(7.75)	(7.51)	(1.84)	(1.78)	(12.66)	(12.65)	(7.53)	(7.62)
Social network	0.034***	0.032***	0.004	0.009	0.012**	0.012**	0.004	0.001
	(3.19)	(2.94)	(0.14)	(0.32)	(2.40)	(2.40)	(0.26)	(0.08)
ARI	−0.003	−0.002	−0.017	−0.019	−0.001	−0.001	−0.011*	−0.012*
	(−0.74)	(−0.48)	(−1.14)	(−1.25)	(−0.81)	(−0.78)	(−1.68)	(−1.82)
Net positive	0.032***	0.033***	0.067*	0.077**	0.020***	0.021***	0.021	0.029
	(3.02)	(3.11)	(1.96)	(2.16)	(4.20)	(4.33)	(1.07)	(1.45)
Risk index	−0.010	−0.011	−0.062	−0.074*	−0.011**	−0.011**	−0.027	−0.029
	(−0.83)	(−0.93)	(−1.47)	(−1.78)	(−1.99)	(−1.97)	(−1.29)	(−1.43)
Video	0.028***	0.028***	0.033	0.033	0.014***	0.014***	−0.003	−0.001
	(3.37)	(3.27)	(0.98)	(0.92)	(3.73)	(3.74)	(−0.19)	(−0.06)
Image	0.040***	0.037***	0.032	0.031	0.009**	0.009**	0.021	0.023
	(3.88)	(3.56)	(0.87)	(0.89)	(2.10)	(2.14)	(1.34)	(1.48)
Constant			1.694**	1.358*			1.557***	1.453***
			(2.26)	(1.80)			(3.74)	(3.49)
Subcategory control	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Location controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table 8 (continued)

	Cleantech sample				Matched non-cleantech sample			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Success	Success	Money pledged	Money pledged	Success	Success	Money pledged	Money pledged
Observations	1172	1172	434	434	4798	4798	1800	1800
Adjusted R^2			0.743	0.737			0.690	0.687
Chi square	301.654	325.072			1172.898	1176.354		
SUEST test on the difference of the coefficients (Chi square)								
	(1)−(5)		(2)−(6)		(3)−(7)		(4)−(8)	
Uncertain	12.068***				6.553**			
Weak modal			24.517***				15.154***	

This table provides the robustness test for the results in Table 4 by using alternative independent variables *Uncertain_R3* and *Weak modal_R3*. Specifically, we replaced misspelled ambiguous words in the project description with their correct form and defined variable *Uncertain_R3* (*Weak modal_R3*) as the ratio of the number of uncertain (weak modal) words to the total number of words. The left panel provides the results for the cleantech sample. The right panel provides the results for the matched non-cleantech sample. In columns (1) and (2) and (5) and (6), the dependent variable is *Success*. We performed the logit regression and provided the marginal effect instead of the coefficients. In columns (3) and (4) and (7) and (8), the dependent variable is *Money pledged*. We performed the OLS regression and provided the coefficients. The *t* statistics adjusted for heteroscedasticity are reported in parentheses

*, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively

availability, very few crowdfunding studies examined the determinants of delayed delivery. Madsen and McMullin (2020) created an index based on backers' comments to measure delayed delivery. Cumming et al. (2023) pointed out that it is of greater importance to investigate significantly delayed delivery. Following Madsen and McMullin (2020) and Cumming et al. (2023), we defined a variable *Delayed delivery* to measure significantly delayed delivery. The variable takes the value of 1 if backers' comments made one year after the end date of the project's funding period include the words "delay" or "refund". Otherwise, it takes the value of 0. We investigate whether tone ambiguity can predict significantly delayed delivery using both the successful cleantech sample and successful non-cleantech sample.

The results are reported in Table 9. The marginal effects of *Uncertain* and *Weak modal* were all positive and significant in columns (1)–(4), indicating that project descriptions with a high proportion of ambiguous words are associated with significantly delayed delivery. Taking cleantech crowdfunding projects as an example, a 1-standard deviation decrease in the percentage of uncertain words in the project description gave rise to a 5.78 percent points ($=0.172 \times 0.336$) increase in the probability of significantly delayed delivery. A 1-standard deviation decrease in the percentage of weak modal words in the project description gave rise to a 7.88 percent points ($=0.363 \times 0.217$) increase in the probability of significantly delayed delivery. The results in Table 9 suggest that tone ambiguity helps predict venture success/failure for both cleantech crowdfunding projects and non-cleantech crowdfunding projects.

