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Timing co-creation: A reward-based crowdfunding perspective

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Abstract

Reward-based crowdfunding provides a rich arena for co-creation, where different types of dialogues between backers and project initiators aid crowdfunding performance. Nevertheless, research on how backers' co-creation, in the form of comments, influences crowdfunding performance is still scarce. Based on signaling theory, this research investigates the impact of backers' specific co-creation comments (we coded comments for co-ideation, co-evaluation, and co-design) on crowdfunding performance. The present study also examines whether the timing of posting co-creation comments influences associated performance benefits. We used a panel dataset of 446 reward-based crowdfunding projects with 7254 observation days. The results show that backers' co-ideation and co-evaluation activity leads to a higher funding amount. Furthermore, the impact of co-ideation is higher for comments made early in the project's lifecycle, while the effect of co-design is wholly contingent on the time of commenting, with early co-design comments contributing negatively to crowdfunding performance.

1 | INTRODUCTION

Co-creation has become one of the leading ways in which firms create value, as more sophisticated product and service offerings may emerge as a result of the dialogue between the firm and external constituents (Kim et al., 2020). Co-creation is defined as "joint activities by parties involved in direct interactions, aiming at contributing to the value that emerges for one or both parties" (Grönroos, 2012: p. 1520). It has been argued to rejuvenate the knowledge base of incumbent firms (Kazadi et al., 2016), keep firms more up-to-date with technological developments (Hidayanti et al., 2018) as well as evolving customer needs (Sjödin et al., 2020).

This study adopts a customer-driven perspective (Von Hippel, 2005) and explores the context of new crowdfunding projects (Laffey et al., 2021). According to previous research, backer co-creation is a crucial element of product development (Gerber & Hui, 2013; Ordanini et al., 2011; Zheng et al., 2018). We distinguish three categories of co-creation that is, co-ideation, co-evaluation, and co-design, as espoused by backers (those customers who have invested in the project) and provide insights into the value these co-creation comments represent. Specifically, we consider how daily co-creation activity, as proxied by the number of co-creation comments in the three different categories, impacts the daily pledged funding amount at different stages of the crowdfunding project.

We adopt the signaling theory to argue that co-ideation, co-evaluation, and co-design offer key cues for future backers on customer engagement as well as general product/market fit (Daniele, 2021). Signaling theory explains how the contingent of backers, through their co-creation activity, builds the track record of the project beyond the initial project initiators' description. Second, with added backer co-creation activity, the community offers legitimacy to the project and strengthens the belief that suggested pathways will be deeply explored and potentially adopted by the project initiator, especially if reiterated often by the broader contingent of backers. Signaling theory has been used before in the crowdfunding context, for example, to allow venture capitalists to gauge project success (Roma et al., 2021) as well as for project initiators to draw additional investors by disclosing more detailed information on the project (Ahlers et al., 2015). We follow prior work but explicitly consider co-creation comments as an additional source of meaningful cues for future backers. This is in line with previous work that found projects with more comments receive more funding (Cornelius & Gokpinar, 2020; Courtney et al., 2017; Kromidha & Robson, 2016).

We contribute to this emerging line of inquiry by considering the type of comments more in-depth, along with the type of co-creation they represent (e.g., Pee, 2016; Russo-spena & Mele, 2012). In addition, we consider the timing of the co-creation comments and argue that projects that receive co-creation comments early on in the crowdfunding campaign are considered more engaging and thus, draw more attention from would-be investors. Although research has indicated that co-creation in crowdfunding may impact the future success of entrepreneurs (Stanko & Henard, 2016; Zheng et al., 2018), there is only an emerging understanding of how backer co-creation activity in the form of comments might impact crowdfunding success. Moreover, little is understood about the preferred timing of co-creation comments to enable crowdfunding performance through additional funds pledged.

The crowdfunding context is particularly meaningful when it comes to research on co-creation. Backers are evidenced to have accentuated interest in the project. First, the reward offered for investing is typically connected to the product outcome, as displayed in the project description (Lipusch et al., 2018). Second, backers (those monetarily invested) are the only ones who can comment. Hence, their suggestions are meaningfully connected to the project outcome that is, a successful product launch (Belleflamme et al., 2014). Third, the real-life context of crowdfunding enhances backer buy-in, unlike other co-creation methods such as virtual competitions and brainstorming sessions (Baswani et al., 2021).

We offer three distinct contributions. First, we empirically unpack the concept of co-creation by considering three different types of co-creation (Russo-Spena & Mele, 2012). Our results emphasize that it is essential to distinguish between different types of co-creation as they differentially add to crowdfunding performance. Second, we add to the signaling theory by outlining how cues from outside firm boundaries (i.e., co-creation comments) influence the perceptions of would-be investors and their inclinations to fund crowdfunding projects. Third, we offer insights into the value of co-creation comments relative to the timing of co-creation comments. Our results outline how co-ideation and co-evaluation comments add to crowdfunding performance, with accentuated benefits for early comments. Co-design by itself does not influence crowdfunding performance. However, early co-design comments are less beneficial than late-stage co-design comments.

2 | LITERATURE REVIEW AND HYPOTHESES DEVELOPMENT

2.1 | Different co-creation types in reward-based crowdfunding

In reward-based crowdfunding sites such as Kickstarter, backers can participate in co-creation by providing comments with suggestions for product improvement, product design, product delivery, and more. Comments are available to all website visitors, but only backers may post (visitors who have contributed funds to the project).

Various types of co-creation occur in the context of crowdfunding. Russo-Spena and Mele (2012) discovered five types of co-creation in a web-based setting; they refer to them as "the 5 Co's.", which consist of co-ideation, co-evaluation, co-design, co-test, and co-launch. Co-ideation entails the process of external constituents contributing their novel ideas, which may pertain to products, packaging, employees, and marketing programs, among other things (Russo-Spena & Mele, 2012). This form of co-creation can be presented by anyone without the need for specialized knowledge. Co-evaluation is the assessment of someone's new ideas. It is when customers, experts, suppliers, partners, and professionals provide feedback on other people's or the company's new ideas, propose improvements, and explain why the idea is worth executing. In an online context, co-evaluation entails commenting on a new idea and voting for the most liked ideas (Russo-Spena & Mele, 2012). Co-design occurs when parties collaborate to produce solutions or ideas where the actors participating have specialized knowledge and skills (Russo-Spena & Mele, 2012). The skill of the participating actors distinguishes co-design from co-ideation. The vocabulary used in co-ideation is more casual. Text-based or relational codes are frequently employed in co-ideation, whereas technical lexical codes are commonly utilized in co-design (Russo-Spena & Mele, 2012). Additionally, the co-design process yields more technical input.