Table 9 The association between tone ambiguity and delayed delivery

	Cleantech sample		Matched non-cleantech sample	
	(1)	(2)	(3)	(4)
	Delayed delivery	Delayed delivery	Delayed delivery	Delayed delivery
Uncertain	0.172***		0.109***	
	(3.00)		(3.03)	
Weak modal		0.363***		0.181***
		(3.09)		(4.34)
Funding goal	0.064***	0.076***	0.063***	0.066***
	(3.04)	(3.70)	(6.16)	(6.47)
Duration	0.097	0.103	0.115***	0.120***
	(1.38)	(1.45)	(3.06)	(3.24)
Rewards	−0.062	−0.071	0.034	0.032
	(−1.32)	(−1.42)	(1.33)	(1.29)
Quick updates	−0.014	−0.005	0.029	0.029
	(−0.37)	(−0.12)	(1.47)	(1.45)
Comment quantity	0.057***	0.059***	0.014***	0.015***
	(4.44)	(4.60)	(4.07)	(4.97)
Backer sentiment	0.034	0.035	0.013	0.013
	(1.21)	(1.18)	(1.10)	(1.09)
Total words	−0.069	−0.096**	−0.046***	−0.049***
	(−1.60)	(−2.28)	(−2.59)	(−2.78)
Featured	−0.038	−0.032	−0.039**	−0.042**
	(−0.86)	(−0.74)	(−2.00)	(−2.15)
Social network	0.006	0.002	−0.001	−0.002
	(0.34)	(0.11)	(−0.16)	(−0.22)
ARI	0.011	0.011	−0.000	0.001
	(1.18)	(1.29)	(−0.02)	(0.22)
Net positive	−0.011	−0.010	−0.015	−0.016
	(−0.46)	(−0.39)	(−1.55)	(−1.59)
Risk index	−0.007	−0.003	−0.010	−0.009
	(−0.26)	(−0.11)	(−0.85)	(−0.81)
Video	−0.002	−0.000	−0.011	−0.012*
	(−0.10)	(−0.01)	(−1.60)	(−1.80)
Image	0.031	0.035	0.017**	0.018**
	(1.42)	(1.58)	(2.29)	(2.43)
Subcategory control	Yes	Yes	Yes	Yes
Year controls	Yes	Yes	Yes	Yes
Location controls	Yes	Yes	Yes	Yes
Observations	434	434	1800	1800
Chi square	88.606	101.006	318.384	317.323

This table examines the association between tone ambiguity and significantly delayed delivery. The dummy variable *Delayed delivery* takes the value of 1 if backers' comments made one year after the end date of the project's funding period include the words "delay" or "refund". Otherwise, it takes the value of 0. The left panel provides the results for the successful cleantech sample. The right panel provides the results for the successful matched non-cleantech sample. We performed the logit regression and provided the marginal effect instead of the coefficients. The *t* statistics adjusted for heteroscedasticity are reported in parentheses

*, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively

Heterogeneous analysis

In this section, we examined whether our findings vary for different sectors of cleantech industry. Following Cumming et al. (2017) and Süsser (2020), we used the cleantech sector classification provided by Cleantech Group.[13] Cleantech Group classify cleantech firms into five sectors: Agriculture & Food, Energy & Power, Materials & Chemicals, Resources & Environment, and Transportation & Logistics. We read the project description of each cleantech crowdfunding to determine which sector a crowdfunding project belongs to. The number of crowdfunding projects in Materials & Chemicals sector, Resources & Environment sector and Transportation & Logistics sector are much fewer than the other two sectors, so we combined these three sectors as "other cleantech sectors". Then, we divided the full cleantech sample in the baseline analysis (Table 4) into three subsamples. The first subsample includes 198 cleantech crowdfunding projects in Agriculture & Food sector. The second subsample includes 685 cleantech crowdfunding projects in Energy & Power sector. The third subsample includes 289 crowdfunding projects in other cleantech sectors. We used the subsamples to re-estimate Eq. (3).

The results are shown in Table 10. The first, middle and right panel reports the results for the Agriculture & Food sector, the Energy & Power sector and other cleantech sectors, respectively. As seen in the three panels, the effects of *Uncertain* and *Weak modal* on *Success* and *Money pledged* were generally negative and significant. Overall, the results suggest that Hypothesis 1 and 2a still hold in different sectors of cleantech industry. It is also worthy to note that there are no significant differences in the effects between the Agriculture & Food sector and the Energy & Power sector.

The interaction between tone ambiguity and backers' endorsements

In this section, we test whether the negative relationship between tone ambiguity and crowdfunding success could be strengthened by backers' endorsements, i.e. high value of comment quantity and positive backer sentiments, i.e., Hypotheses 3 and 4.

Table 11 reports the regression results for Hypothesis 3. In columns (1) and (2), the dependent variable is *Success.* In columns (3) and (4), the dependent variable is *Money pledged.* The results show that the marginal effects of the interaction terms *Uncertain* × *High comment quantity* and *Weak modal* × *High comment quantity* are negative in columns (1) and (2), and the coefficients on the interaction terms *Uncertain* × *High comment quantity* and *Weak modal* × *High comment quantity* are significantly negative in columns (3) and (4). Overall, the results suggest that the negative relationship between tone ambiguity and crowdfunding success could be strengthened by the presence of high value of comment quantity. For example, a 1-standard deviation decrease in the percentage of uncertain words would give an extra 2.61 percent points ($=0.066 \times 0.395$) rise in the probability of success, if the value of *Comment quantity* ranked in the top 50% of the cleantech sample. A 1-standard deviation decrease in the percentage of weak modal words would give an extra 5.21 percent points ($=0.202 \times 0.258$) rise in the probability of success, if the value of *Comment quantity* ranked in the top 50% of the cleantech sample.

[13] See https://www.cleantech.com/industries/.

Table 10 Heterogenous analysis based on different sectors of cleantech

	Agriculture and Food sample				Energy and Power sample				Other cleantech sectors sample			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	Success	Success	Money pledged	Money pledged	Success	Success	Money pledged	Money pledged	Success	Success	Money pledged	Money pledged
Uncertain	−0.135		−0.446*		−0.137***		−0.125		−0.183***		−0.628***	
	(−1.51)		(−1.87)		(−3.29)		(−0.80)		(−2.86)		(−3.05)	
Weak modal		−0.447***		−1.082*		−0.260***		−0.549*		−0.258***		−0.795***
		(−3.73)		(−1.76)		(−3.90)		(−1.79)		(−2.95)		(−2.72)
Funding goal	−0.171***	−0.193***	0.707***	0.669***	−0.111***	−0.112***	0.519***	0.517***	−0.123***	−0.134***	0.772***	0.735***
	(−4.00)	(−5.21)	(6.28)	(5.31)	(−8.76)	(−9.11)	(7.48)	(7.51)	(−3.85)	(−4.15)	(9.75)	(8.78)
Duration	0.118	0.171	0.803*	0.938**	−0.077	−0.079	0.271	0.253	−0.055	−0.035	0.596**	0.537**
	(0.81)	(1.30)	(1.99)	(2.17)	(−1.64)	(−1.64)	(1.40)	(1.29)	(−0.60)	(−0.39)	(2.36)	(2.07)
Rewards	0.226***	0.279***	0.560**	0.532**	0.132***	0.128***	0.113	0.134	0.071	0.071	0.165	0.167
	(3.84)	(4.29)	(2.48)	(2.16)	(4.59)	(4.54)	(0.92)	(1.09)	(1.27)	(1.26)	(1.12)	(1.16)
Quick updates	0.148***	0.132***	0.241	0.244	0.092***	0.088***	0.267***	0.253***	0.051	0.060	0.002	−0.001
	(3.54)	(3.51)	(1.30)	(1.32)	(4.17)	(3.89)	(2.87)	(2.75)	(1.19)	(1.37)	(0.02)	(−0.01)
Comment quantity	0.069**	0.076***	0.329***	0.302***	0.083***	0.082***	0.337***	0.345***	0.106***	0.102***	0.312***	0.314***
	(2.55)	(3.33)	(5.10)	(5.18)	(12.10)	(12.11)	(10.67)	(11.43)	(6.90)	(7.11)	(7.50)	(7.59)
Backer sentiment	0.033	0.062	0.082	0.114	0.091***	0.088***	0.306***	0.291***	0.045	0.037	0.037	0.044
	(0.78)	(1.36)	(0.51)	(0.75)	(4.10)	(3.96)	(3.60)	(3.53)	(1.25)	(1.01)	(0.41)	(0.48)
Total words	0.034	0.072	−0.189	−0.101	−0.010	−0.000	0.039	0.033	0.000	0.020	0.063	0.202
	(0.66)	(1.47)	(−1.12)	(−0.56)	(−0.43)	(−0.01)	(0.41)	(0.34)	(0.00)	(0.35)	(0.49)	(1.66)
Featured	0.334***	0.339***	−0.108	−0.212	0.163***	0.160***	0.277***	0.282***	0.287***	0.292***	−0.286**	−0.271*
	(4.95)	(6.13)	(−0.42)	(−0.80)	(5.51)	(5.45)	(2.71)	(2.80)	(4.35)	(4.30)	(−2.18)	(−1.93)
Social network	0.044*	0.041*	0.061	0.025	0.006	0.005	0.004	0.003	0.069***	0.077***	0.031	0.056

Table 10 (continued)

	Agriculture and Food sample				Energy and Power sample				Other cleantech sectors sample			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	Success	Success	Money pledged	Money pledged	Success	Success	Money pledged	Money pledged	Success	Success	Money pledged	Money pledged
	(1.85)	(1.81)	(0.74)	(0.28)	(0.53)	(0.39)	(0.09)	(0.07)	(2.63)	(2.88)	(0.59)	(1.08)
ARI	0.004	0.008	−0.012	−0.014	−0.007*	−0.006	−0.019	−0.020	0.007	0.006	−0.008	−0.015
	(0.55)	(1.26)	(−0.29)	(−0.30)	(−1.73)	(−1.41)	(−0.92)	(−0.97)	(0.64)	(0.53)	(−0.34)	(−0.59)
Net positive	0.036	0.035	0.023	0.032	0.039***	0.042***	0.089*	0.080	0.010	0.014	0.023	0.058
	(1.51)	(1.54)	(0.27)	(0.35)	(3.27)	(3.64)	(1.71)	(1.54)	(0.39)	(0.51)	(0.39)	(0.98)
Risk index	−0.067**	−0.082***	−0.135	−0.125	0.010	0.008	−0.079	−0.080	−0.012	−0.013	−0.039	−0.017
	(−2.10)	(−2.82)	(−1.20)	(−1.12)	(0.71)	(0.60)	(−1.25)	(−1.30)	(−0.47)	(−0.49)	(−0.53)	(−0.22)
Video	0.083***	0.103***	0.003	0.034	0.027**	0.028***	0.043	0.037	0.025	0.024	0.025	0.025
	(2.93)	(3.60)	(0.03)	(0.37)	(2.54)	(2.64)	(0.68)	(0.58)	(1.62)	(1.54)	(0.79)	(0.72)
Image	0.054**	0.060**	0.162*	0.156*	0.038***	0.037***	−0.002	−0.006	0.065***	0.058**	−0.056	−0.088
	(2.20)	(2.53)	(1.81)	(1.86)	(2.77)	(2.67)	(−0.04)	(−0.12)	(2.79)	(2.50)	(−0.90)	(−1.43)
Constant			−0.287	−0.968			2.878**	3.114***			−0.422	−0.818
			(−0.15)	(−0.49)			(2.55)	(2.72)			(−0.29)	(−0.54)
Year controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Location controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R^2	198	198	72	72	685	685	238	238	289	289	124	124
Chi square			0.727	0.725			0.723	0.726			0.729	0.718