Co-test is a collaboration in improving a prototype of a product or service before it is marketed, while co-launch is a collaboration in launching the product/services together onto the market (Russo-Spena & Mele, 2012). Among the five co-creation types, only three types of co-creation align with our focus that is, the cognitive process of idea refinement (Gohary et al., 2016): co-ideation, co-evaluation, and co-design. Co-test and co-launch are more focused on implementation and thus fall outside the focus of this study.

In this study, we argue that co-creation is associated with crowdfunding project performance. In crowdfunding, the project initiator has knowledge about the project that is not disclosed to third parties (i.e., potential backers). As a result, backers face information asymmetries. Signaling Theory (Spence, 1978) states that decision-makers (i.e., potential backers) would use observable cues as well as manipulable signals from the signaler (i.e., project initiators) to substantiate assumptions about non-observable outcomes. Before contributing money to a crowdfunding project, backers seek as much available information as possible to decrease information asymmetries. In crowdfunding, the information asymmetry is exacerbated by the fact that inexperienced investors—that is, backers—do not conduct the due diligence that experienced investors do when evaluating investment opportunities (Agrawal et al., 2014). Signals from a third party (i.e., co-creation comments) are often seen as more credible information than the signals provided by project initiators (i.e., project description, project video). Co-ideation, co-evaluation, and co-design comments signal other backers' interest in the project, which reassures backers when they confront significant uncertainty

(Colombo et al., 2014). When it is impossible to evaluate the quality of a project directly, backers gather knowledge by observing the behavior of other backers, which helps them to make funding decisions.

Many previous crowdfunding studies that employ signaling theory use the number of backers' comments as one of the signals to indicate project legitimacy (Clauss et al., 2018; Courtney et al., 2017; De Larrea et al., 2019; Kromidha & Robson, 2016; Petitjean, 2018; Wang et al., 2018). In this study, we examined more detailed information, specifically the content of backers' comments (i.e., co-ideation, co-evaluation, and co-design comments). We argue that increased activity in each of the co-creation domains under consideration strengthens the project's (a) community-driven representation, which signals the reasons and ways in which it resonates with the market context, and (b) legitimacy through the affirmation of shared opinions and beliefs, which give potential backers more reasons to fund the project.

2.2 | The impact of co-ideation on crowdfunding success

Co-ideation occurs when external constituents, for example, lead users, customers, consumers, investors, or intermediaries, generate new ideas for firms. Ideas may relate to products, packaging, social responsibility programs, and so forth, and are not restricted to brand-new concepts as they may also represent enhancements to existing activity (Quero & Ventura, 2015; Russo-Spena & Mele, 2012).

For project initiators, co-ideation from backers increases the influx of novel ideas, which would be challenging to generate autonomously as firms are resource and time-restricted, especially for start-ups. Co-ideation then offers insights into the product domain and additional customer-aligned innovation trajectories (Pee, 2016). Initial project descriptions are usually rather succinct, where focus adds to clarity but distracts from broader product (or portfolio) potential. As co-ideation comments bring more idea breadth into the product or service (Azzari et al., 2021), it raises the potential for customerization (Zhang & Chen, 2008).

Backers' comments may also draw from differential environmental perspectives, raising awareness of the diverging potential for application, allowing more backers to identify with the product. This leads to increased product/market fit where products that are better suited to client needs build customer receptiveness and thus acquire more funding (Cornelius & Gokpinar, 2020; eFranke & Schreier, 2010). Here is an example of backers' co-ideation comment:

> "Looking at the other comments here about use in cars and as a sports watch, I'm hoping it could be used as a cycle computer, giving a speed readout and tracking rides." (Kickstarter, 2022, Project: Bangle.js 2: The Open Smart Watch)

For potential backers, co-ideation comments that contain ideas to improve product usability and product design from other backers, signal the technical feasibility and market viability of the product—a process similar to releasing information through customer reviews in online transactions (Courtney et al., 2017). Co-ideation then signals not only backers' interest but also the future possibilities of the product/services (Stanko & Henard, 2016), which attracts more would-be backers towards the project.

In this study, we focus on the impact of co-ideation on funding amount on a daily basis. We argue that co-ideation comments that are readily available (i.e., posted at the top of the comment chain) are most impactful in persuading would-be backers to invest. With more co-ideation activity on a given day, would-be backers are more actively confronted with the broader potential of the focal project and are more likely to invest.

> **H1a.** Backers' co-ideation activity positively influences crowdfunding performance.

2.3 | The impact of co-evaluation on crowdfunding success

Co-evaluation includes the evaluation or appraisal of new ideas (Russo-Spena & Mele, 2012). Commenting and voting are two types of co-evaluation activities on reward-based crowdfunding platforms that justify why and how new ideas add relevantly to the initial project description.

Co-evaluation adds clarity to newly proposed ideas and puts them in perspective, especially with multiple evaluations of the same idea (Russo-Spena & Mele, 2012). Co-evaluation aids in legitimizing new development cues, which not only speeds up adoption and implementation, but also conveys to backers the value of proposed ideas and future development pathways. Here is an example of co-evaluation comments:

Backer 1's comment (co-ideation):

> "Will there be such an amazing wooden charging stand? I really like that."

Backer 2's reply (co-evaluation):

> "Yes, that would be great (especially given the shipping cost). 2 are sold already if you can manage that:-)"

Backer 3's reply (co-evaluation):

> "I would also be interested in a charging stand, assuming it could be shipped along with the watch itself."

Backer 4's reply (co-evaluation):

> "That would be neat!"

(Kickstarter, 2022, Project: Bangle.js 2: The Open Smart Watch).

From the perspective of backers, co-evaluation serves as a signal of interest from those who have already pledged. This raises the profile of the project and adds critical appraisal, allowing would-be backers to formulate a better-founded opinion about the project (Kromidha & Robson, 2016). Second, co-evaluation that appraises new ideas proposed by the project initiators signals project initiators' innovativeness, credibility, and project quality, which leads to trust in backing the project. (Courtney et al., 2017). Co-evaluation comments serve as a trustworthy third-party source of information. It is really hard to alter or manipulate the backers' comments because, unlike other e-commerce websites, not all audiences can directly post comments on crowdfunding sites. In Kickstarter, for example, one needs to contribute money to the project to post comments. Third, co-evaluation fosters a sense of community, where backers actively contribute to a joint understanding of the project at hand (Gebauer et al., 2013), affecting purchase intention (Blasco-Arcas et al., 2014).