This table provides the heterogeneous analysis based on different sectors of cleantech. Specifically, using the cleantech sector classification provided by Cleantech Group, we divided the cleantech sample in Table 4 into three subsamples: Agriculture & Food sector, Energy & Power sector, and other cleantech sectors. Then, we used subsamples to estimate Eq. (3). The left, middle and right panel reports the results for the agriculture & food sector, energy and power sector and other cleantech sector, respectively. In columns (1) and (2), (5) and (6) and (9) and (10), the dependent variable is *Success*. We performed the logit regression and provided the marginal effect instead of the coefficients. In columns (3) and (4), (7) and (8) and (11) and (12), the dependent variable is *Money pledged*. We performed the OLS regression and provided the coefficients. The *t* statistics adjusted for heteroscedasticity are reported in parentheses

*, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively

Table 11 The interaction between tone ambiguity and comment quantity

	(1) Success	(2) Success	(3) Money pledged	(4) Money pledged
Uncertain	−0.094*		−0.075	
	(−1.73)		(−0.65)	
Uncertain × High comment quantity	−0.066		−0.329***	
	(−1.19)		(−2.98)	
Weak modal		−0.103		−0.155
		(−1.48)		(−0.73)
Weak modal × High comment quantity		−0.202**		−0.786***
		(−2.51)		(−3.72)
Comment quantity	0.095***	0.099***	0.359***	0.372***
	(9.45)	(10.99)	(13.29)	(13.62)
Funding goal	−0.120***	−0.125***	0.611***	0.589***
	(−10.58)	(−11.06)	(12.71)	(12.40)
Duration	−0.070*	−0.066	0.407***	0.379***
	(−1.75)	(−1.60)	(2.78)	(2.60)
Rewards	0.130***	0.130***	0.229**	0.241***
	(5.21)	(5.25)	(2.48)	(2.65)
Quick updates	0.086***	0.081***	0.157**	0.134**
	(4.51)	(4.19)	(2.54)	(2.15)
Backer sentiment	0.075***	0.071***	0.189***	0.180***
	(4.32)	(4.11)	(3.29)	(3.28)
Total words	0.008	0.021	0.026	0.063
	(0.38)	(1.05)	(0.41)	(1.03)
Featured	0.216***	0.209***	0.135*	0.131*
	(7.92)	(7.62)	(1.86)	(1.82)
Social network	0.034***	0.034***	0.010	0.016
	(3.18)	(3.12)	(0.36)	(0.59)
ARI	−0.003	−0.001	−0.015	−0.015
	(−0.67)	(−0.30)	(−0.98)	(−1.03)
Net positive	0.032***	0.036***	0.090**	0.089**
	(3.11)	(3.45)	(2.56)	(2.54)
Risk index	−0.010	−0.012	−0.067	−0.066
	(−0.83)	(−0.94)	(−1.58)	(−1.60)
Video	0.028***	0.028***	0.041	0.037
	(3.35)	(3.25)	(1.23)	(1.08)
Image	0.040***	0.037***	0.033	0.024
	(3.84)	(3.51)	(0.92)	(0.68)
Constant			1.257*	1.359*
			(1.69)	(1.82)
Subcategory control	Yes	Yes	Yes	Yes
Year controls	Yes	Yes	Yes	Yes
Location controls	Yes	Yes	Yes	Yes
Observations	1172	1172	434	434
Adjusted R^2			0.736	0.741
Chi square	301.326	332.053		

This table tests whether the negative relationship between tone ambiguity and crowdfunding success in cleantech samples will be strengthened by the presence of high value of comment quantity. In columns (1) and (2), the dependent variable is *Success*. We performed the logit regression and provided the marginal effect instead of the coefficients. In columns (3) and (4), the dependent variable is *Money pledged*. We performed the OLS regression and provided the coefficients. The *t* statistics adjusted for heteroscedasticity are reported in parentheses

*, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively

Table 12 The interaction between tone ambiguity and backer sentiment

	(1) Success	(2) Success	(3) Money pledged	(4) Money pledged
Uncertain	−0.056		−0.232**	
	(−1.48)		(−2.15)	
Uncertain × Positive backer sentiment	−0.208***		−0.391**	
	(−4.10)		(−2.32)	
Weak modal		−0.143**		−0.612***
		(−2.38)		(−3.31)
Weak modal × Positive backer sentiment		−0.258***		−0.647**
		(−3.27)		(−2.21)
Backer sentiment	0.181***	0.140***	0.348***	0.326***
	(6.00)	(5.29)	(4.57)	(4.25)
Funding goal	−0.119***	−0.122***	0.611***	0.591***
	(−10.94)	(−11.21)	(12.85)	(12.45)
Duration	−0.066*	−0.066	0.410***	0.370**
	(−1.71)	(−1.64)	(2.80)	(2.51)
Rewards	0.125***	0.130***	0.225**	0.244***
	(4.99)	(5.18)	(2.42)	(2.62)
Quick updates	0.085***	0.085***	0.165***	0.137**
	(4.60)	(4.52)	(2.67)	(2.20)
Comment quantity	0.076***	0.079***	0.324***	0.327***
	(11.65)	(12.27)	(14.41)	(15.18)
Total words	0.018	0.027	0.038	0.065
	(0.91)	(1.35)	(0.58)	(1.06)
Featured	0.200***	0.200***	0.122*	0.128*
	(7.37)	(7.38)	(1.68)	(1.77)
Social network	0.031***	0.034***	0.009	0.016
	(3.01)	(3.16)	(0.33)	(0.57)
ARI	−0.003	−0.002	−0.017	−0.020
	(−0.88)	(−0.53)	(−1.18)	(−1.41)
Net positive	0.033***	0.035***	0.075**	0.078**
	(3.29)	(3.37)	(2.10)	(2.23)
Risk index	−0.007	−0.011	−0.065	−0.068
	(−0.59)	(−0.93)	(−1.51)	(−1.59)
Video	0.030***	0.030***	0.039	0.039
	(3.49)	(3.34)	(1.13)	(1.03)
Image	0.042***	0.038***	0.033	0.025
	(4.08)	(3.67)	(0.91)	(0.71)
Constant			1.388*	1.595**
			(1.84)	(2.11)
Subcategory control	Yes	Yes	Yes	Yes
Year controls	Yes	Yes	Yes	Yes
Location controls	Yes	Yes	Yes	Yes
Observations	1172	1172	434	434
Adjusted R^2			0.738	0.740
Chi square	293.749	327.392		

This table tests whether the negative relationship between tone ambiguity and crowdfunding success in the cleantech samples will be strengthened by the presence of positive backer sentiments. In columns (1) and (2), the dependent variable is *Success*. We performed the logit regression and provided the marginal effect instead of the coefficients. In columns (3) and (4), the dependent variable is *Money pledged*. We performed the OLS regression and provided the coefficients. The *t* statistics adjusted for heteroscedasticity are reported in parentheses

*, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively

Table 12 reports the regression results for Hypothesis 4. In columns (1) and (2), the dependent variable is *Success.* In columns (3) and (4), the dependent variable is *Money pledged.* The results show that the marginal effects of the interaction terms *Uncertain* × *Positve backer sentiment* and *Weak modal* × *Positive backer sentiment* are significantly negative in columns (1) and (2), and the coefficients on the interaction terms *Uncertain* × *Positive backer sentiment* and *Weak modal* × *Positive backer sentiment* are significantly negative in columns (3) and (4). The results suggest that the negative relationship between tone ambiguity and crowdfunding success could be strengthened by the presence of positive backer sentiment. For example, a 1-standard deviation decrease in the percentage of uncertain words was associated with an extra 8.22 percent points ($=0.208 \times 0.395$) rise in the probability of success, if the value of *Backer sentiment* ranked in the top 50% of the cleantech sample. A 1-standard deviation decrease in the percentage of weak modal words gave rise to an extra 6.66 percent points ($=0.258 \times 0.258$) increase in the probability of success, if the value of *Backer sentiment* ranked in the top 50% of the cleantech sample.

Overall, the results in Tables 11 and 12 support Hypotheses 3a and 4a, indicating that in the presence of high value of comment quantity and positive backer sentiments, the negative relationship between tone ambiguity and the average amount of money pledged will be more pronounced. According to previous analysis, this is because backers' endorsements can validate and complement founder-originated signals. Investors will integrate the information conveyed through tone ambiguity and that from backers' endorsements to paint a more complete picture of the project. Provided that the information is consistent across different channels, investors will be more willing to provide capital.

Conclusions and implications

Crowdfunding provides a promising way for innovative but risky new ventures to fund their NPD projects from the crowd. To enhance the credibility of disclosure and convince potential investors to support the projects, founders are struggling with how to phrase the project description. To the best of our knowledge, this is the first study on whether founders of innovative but risky projects could boost the success of crowdfunding by providing a project description with a less ambiguous tone and the moderate effect of the industry information environment on the association between tone ambiguity and crowdfunding success. Research on this issue is crucial to understanding the mechanism of information communication in innovative but risky crowdfunding and has important implications for founders.

Theoretical implications

First, we demonstrated that founders of high-quality projects could create a reliable signal of quality by providing a project description with a less ambiguous tone and thus boost the success of crowdfunding. Using an emerging framework of signal theory that integrates the signal production cost and consequence costs, we posit that when the signal production cost is relatively cheap, reputational concerns, from future careers, social networks, ex post sales and subsequent funding, help distinguish high-quality projects from low-quality projects. More specifically, the usage of ambiguous words establishes

ill-informed expectations (about the quality of the promised product) and thus generates a high risk of failing to meet the expectation. When founders fail to meet the expectation (fail to deliver the promised product), they face serious reputation consequences. However, the risk of failing to fulfill the promised product is lower for high-quality projects. Thus, the reputational costs distinguish high-quality projects from low-quality projects.