Restrictions in most reward-based crowdfunding sites, which require someone to become a backer (by donating money, usually USD 1) before commenting on a project, result in a high number of valuable comments for the project's success as opposed to trash-talking. The requirement to contribute money before commenting on the project appears to filter the audience so that even negative comments or evaluations are still aimed at product improvement because the comments are given by those who care about the product development process and desire the finished product. We argue that all co-evaluation comments will benefit the project's success.

As we are concerned with the impact of co-evaluation on funding amount on a daily basis, it is important to consider the visibility of co-evaluation activity on the platform. As recent co-evaluation efforts are more visible and arguably more up-to-date, as the joint understanding progresses over time, the daily co-evaluation activity is expected to immediately affect the daily funding amount. Moreover, with more daily co-evaluation activity, the community aspect of co-creation becomes more pronounced, with backers starting to weigh in on each other's comments, increasing the depth of ensuing comments.

> **H1b.** Backers' co-evaluation activity positively influences crowdfunding performance.

2.4 | The impact of co-design on crowdfunding success

Co-design is a collection of activities centered on the engagement of a group of individuals with specialized knowledge in generating ideas and solutions (Russo-Spena & Mele, 2012). What differentiates co-ideation and co-design in reward-based crowdfunding is the expertise offered by backers. In co-design, the language is more technical (Gembarski & Lachmayer, 2017) because the ideas are proposed by someone with accentuated expertise.

From the perspective of backers, co-design comments signal that experts monitor and support the projects. Would-be backers may assume experts have the necessary knowledge to provide credible information to improve the product or solve consumers' problems (Uribe et al., 2016). Here is an example of a co-design comment:

> "…A good stretch goal would be an option to upgrade the blade steel, i.e., LC200N, a nitrogen alloy with superior hardness/edge retention and excellent corrosion resistance, and consistent with your quality nautical tool." (Kickstarter, 2022, Project: Kraken Blade by Oceanus Brass).

In this study, we focus on the impact of co-design on the funding amount on a daily basis. We argue that co-design comments not only benefit firms by providing knowledge and expertise, but also by giving assurance to potential backers regarding the current state of the project and the future-oriented project direction. The amount of expert comments signals the project's legitimacy. Projects with more daily co-design comments could be regarded as having more potential because more experts are invested and contributed their knowledge to enhance the project's chances of success. Projects with more co-design comments and more elaborated expert advice are also perceived as having less risk, thereby lowering the threshold to invest for would-be backers (Soesilo et al., 2020).

Again, given the visibility of comments on the Kickstarter platform, co-design comments on a given day are expected to be of particular value as backers are confronted with expert opinions and evidenced expert buy-in, lowering the risk profile of the project and increasing the professional scope of the product/service influencing would-be backers' funding decisions.

> **H1c.** Backers' co-design activity positively influences crowdfunding performance.

2.5 | The moderating impact of the time of comments

Previous research found that comments and updates posted in the first week of crowdfunding have a higher impact on project success compared to those posted in the second week (Lai et al., 2017). According to Signaling Theory (Spence, 1978), decision-makers will utilize both observable cues and manipulable signals from the other party to justify assumptions about non-observable outcomes. In the crowdfunding context, the signaler (project initiators) possesses much information about the project that is not shared with potential backers. Therefore, potential backers experience information asymmetries. At the beginning of the project, the primary signals come from project initiators (i.e., project description and project video). Early backers' co-creation comments act as a third-party signal that reassures backers when they face high uncertainty at the beginning of the project (Colombo et al., 2014), as these comments signal other backers' interest in the project. When the quality of a project cannot be directly observed, backers derive information from looking at the behavior of other backers. In a reward-based crowdfunding website such as Kickstarter, one needs to contribute monetarily to the project

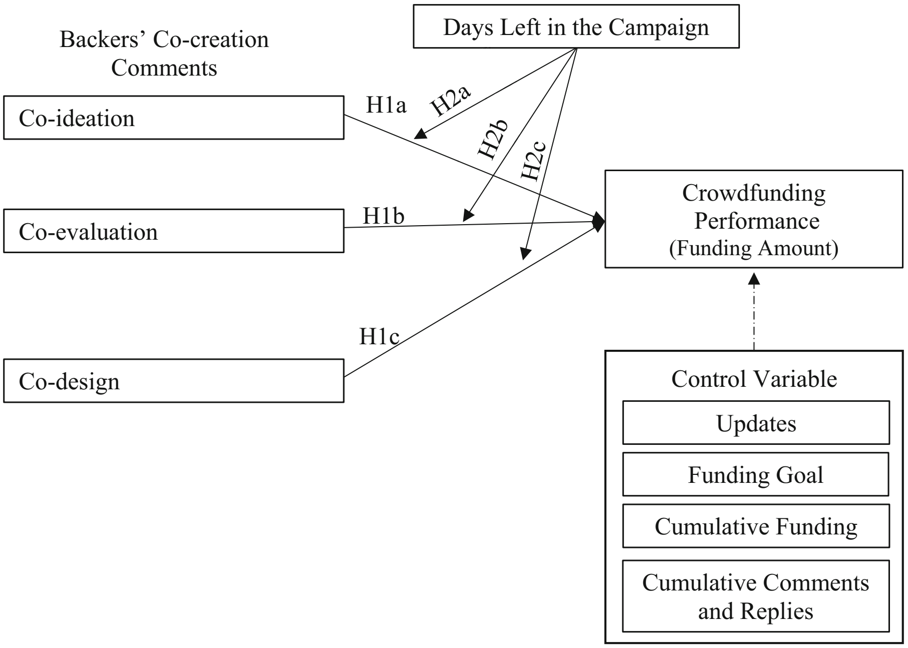

FIGURE 1 Conceptual model.

before one can post comments. Thus, early comments signal early purchases. People are led to believe that a product is good and should be purchased when they notice that other people also buy the product (Ismagilova et al., 2020).

From the perspective of the project initiators, early co-creation comments mean early feedback. Using this feedback, project initiators can anticipate issues, learn about customer preferences, and accommodate a broader range of customers. At the beginning of the project, the initiators have more time to carefully consider the feedback, make an adjustment to incorporate the feedback, and modify the products. As a result, would-be backers may have higher anticipation for value deliverables of early-stage comments than late-stage co-creation comments. Figure 1 illustrates the conceptual model of this study.