Previous studies on the role of tone in information disclosure have focused on mature markets, where there are rigorous disclosure requirements and professional participants such as financial analysts and institutional investors. They found that tone ambiguity greatly influences the credibility of disclosure. Our above finding suggests that a similar result holds even in a nascent market that takes place in a virtual setting (online), lacks explicit disclosure norms and clear regulations and is combined with the inexperience of investors. However, the mechanism behind our findings is different from previous studies.

Second, we found that the signaling effectiveness of a less ambiguous tone may be more pronounced in a noisier information environment. On the one hand, given that potential investors in a noisier information environment severely lack information, they may pay more attention to the signals. This suggests that the signaling effectiveness of a less ambiguous tone may be more pronounced in a noisier information environment. On the other hand, in a noisier information environment, the ambiguous tone of the project description may be viewed as an industry risk rather than the low quality of the project. If this is true, tone ambiguity will not be perceived as a signal of project quality. Our evidences are consistent with the first view, suggesting that the marginal benefit of the signal is larger in a noisier information environment.

Third, we further examined whether the signaling effectiveness of a less ambiguous tone could be strengthened by backers' endorsements. On one hand, the credibility of a less ambiguous description could be validated and complemented by backers' endorsements. One the other hand, signaling from backers' endorsements may also substitute/offset the signal conveyed through tone ambiguity. The empirical evidences showed that the negative relationship between tone ambiguity and cleantech crowdfunding success is strengthened when cleantech crowdfunding projects have high value of comment quantity or positive backer sentiments, supporting the first argument.

Practical implications

Our study provides insights for potential investors on how to evaluate the credibility of disclosure and whether or not to support a crowdfunding project. Specifically, our results suggest that an ambiguous description in innovative but risky crowdfunding projects might not just be an issue of falling short in "plain English". A high percentage of ambiguous words is related to founders' information-concealing behavior and implies more uncertainty about future outcomes. Since there are many variances in the form and content of crowdfunding project pitches, it is difficult for potential investors to process a large amount of information at the same time and compare the quality of different projects. Our research provides investors a way to avoid information overload, which is likely to improve investors' funding decisions (Mahamood et al. 2019). More specifically, we recommend investors to search ambiguous words (e.g., Loughran and McDonald (2011)'s uncertain word list and weak modal word list) in project descriptions and just

allocate their limited attention into projects with a low percentage of ambiguous words. According to our statistics, the 10 most common ambiguous words in our sample are "*could*", "*possible*", "*may*", "*believe*", "*almost*", "*might*", "*nearly*", "*depending*", "*pending*" and "*approximate*". Investors could pay more attention to these words.

Our study also provides valuable implications for founders of high-quality projects on how to better phrase the project description and thus boost crowdfunding success. Our results accentuate the necessity of not using ambiguous words in the project description, since it significantly weakens the credibility of disclosure. Our results suggest that founders of high-quality projects could create a reliable signal of quality by providing project descriptions with a less ambiguous tone. For example, according to our estimation, a 1-standard deviation decrease in the percentage of weak modal words increased the success rate of cleantech crowdfunding by 17.78%, and increased the average amount of money pledged by 16.14%. Given that the production cost of tone is smaller than the cost of improving product quality, the return is economically significant. Our results also suggest that the marginal benefit of signaling is larger when there is greater uncertainty about project prospects. This enables a less ambiguous description to play a more important role in mitigating information asymmetry.

Limitations

Despite its merits, this study also has several limitations and leaves us with unanswered questions. First, there is no perfect fix for the possible endogeneity bias, which is a common issue in tone studies (Loughran and McDonald 2011). Although we built a research sample in a single industry (cleantech industry) to control for between-industry effects (Kyriakopoulos and Ruyter 2004), controlled appropriate variables to minimize the role of omitted variables, adopted two kinds of matching methods to correct endogeneity biases resulting from observable factors and used alternative word lists of tone ambiguity to mitigate measurement error, our results may still suffer from endogeneity biases. Second, we adopted a "word percentage approach" to measure tone ambiguity in the project description. Despite its universality and efficiency in processing large quantities of data, this approach is likely to miss some nuances of a complex phenomenon, such as language use (Parhankangas and Renko 2017). Third, we chose the uncertain and weak modal word lists from Loughran and McDonald (2011), which were developed to reflect the ambiguous tone in financial documents. We call for future studies to identify other relevant words and explore whether their use has a great impact on crowdfunding success.

Abbreviations

CGI	Computer-generated imagery
IPO	Initial public offering
NPD	New product development
PRISMA	Preferred Reporting Items for Systematic Reviews and Meta-Analyses
PSM	Propensity Score Matching
URLs	Uniform resource locators

Acknowledgements

We thank the editor for handling our manuscript and the anonymous reviewers for their insightful comments and suggestions. We also acknowledge the financial support from the National Nature Science Foundation of China (72073063, 71673133).

Author contributions
YL designed the framework and methodology of this work, and was a major contributor in performing the regression and writing the manuscript. KZ programmed the code to collect the research data, and was a major contributor in writing the manuscript. WX help designed the framework of this work, and substantively revised the manuscript. ZZ performed the regression estimation and interpretation of data. All authors read and approved the final manuscript.

Funding
We acknowledge the financial support from the National Natural Science Foundation of China (72073063, 71673133).

Availability of data and materials
The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Declarations

Competing interests
The authors declare that they have no competing interests.

Received: 26 May 2022 Accepted: 22 June 2023
Published online: 18 January 2024

References

Abdullan AR (2019) Investigations into the structure of crowdfunding research and the role of the content and linguistic cues in risk disclosure in crowdfunding campaigns. RMIT University, Master Thesis.
Ahmed F, Nürnberger A (2009) Evaluation of n-gram conflation approaches for Arabic text retrieval. J Am Soc Inf Sci Tec 7:1448–1465
Allison TH, Davis BC, Webb JW, Short JC (2017) Persuasion in crowdfunding: an elaboration likelihood model of crowdfunding performance. J Bus Ventur 32:707–725
Anglin AH, Short JC, Drover W, Stevenson RM, McKenny AF, Allison TH (2018) The power of positivity? The influence of positive psychological capital language on crowdfunding performance. J Bus Ventur 33:470–492
Baginskin S (2016) Contemporaneous verification of language: evidence from management earnings forecasts. Rev Account Stud 21(1):165–197
Bellavitis C, Filatotchev I, Kamuriwo DS, Vanacker T (2017) Entrepreneurial finance: new frontiers of research and practice Editorial for the special issue embracing entrepreneurial funding innovations. Ventur Cap 19(1–2):1–16
Bergh DD, Connelly BL, Ketchen DJ, Shannon LM (2014) Signaling theory and equilibrium in strategic management research: an assessment and a research agenda. J Manag Stud 51(8):1334–1360
Bjornali ES, Ellingsen A (2014) Factors affecting the development of clean-tech start-ups: a literature review. Energy Procedia 58:43–50
Bukhari F, Usman S, Usman M, Hussain K (2020) The effects of creator credibility and backer endorsement in donation crowdfunding. Balt J Manag 15(2):215–235
Cascino S, Correia M, Tamayo A (2019) Does consumer protection enhance disclosure credibility in reward crowdfunding? J Account Res 57(5):1247–1302
Connelly BL, Certo ST, Ireland RD, Reutzel CR (2011) Signaling theory: a review and assessment. J Manag 37(1):39–67
Costello FJ, Lee KC (2022) Exploring investors' expectancies and its impact on project funding success likelihood in crowdfunding by using text analytics and Bayesian networks. Decis Support Syst 154:113695
Courtney C, Dutta S, Li Y (2017) Resolving information asymmetry: signaling, endorsement, and crowdfunding success. Entrep Theory Pract 41(2):265–290
Crescenzo VD, Ribeiro-Soriano D, Covin JG (2020) Exploring the viability of equity crowdfunding as a fundraising instrument: a configurational analysis of contingency factors that lead to crowdfunding success and failure. J Bus Res 115:348–356
Cumming DJ, Leboeuf G, Schwienbacher A (2017) Crowdfunding cleantech. Energy Econ 65(6):292–303
Cumming DJ, Hornuf L, Karami M, Schweizer D (2023) Disentangling crowdfunding from fraudfunding. J Bus Ethics 182:1103–1128
Deng LF, Ye Q, Xu DP, Sun WJ, Jiang GX (2022) A literature review and integrated framework for the determinants of crowdfunding success. Financial Innov. https://doi.org/10.1186/s40854-022-00345-6
Doran DT (2011) Stock splits and false signaling cost within a management reputation framework. J Appl Bus Res 11(3):115–126
Du JJ (2022) Project attribute information and initiator's commitment in crowdfunding message strategy: an empirical investigation of financing performance in agri-food crowdfunding. Sustain 14(19):12702
Ellman M, Hurkens S (2019) Optimal crowdfunding design. J Econ Theory 184:104939
Ertugrul M, Lei J, Qiu J, Wan C (2017) Annual report readability, tone ambiguity, and the cost of borrowing. J Financ Quant Anal 52(2):811–836
Friberg R, Seiler T (2017) Risk and ambiguity in 10-Ks: an examination of cash holding and derivatives use. J Corp Finance 45:608–631
Gafni H, Marom D, Sade O (2019) Are the life and death of an early-stage venture indeed in the power of the tongue? Lessons from online crowdfunding pitches. Strat Entrep J 13:3–23
Hendersen BJ, Pearson ND, Wang L (2015) New evidence on the financialization of commodity markets. Rev Financ Stud 28(5):1285–1311
Herve F, Schwienbacher A (2018) Crowdfunding and innovation. J Ecno Surv 32(5):1514–1530