> **H2a.** The positive relationship between co-ideation and crowdfunding performance is stronger in the early days of the project.

> **H2b.** The positive relationship between co-evaluation and crowdfunding performance is stronger in the early days of the project.

> **H2c.** The positive relationship between co-design and crowdfunding performance is stronger in the early days of the project.

3 | RESEARCH METHOD

The unit of analysis in this study is reward-based crowdfunding projects. This study uses a customized Python's Beautiful Soup web crawler program to retrieve secondary data from Kickstarter, the biggest reward-based crowdfunding platform. As of 2022, 21,589,614 backers have contributed by pledging over $6.9 billion (Kickstarter, 2022). Kickstarter uses the "All or Nothing" funding mechanism, which means the initiators will get the money if the project reaches the funding goal. If they fail, the pledged money will be returned to the backers.

We collected the daily data of all crowdfunding projects launched from the 18th until the 23rd of September 2021. As the duration of each project varies from 4 to 60 days, the data-collecting process runs for 66 consecutive days. There are 525 projects collected from all categories. We excluded canceled projects (67), non-English projects (5), and projects with more than 700 comments (7). We followed each project from the day the project was launched until the crowdfunding period ended. We analyzed 446 projects with 7254 observation days, 9854 backers' comments, and project initiators' replies. The comments and replies included in the analysis are only those made before the project ends.

After all comments were collected, two independent coders manually coded all the backers' comments into the three types of co-creation: co-ideation, co-evaluation, and co-design comments. First, coders read all the project descriptions and project updates. Coders also watched the project's video to understand the project initiators' ideas. If backers' comments contain new ideas not proposed by initiators in the project description, the comments can be categorized as co-ideation or co-design. It will be categorized as co-ideation if the backers use more informal language, text- or relational code-based (i.e., like/dislike). Below is an example of a co-ideation comment.

> "I'd love to see some cute cold climate pets. Like reindeer to ride, or adorable snow leopards!" (Kickstarter, 2022, Project: Roots of Pacha)

The above comment is categorized as a co-ideation comment because the backers use informal language in the comment and show no expertise. Anyone can understand the ideas easily.

TABLE 1 Variables in this study.

Variables	Definition
Dependent variable	
Funding Amount	The daily funding amount each project receives each day (natural-logged).
Independent variable	
Co-ideation	The daily number of co-ideation comments each project receives. Co-ideation is backers' comments that suggest ideas of new product concepts, services, packaging, delivery, or specific campaign initiatives in which backers use more informal language (Russo-Spena & Mele, 2012).
Co-evaluation	The daily number of co-evaluation comments each project receives. Co-evaluation is backers' comments that contain the appraisal of the project initiator's ideas or the appraisal of other backers' ideas (Russo-Spena & Mele, 2012).
Co-design	The daily number of co-design comments each project receives. Co-design is backers' comments that suggest ideas that are more technical in nature in which backers use more standardized language and show special expertise/knowledge (Russo-Spena & Mele, 2012).
Moderating variable	
Days Left in the Campaign	The number of days left (on the day the comment is posted) before the project ends.
Control variables	
Updates	The daily number of updates.
Funding Goal	The funding target in 100 USD.
Cumulative Funding	The cumulative funding amount for each project in 1000 USD.
Cumulative Comments and Replies	The accumulated number of comments from backers and replies from project initiators that the project has received on each particular day.

A comment will be categorized as co-design if the backers use more standardized language and show expertise/ special knowledge when proposing an idea. Here is an example of a co-design comment.

> "…A good stretch goal would be an option to upgrade the blade steel that is, LC200N, a nitrogen alloy with superior hardness/edge retention and excellent corrosion resistance, and consistent with your quality nautical tool." (Kickstarter, 2022, Project: Kraken Blade by Oceanus Brass).

The above comment is categorized as a co-design comment as the backer uses more standardized language (i.e., superior hardness/ edge retention and excellent corrosion resistance). The backer also shows expertise as he could mention a specific type of blade steel (i.e., LC200N), which is not common knowledge. Comments that evaluate new ideas will be coded as co-evaluation comments. Other comments (i.e., questions about payment or usage) are not coded. All disagreements between coders in categorizing comments were resolved through discussion. The average inter-rater reliability is 90.5%, indicating a high agreement (Hajli et al., 2017).

Panel data regression with a fixed effect model is used to test the hypothesis using Stata 17.0. The variables used in this study are shown in Table 1. The dependent variable, crowdfunding performance, is measured by *Funding Amount*, which represents the daily funding amount of each project. The same measure is used by previous studies (e.g., Kromidha & Robson, 2016). There are three independent variables: (1) *Co-ideation*, measured by the daily number of co-ideation comments; (2) *Co-evaluation*, measured by the daily number of co-evaluation comments; (3) *Co-design*, measured by the daily number of co-design comments. The moderating variable, the time of comment, is measured by the *Days Left in the Campaign*, which represents the number of days left before the project ends. We use four control variables: (1) *Updates*, measured by the daily number of updates posted by the project initiators; (2) *Funding Goal*, measured by the amount of funding goal in 1000 USD; (3) *Cumulative Funding*, measured by the cumulative funding amount for each project in 1000 USD; and (4) *Cumulative Comments and Replies*, measured by the accumulated number of comments from backers and replies from project initiators that the project has received on each particular day. We included updates, funding goals, cumulative funding, and cumulative comments and replies as control variables because previous research shows that projects with small funding targets have a greater chance of success (Clauss et al., 2018; Frydrych et al., 2014). Earlier studies also found that projects with more updates, more comments from backers and project initiators, have better success rates (Clauss et al., 2018; De Larrea et al., 2019; Kromidha & Robson, 2016; Mollick, 2014; Petitjean, 2018). Prior cumulative funding also influences funding success (Burtch et al., 2018).

4 | RESULTS

4.1 | Descriptive statistic

Table 2 shows the descriptive statistics with the crowdfunding project as the observation unit. Table 3 shows the descriptive statistics with the crowdfunding day as the observation unit. For the 446 reward-based crowdfunding projects, we observed 7254 campaign days, defined as days when backers had the opportunity to contribute money to a specific crowdfunding project. There are 292 successful projects and 154 unsuccessful projects. In total, 93,891 backers participated, and USD 10,769,377 was pledged, with an average of USD 24,146 and 210 backers per project. The average project gets 10 backers and USD 1507 each day. The amount of funding that the project receives per day varies. Similar to backers, the funding amount per day can decrease significantly because backers can cancel their contribution at any time as long as the project has not ended. The smallest daily funding amount is USD −64,013, while the largest is USD 388,281.

TABLE 2 Descriptive statistics for our sample of Kickstarter projects ($N_{projects} = 446$).

Variable	Mean	Median	SD	Min	Max
Total Funding Amount	24,146	3731	114,797	1	1,703,669
Total Backers	210	51	533.67	1	6277
Total Comments	15.28	1	44.84	0	553
Total Co-ideation	1.67	0	7.82	0	108
Total Co-evaluation	3.65	0	16.43	0	192
Total Co-design	0.10	0	1.06	0	15
Total Replies	4.92	0	20.27	0	193
Replies to Co-creation	2.65	0	12.23	0	139
Project Duration	32.18	30	12.78	4	60
Total Updates	2.96	1	5.140	0	47
Funding Goal	18.42	5	71.84	0,02	1200

Note: *Funding Goal*, the amount of funding goal for each project in 1000 USD; *Project Duration*, duration of project in number of days; *Replies to Co-creation*, total project initiators' replies toward backers' co-creation comments; *Total Backers*, total number of backers for each project; *Total Co-design*, total number of co-design comments that each project receives; *Total Co-evaluation*, total number of co-evaluation comments that each project receives; *Total Co-ideation*, total number of co-ideation comments that each project receives; *Total Comments*, total number of comments that each project receives; *Total Funding Amount*, total amount of funding for each project in USD; *Total Replies*, total project initiators' replies toward all backers' comments; *Total Updates*, total number of project initiators' updates.

TABLE 3 Descriptive statistics for all observation days ($N_{days} = 7254$).

Variable	Mean	SD (overall)	SD (between)	SD (within)	Min	Max
Funding Amount	1507	11,174	4940	9359	−64,013	388,281
Ln. Funding Amount	5.00	2.14	1.75	1.38	0	13
Number of Backers	10.35	47.22	22.16	41.09	−10	1848
Total Comments	0.93	3.86	2.30	3.01	0	129
Co-ideation	0.10	0.64	0.34	0.53	0	33
Co-evaluation	0.22	0.99	0.53	0.81	0	18
Co-design	0.006	0.11	0.04	0.10	0	5
Total Replies	0.30	1.28	0.71	1.02	0	33
Replies to Co-creation	0.16	0.79	0.40	0.66	0	26
Number of Updates	0.18	0.42	0.19	0.38	0	4

Note: *Co-design*, daily number of co-design comments that each project receives; *Co-evaluation*, daily number of co-evaluation comments that each project receives; *Co-ideation*, daily number of co-ideation comments that each project receives; *Funding Amount*, daily amount of funding in USD; *Ln. Funding Amount*, natural log of funding amount; *Number of Backers*, daily number of backers; *Number of Updates*, daily number of project initiators' updates; *Replies to Co-creation*, daily project initiators' replies toward backers' co-creation comments; *Total Comments*, daily number of comments that each project receives; *Total Replies*, daily project initiators' replies toward all backers' comments.

4.2 | Panel data regression

Table 4 shows the correlations between variables are below 0.8, suggesting multicollinearity is not a severe problem (Greene, 2008). The variance inflated factor (VIF) values ranged from 1.13 to 2.28. The VIF value is far below 10, indicating the absence of multicollinearity (Gujarati, 2021).

The Hausman test was conducted to determine the suitable estimation method of the panel data regression. The results of the Hausman tests are in support of fixed effects, which is in line with other panel studies on crowdfunding (Block et al., 2018; Kuppuswamy & Bayus, 2017). Using the fixed effect estimation method allows us to control for unobservable characteristics that may influence the project's performance (e.g., project description length, project initiators' characteristics) that remain constant throughout the funding cycle (Kleinert & Volkmann, 2019).

Table 5 shows the regression result with the natural log of total funding amount as the dependent variable. Following Cornelius and Gokpinar (2020), robust standard errors clustered at the project level are used because of their robustness to heteroscedasticity and autocorrelation. Model 1 includes the control variables. Model 2 incorporates control and independent variables: co-ideation, co-evaluation, and co-design. Model 3 contains control variables, independent variables, and the interaction of independent variables with the time of comments.

TABLE 4 Variance inflated factor (VIF) value and correlation matrix.

	Variable	VIF	1	2	3	4	5	6	7	8	9
1	Funding Amount		1.000								
2	Updates	1.21	0.025	1.000							
3	Funding Goal	1.13	−0.001	−0.045	1.000						
4	Cumulative Funding	1.72	0.157	0.032	0.018	1.000					
5	Cumulative Comments and Replies	2.28	0.131	0.171	−0.026	0.591	1.000				
6	Co-ideation	1.34	0.149	0.153	−0.009	0.167	0.359	1.000			
7	Co-evaluation	1.51	0.069	0.178	−0.011	0.117	0.315	0.310	1.000		
8	Co-design	1.15	0.077	0.051	0.005	0.218	0.198	0.269	0.139	1.000	
9	Days Left in the Campaign	1.22	−0.001	−0.070	0.041	−0.057	−0.139	−0.021	−0.034	−0.019	1.000

Note: *Number of Backers*: Daily number of backers. *Updates*: Daily number of project initiators' updates. *Funding Goal*: the amount of funding goal for each project in thousand USD. *Cumulative Funding*: the cumulative funding amount for each project in thousand USD. *Cumulative Comments and Replies*: The accumulated number of comments from backers and replies from project initiators that the project has received on each particular day. *Co-ideation*: Daily number of co-ideation comments that each project receives. *Co-evaluation*: Daily number of co-evaluation comments that each project receives. *Co-design*: Daily number of co-design comments that each project receives. *Days Left in the Campaign*: The time the co-creation comments was posted, measured in number of days left before the project ends.

TABLE 5 Panel data regression results: funding amount.