Huang S, Pickernell D, Battisti M, Nguyen T (2022) Signaling entrepreneurs' credibility and project quality for crowdfunding success: cases from the Kickstarter and Indiegogo environments. Small Bus Econ 58:1801–1821
Janney JJ, Folta TB (2006) Moderating effects of investor experience on the signaling value of private equity placements. J Bus Ventur 21:27–44
Jin X, Li J, Gao J (2022) Joint effect of linguistic style and ethnicity on entrepreneurial fundraising: evidence from equity crowdfunding. J Int Financ Mark I 81:101660
Kerr W, Nanda R, Rhodes-Kropf M (2014) Entrepreneurship as experimentation. J Econ Perspect 28(3):25–48
Khan SAR, Mathew M, Dominic PDD, Umar M (2022) Evaluation and selection strategy for green supply chain using interval-valued q-rung orthopair fuzzy combinative distance-based assessment. Environ Dev Sustain 24:10633–10665
Kim K, Park J, Pan Y, Zhang K, Zhang X (2022) Risk disclosure in crowdfunding. Inform Syst Res 33(3):765–1118
Kyriakopoulos K, Ruyter K (2004) Knowledge stocks and information flows in new product development. J Manag Stud 41(8):1469–1498
Lee N, Sameen H, Cowling M (2015) Access to finance for innovative SMEs since the financial crisis. Res Policy 44(2):370–380
Li J, Yang L, Zhao M, Liao M, Cao Y (2022) Exploring the success determinants of crowdfunding for cultural and creative projects: an empirical study based on signal theory. Technol Soc 70:102036
Liberti JM, Petersen MA (2019) Information: hard and soft. Rev Corp Financ Stud 8(1):1–41
Loughran T, McDonald B (2011) When is a liability not a liability? Textual analysis, dictionaries, and 10-Ks. J Financ 66(1):35–65
Loughran T, McDonald B (2013) IPO first-day returns, offer price revisions, volatility and form S-1 language. J Financ Econ 109(2):307–326
Lu YJ, Chang RD, Lim S (2018) Crowdfunding for solar photovoltaics development: a review and forecast. Renew Sust Energ Rev 93:439–450
Madhmood A, Luffarelli J, Mukesh M (2019) What's in a logo? The impact of complex visual cues in equity crowdfunding. J Bus Ventur 34:41–62
Madsen J, McMullin J (2020) Economic consequences of risk disclosures: evidence from crowdfunding. Account Rev 95(4):331–363
Mendes-Da-Silva W, Felipe I, Leal C, Aguiar M (2022) How the tone of mass media news affects pledge amounts in reward crowdfunding campaigns. J Small Bus Manage. https://doi.org/10.1080/00472778.2022.2041198
Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group (2009) Preferred reporting items for systematic reviews and meta-analyses: The PRISMA statement. Phys Ter 89(9):873–880
Mollick E (2014) The dynamics of crowdfunding: an exploratory study. J Bus Ventur 29:1–16
Moradi M, Badrinarayanan V (2021) The effects of brand prominence and narrative features on crowdfunding success for entrepreneurial aftermarket enterprises. J Bus Ventur 124:286–298
Parhankangas A, Renko M (2017) Linguistic style and crowdfunding success among social and commercial entrepreneurs. J Bus Ventur 32:215–236
Park H, Patel P (2015) How does ambiguity influence IPO underpricing? The role of the signaling environment. J Manag Stud 52(6):796–818
Pernick R, Wilder C (2007) The cleantech revolution: the next big growth and investment opportunity. Harper Collins Publisher, New York
Rau PR (2020) Law, trust, and the development of crowdfunding. Working Paper, Available at. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2989056
Roma P, Petruzzelli AM, Perrone G (2017) From the crowd to the market: the role of reward-based crowdfunding performance in attracting professional investors. Res Policy 46(9):1606–1628
Scheaf DJ, Davis BC, Webb JW, Coombs JE, Borns J, Holloway G (2018) Signals' flexibility and interaction with visual cues: Insights from crowdfunding. J Bus Ventur 33:720–741
Slimane FB, Rousseau A (2020) Crowdlending campaigns for renewable energy: success factors. J Clean Prod 249:119330
Süsser D (2020) Accelerating cleantech commercialization in Israel: green innovation as catalyst for sustainable development. Israel Public Policy Inst Policy Paper Series. https://doi.org/10.2312/iass.2020.026
Yin X, Zhu K, Wang H, Zhang J, Wang W, Zhang H (2022) Motivating participation in crowdsourcing contests: the role of instruction-writing strategy. Inform Manage 59(3):103616
Wang N, Li Q, Liang H, Ye T, Ge S (2018) Understanding the importance of interaction between creators and backers in crowdfunding success. Electron Commer Res Appl 27:106–117
Wu DX, Yao X, Guo JL (2021) Is textual tone informative or inflated for firm's future value? Evidence from Chinese listed firms. Econ Model 94:513–525
Zhang Y, DeCarlo TE, Manikas AS, Bhattacharya A (2022) To exploit or explore? The impact of crowdfunding project descriptions and backers' power states on funding decisions. J Acad Mark Sci. https://doi.org/10.1007/s11747-022-00871-w
Zhang Y, Khan SAR (2022) Evolutionary game analysis of green agricultural product supply chain financing system: COVID-19 pandemic. Int J Logist-Res App 25(7):1115–1135
Zhu X (2022) Proximal language predicts crowdfunding success: behavioral and experimental evidence. Comput Hum Behav 131:107213
Ziegler T, Shneor R, Wenzlaff K, Wang B, Kim J, Paes FFC, Suresh K, Zhang BZ, Mammadova L, Adams N (2020) The global alternative finance market benchmarking report. Available at https://www.jbs.cam.ac.uk/wp-content/uploads/2020/08/2020-04-22-ccaf-global-alternative-finance-market-benchmarking-report.pdf. Accessed 15 Jan 2021

Publisher's Note