Independent variables	Model 1 Control variable	Model 2 Independent variable	Model 3 Interaction effect
Control variables			
Updates	0.411*** (0.039)	0.362*** (0.041)	0.363*** (0.041)
Funding Goal	−0.001*** (0.001)	−0.001*** (0.001)	−0.001** (0.001)
Cumulative Funding	−0.001* (0.001)	−0.001 (0.001)	−0.001* (0.001)
Cumulative Comments and Replies	−0.003*** (0.001)	−0.004*** (0.001)	−0.001** (0.001)
Independent variables			
Co-Ideation		0.101** (0.045)	0.011 (0.073)
Co-Evaluation		0.076*** (0.026)	0.058 (0.036)
Co-Design		−0.041 (0.120)	0.473*** (0.150)
Days Left in the Campaign			0.017*** (0.002)
Interaction			
Co-Ideation × Days Left in the Campaign			0.005** (0.003)
Co-Evaluation × Days Left in the Campaign			0.001 (0.001)
Co-Design × Days Left in the Campaign			−0.035### (0.009)
Fixed effects			
Project	Yes	Yes	Yes
N (observations)	7254	7254	7254
N (projects)	446	446	446
R^2	0.019	0.023	0.039
Prob > *F*	0.000	0.000	0.00

Note: Dependent variable is the natural log of daily *funding amount*. Robust standard errors clustered at the project level are in parentheses; *Updates*, daily number of updates for each project; *Funding Goal*, the amount of funding goal for each project in 1000 USD; *Cumulative Funding*, the cumulative funding amount for each project in 1000 USD; *Cumulative Comments and Replies*, the accumulated number of comments from backers and replies from project initiators that the project has received on each particular day; *Co-ideation*, daily number of co-ideation comments; *Co-evaluation*, daily number of co-evaluation comments; *Co-design*, daily number of co-design comments; *Days Left in the Campaign*, the time the co-creation comments was posted, measured in number of days left before the project ends.
***$p < .01$; **$p < .05$; *$p < .1$; ###$p < .01$ regression coefficient signs are different to those hypothesized.

Model 1 shows that the number of updates positively influences the funding amount ($\beta = .411$, $p < .05$). The funding goal ($\beta = -.001$, $p < .05$) negatively impacts the funding amount, which means that the more updates posted by the project initiators, the higher the funding amount. The funding amount is also higher for projects with smaller funding goals. The findings are consistent with previous studies (Clauss et al., 2018; Frydrych et al., 2014; Mollick, 2014). Model 1 also shows that the cumulative comments and replies ($\beta = -.003$, $p < .05$) negatively impact the funding amount. Unlike previous studies (De Larrea et al., 2019; Kromidha & Robson, 2016; Petitjean, 2018), which found that the total number of comments during fundraising was positively correlated with the total amount of funding, we discovered that the fewer daily cumulative comments and replies, the greater the daily funding amount.

Model 2 shows our main effects. Co-ideation has a positive and statistically significant coefficient ($\beta = .101$, $p < .05$), supporting hypothesis 1a. The more co-ideation comments the project receives, the higher the funding amount. One additional co-ideation comment increases the funding amount by 10.62% on a given day. Co-evaluation also positively impacts the funding amount ($\beta = .076$, $p < .05$), providing support for hypothesis 1b. One additional co-evaluation comment increases the funding amount by 7.89% on a given day. We found no effect of co-design ($\beta = -.041$, $p > .05$) on the funding amount. Thus, hypothesis 1c is not supported.

Model 3 shows the interaction effect. The results support hypothesis 2a, that the impact of co-ideation on the number of backers is higher for co-ideation comments posted long before the project ends ($\beta = .005$, $p < .05$). We found no support for hypotheses 2b and 2c. There is no significant effect of the interaction between co-evaluation and the days left in the campaign ($\beta = .001$, $p > .05$). The interaction of time of comments and co-design is not in the direction we expected, as the impact of co-design on the number of backers is lower for co-design comments posted long before the project ends ($\beta = -.035$, $p < .05$).

TABLE 6 Robustness check (alternative dependent variable: percentage success).

Independent variables	Model 1 Control variable	Model 2 Independent variable	Model 3 Interaction effect
Control variables			
Updates	0.409*** (0.039)	0.360*** (0.041)	0.361*** (0.041)
Funding Goal	−0.002*** (0.001)	−0.002*** (0.001)	−0.001** (0.001)
Cumulative Funding	−0.002* (0.001)	−0.001 (0.001)	−0.001* (0.001)
Cumulative Comments and Replies	−0.003*** (0.001)	−0.004*** (0.001)	−0.001** (0.001)
Independent Variables			
Co-Ideation		0.101** (0.045)	0.012 (0.074)
Co-Evaluation		0.076*** (0.026)	0.058 (0.036)
Co-Design		−0.046 (0.119)	0.466*** (0.150)
Days Left in the Campaign			0.017*** (0.002)
Interaction			
Co-Ideation × Days Left in the Campaign			0.005** (0.003)
Co-Evaluation × Days Left in the Campaign			0.001 (0.001)
Co-Design x Days Left in the Campaign			−0.035### (0.009)
Fixed Effects			
Project	Yes	Yes	Yes
N (observations)	7254	7254	7254
N (projects)	446	446	446
R^2	0.019	0.023	0.039
Prob > *F*	0.000	0.000	0.00

Note: The dependent variable is *Log Percentage Success* (funding amount divided by the funding goal). Model 1 includes the control variables. Model 2 incorporates control variables and independent variables: co-ideation, co-evaluation, and co-design. Model 3 contains control variables, independent variables, and the interaction of independent variables with time of comments. Dependent variable is the natural log of *Percentage Success* (funding amount divided by the funding goal). Robust standard errors clustered at the project level are in parentheses. *Co-design*, daily number of co-design comments; *Co-evaluation*, daily number of co-evaluation comments; *Co-ideation*, daily number of co-ideation comments; *Cumulative Comments and Replies*, the accumulated number of comments from backers and replies from project initiators that the project has received on each particular day; *Cumulative Funding*, the cumulative funding amount for each project in 1000 USD; *Days Left in the Campaign*, the time the co-creation comments was posted, measured in number of days left before the project ends; *Funding Goal*, the amount of funding goal for each project in 1000 USD; *Updates*, daily number of updates for each project.

***$p < .01$; **$p < .05$; *$p < .1$; ###$p < .01$ regression coefficient signs are different to those hypothesized.

4.3 | Robustness checks

As robustness checks, a panel data regression with a fixed effect model was conducted with an alternative dependent variable, Log Percentage of Success, to check the robustness of our regression result. The percentage of success is the total funding amount divided by the funding goal of each project, where 100% equals the amount initially requested. Previous studies also use this measure as a crowdfunding performance indicator, for example, Mollick (2014), De Larrea et al. (2019). The results in Table 6 support the robustness of our findings by providing similar results.

In addition, we conducted an additional robustness check by incorporating lagged independent variables in our fixed effect panel data regression model, to mitigate the potential endogeneity concerns in our study (Zaefarian et al., 2017). Furthermore, by including lagged co-creation comments as independent variables, we can capture the temporal dynamics of backers' interaction and collaboration leading up to crowdfunding outcomes. These lagged variables account for the fact that engagement and backers' involvement may not immediately translate into changes in crowdfunding performance; instead, their impact might also manifest over time. Considering the historical pattern of co-creation comments and their influence on subsequent funding amounts will provide a more comprehensive perspective on how backers' interactions contribute to the overall crowdfunding performance. The results of the additional robustness check in Table 7 are consistent with our initial findings.

5 | DISCUSSION

Our findings demonstrate that not all types of co-creation comments impact crowdfunding performance equally. Results show that while co-ideation and co-evaluation have a positive relationship with the daily funding amount, this effect does not hold for co-design. The number of co-ideation comments reflects a general interest in the project and additional suggestions espoused in co-ideation comments signal additional breadth to the original project description. The co-evaluation comments provide critical appraisals of the project and

TABLE 7 Robustness check (fixed effect with lagged variables).

Independent variables	Model 1 control variable	Model 2 independent variable	Model 3 interaction effect
Control variables			
Updates	0.411*** (0.042)	0.406*** (0.042)	0.364*** (0.044)
Funding Goal	−0.001 (0.002)	−0.001 (0.002)	−0.001 (0.014)
Cumulative Funding	−0.001*** (0.001)	−0.001** (0.001)	−0.001** (0.001)
Cumulative Comments and Replies	−0.003*** (0.001)	−0.004*** (0.001)	−0.001* (0.001)
Independent variables			
Co-Ideation		0.057** (0.028)	0.060 (0.064)
Co-Evaluation		0.054*** (0.018)	0.023 (0.038)
Co-Design		0.126 (0.186)	0.633** (0.321)
Days Left in the Campaign			0.011*** (0.001)
Interaction			
Co-Ideation × Days Left in the Campaign			0.001** (0.003)
Co-Evaluation × Days Left in the Campaign			0.001 (0.001)
Co-Design x Days Left in the Campaign			−0.038## (0.020)
Fixed effects			
Project	Yes	Yes	Yes
N (observations)	7254	7254	7254
N (projects)	446	446	446
R^2	0.019	0.022	0.022
Prob > F	0.000	0.000	0.00

Note: The dependent variable is *Log Funding Amount*. All independent variables are lagged. Model 1 includes the control variables. Model 2 incorporates control variables and independent variables: co-ideation, co-evaluation, and co-design. Model 3 contains control variables, independent variables, and the interaction of independent variables with time of comments. Dependent variable is the natural log of daily *funding amount*. Robust standard errors clustered at the project level are in parentheses. *Co-design*, daily number of co-design comments; *Co-evaluation*, daily number of co-evaluation comments; *Co-ideation*, daily number of co-ideation comments; *Cumulative Comments and Replies*, the accumulated number of comments from backers and replies from project initiators that the project has received on each particular day; *Cumulative Funding*, the cumulative funding amount for each project in 1000 USD; *Days Left in the Campaign*, the time the co-creation comments was posted, measured in number of days left before the project ends; *Funding Goal*, the amount of funding goal for each project in 1000 USD; *Updates*, daily number of updates for each project.
***p < .01; **p < .05; *p < .1; ##p < .05 regression coefficient signs are different to those hypothesized.

help businesses understand the evaluation of a new idea as well as how backers appraise the idea. It offers confirmation of the original project description and substantiates co-ideation comments offered by backers. Together, it provides insights for would-be backers on how a project is perceived by others and gives direction to the project, for example, by emphasizing certain aspects while discarding or shelving others. Our results for co-ideation and co-evaluation extend previous studies, which found that the greater the exchange of signals between backers and the project initiators in a crowdfunding project, the greater the project's success. (Clauss et al., 2018; Cornelius & Gokpinar, 2020; Courtney et al., 2017; Kromidha & Robson, 2016; Petitjean, 2018; Wang et al., 2018).

In our study, co-design does not affect the funding amount, suggesting that expert comments do not influence crowdfunding performance. After careful consideration of our data, we found that a potential explanation for this non-effect could be that the majority of co-design comments did not stimulate conversations with other backers (although most were replied to by project initiators). This is very different from the co-ideation and co-evaluation comments, which elicited multiple comments from other backers. Another aspect to consider here is that co-design activities are very specific and require specialized knowledge to comprehend (Trischler et al., 2018), making it difficult for non-expert backers to weigh in or gauge the value of these comments.

Beyond the direct relationships between co-creation and crowdfunding performance, we engaged with the assumption that the timing of co-creation comments matters. Following Petitjean (2018), we argue that early co-creation comments may be more influential in building daily backer buy-in as they reflect the immediacy of the interest a project receives. As the number of backer comments builds up over time, the value of additional comments may suffer from diminishing returns as they become, for example, more repetitive or start to explore more peripheral aspects of the project description.

Our related findings show mixed evidence. Early co-ideation had a greater positive impact on crowdfunding performance, the timing of co-evaluation was shown to be non-consequential, while early co-design comments had a negative impact. First, for our result on co-ideation, our findings confirm previous studies where early-stage backer activity (in their case, the number of backers and funding amount) signals project legitimacy that minimizes the negative effects of asymmetric information (Petitjean, 2018). Given that early funders have little information about crucial elements of the project, the time profile of a project's backers may provide indicators of possible success (Davies & Giovannetti, 2018) and also have a positive signaling externality, which encourages herd behavior (Colombo et al., 2014). More specifically, for our study, we confirm that early co-ideation, where the broader potential of the initial project is added, functions to attract more funding than late co-ideation comments.

Interestingly, we did not find a time-variant effect for co-evaluation, highlighting that co-evaluation remains impactful by itself irrespective of the timing. A potential explanation for this non-finding could be that co-evaluation, given its focus on critical appraisal, would function to defuse some more radical suggestions in the early stage of the project, thereby reducing the perceptions of future scalability of the project. This process of bringing potential 'down to earth' may undermine additional backer buy-in at the onset of the project campaign. Another potential explanation of this non-finding could be that given the more general role of co-evaluation comments in signaling backers' appraisal of ideas, late-stage co-evaluation could be just as important as early-stage co-evaluation, especially as over time, a more shared consensus of what backers determine as desirable, feasible, and befitting may emerge (Russo-Spena & Mele, 2012).

Interestingly, we found that co-design comments impact crowdfunding performance more negatively if the co-design comments are posted at the start of the project campaign. A potential explanation for this counter-intuitive finding may be that a greater number of early-stage expert feedback could potentially signal a lack of expertise (Micheli & Gemser, 2016), especially if many product issues are highlighted by experts to be improved at the beginning of the project, when new projects receive fewer comments compared to at a later crowdfunding stage. A high number of early co-design comments could also signal that the initial project description is still underdeveloped, which raises doubt about the project team and the project readiness.

Overall, our results confirm previous findings that third-party signals (i.e., other backers' comments and contributions) are an important aspect that weighs in on crowdfunding performance. Our results also provide clear evidence that it is meaningful to conceptually separate the types of co-creation comments made by backers as they differentially influence crowdfunding performance. Moreover, our result also extends previous studies by showing that some comments made at the beginning of the crowdfunding campaign may be detrimental.

5.1 | Theoretical implications

Although recent studies have extensively examined the success factors of reward-based crowdfunding, little research has focused on the impact of co-creation on reward-based crowdfunding success. Previous studies on factors impacting funding performance focused on project characteristics such as project description (Mollick, 2014), reward type (Clauss et al., 2018), and funding type (Lagazio & Querci, 2018). Other studies have examined project initiator characteristics such as team composition (Frydrych et al., 2014) and entrepreneurial passion (Li et al., 2017). Yet another stream focused on the use of the media (Courtney et al., 2017) and social influences (Colombo et al., 2014; Kromidha & Robson, 2016).

With emerging interest in backers' characteristics and perceptions (Allison et al., 2017; Davis et al., 2017), our study is a timely inquiry into the specific actions of backers as they co-create the project notion as well as influence the perceptions of would-be backers in the crowdfunding arena. Therefore, our result contributes to the literature on crowdfunding performance by outlining how co-creation not only adds to the potential future development of products and services (see e.g., Hidayanti et al., 2018), but also provides an important signaling function to the broader community in terms of how the product or service is received. This study adds to the literature about signaling

(Spence, 1978) in crowdfunding by showing the type of comments (i.e., co-ideation and co-evaluation) that can increase crowdfunding performance. Previous research investigating comments as signals that reduce information asymmetries in the crowdfunding context only utilizes the number of backers' comments. Past research shows that a higher number of backers comments lead to a better success rate (Clauss et al., 2018; Courtney et al., 2017; Kromidha & Robson, 2016; Kunz et al., 2017; Petitjean, 2018). However, the type of comments the project initiators should ask for is still under-researched.

Furthermore, this research contributes to the literature on co-creation by measuring the impact of different types of co-creation activity. Past studies on the impact of customer co-creation in crowdfunding mostly considered co-creation a homogeneous activity (Kim & Hall, 2020; Mastrangelo et al., 2019; Zheng et al., 2018). In this study, we decompose co-creation into three categories: co-ideation, co-evaluation, and co-design, and show the type of co-creation activity that the project initiators should focus on. Moreover, to the best of our knowledge, this is the first study that empirically tests the impact of actual co-creation activities in the form of dialogues between actors in the context of reward-based crowdfunding. Previous studies about co-creation in crowdfunding analyze co-creation by interviewing the actors involved (Quero & Ventura, 2019) and measuring co-creation perceptually (Kim & Hall, 2020; Mastrangelo et al., 2019; Zheng et al., 2018). We answer calls to measure the impact of co-creation using more objective data to improve the validity of findings (Pee, 2016).

Finally, this study contributes to the literature about the timing of signals in crowdfunding. Past research shows that early investment is a critical factor in increasing the probability of a campaign's success as it signals the interest of early investors that minimize the negative effects of asymmetric information on adverse selection (Colombo et al., 2014; Davies & Giovannetti, 2018; Petitjean, 2018). Our study complements previous studies by indicating another factor that can be used to signal the projects' legitimacy to potential backers at a later crowdfunding stage (i.e., co-design comments). The study demonstrates that at a later stage of crowdfunding (when backers have formed a consensus on feasible ideas), expert feedback signals that the consensus has led the product development in the right direction and attracted potential backers.

5.2 | Practical implications

The findings of this study provide practical implications. First, project initiators can assign priority to the comments. A significant amount of time and effort is required to maintain relationships with backers (Stanko & Henard, 2016). The number of comments can sometimes be too much to handle for new ventures with limited resources. By knowing the type of comments that are most impactful for the project performance, organizations can focus on facilitating certain types of co-creation activities (i.e., co-ideation and co-evaluation) and proactively asking backers to give feedback or ideation about the project.

Second, the study demonstrates that the time these co-creation comments were posted matters to project performance. Project initiators are encouraged to proactively ask for co-ideation and co-evaluation comments early in the project and ask for co-design comments when the project is near the deadline. Currently, many entrepreneurs still do not use the comments and update features (Lipusch et al., 2020). We found very few project initiators who proactively ask for backers' feedback. By knowing the right time to ask for specific comments, project initiators can better plan their communication strategy before launching a crowdfunding project.

Third, the findings of this study can be used by crowdfunding platforms to improve the website features to enable backers and entrepreneurs to co-create more actively. Most crowdfunding platforms provide many features to inform project quality but minimal features to facilitate co-creation. An 'ideas voting' feature will be beneficial as it enables project initiators to know the preferred ideas without manually counting the co-evaluation comments. Another feature that should be implemented is comments tagging, which enables project initiators to display the most discussed co-creation comments on top of the comment section so potential backers can find the most interesting ideas more easily.

6 | LIMITATIONS AND FURTHER RESEARCH AVENUES

Although the study adds to our knowledge of co-creation in reward-based crowdfunding, it is not without limitations. First, this study only focuses on reward-based crowdfunding with an "All or Nothing" funding mechanism. Future studies may investigate crowdfunding projects with another funding mechanism, the "Keep it All" type, in which project initiators will obtain the money regardless of whether they successfully reach the funding goal. Future studies can also investigate co-creation in other crowdfunding types, such as equity crowdfunding.

Second, we found that co-evaluation comments can contain positive and negative sentiments. In this research, the sentiment of the co-evaluation is not measured. Previous studies found that backers' positive sentiment increases the likelihood of funding success (Courtney et al., 2017) and positively moderates the impact of the number of comments on funding success (Wang et al., 2018). A future study might investigate whether the negative sentiment in the co-evaluation comments might decrease the funding amount.

Third, future studies should explore the impact of different project initiators' replies on backers' co-creation comments. A previous study found that project initiators' reply length and reply speed to backers' comments positively impact crowdfunding success (Wang et al., 2018). However, the study measured the project initiators' replies toward general comments, not specific to co-creation comments. It would be interesting to know how project initiators should reply to co-creation comments to achieve funding success.

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DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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