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ENTREPRENEURIAL DISAPPOINTMENT:
LET DOWN AND BREAKING DOWN, A MACHINE-LEARNING STUDY

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ENTREPRENEURIAL DISAPPOINTMENT: LET DOWN AND BREAKING DOWN, A MACHINE-LEARNING STUDY

Despite its importance, our understanding of what entrepreneurial disappointment is, its attributions, and how it relates to depression is limited. Drawing on a corpus of 27,906 semi-anonymous online posts, we identified entrepreneurial disappointment, inductively uncovered its attributions and examined how depression differs between attributions. We found that posts with internal, stable, and global disappointment attributions (e.g., not fitting entrepreneurial norms) are, on average, higher in depression symptoms than posts with external, unstable, and specific disappointment attributions (e.g., firm performance). Our findings offer novel theoretical and methodological avenues for future research on entrepreneurs' affective experiences and mental health.

INTRODUCTION

> *"I've been trying to raise a pre-seed round and the amount of people ignoring us and not giving us decisive answers has thrown me into a pit of depression."* – Quote from our data

Because founding a venture involves setting hopes and expectations under conditions of uncertainty, disappointment is a highly relevant topic for entrepreneurship scholarship. Disappointment is prevalent (Schimmack & Diener, 1997), particularly in entrepreneurship, due to the uncertain conditions in which expectations are formed (Goel & Karri, 2006; Norem, 2001) and the limited control entrepreneurs have over outcomes (Kato & Wiklund, 2011). Researchers have invoked disappointment to explain different empirical findings (such as the adverse effects of entrepreneurs' identification with their ventures; Lahti et al., 2019), yet disappointment has not been defined and investigated in its own right in the literature on entrepreneurship (c.f., McGrath, 1995). Drawing on the extant psychology literature (Bell, 1985; van Dijk & Zeelenberg, 2002a, 2002b), we conceptualize entrepreneurial disappointment as *an entrepreneur's negative emotions and feelings of limited control concerning the unexpected disconfirmation of a desired condition*.

Disappointment is particularly interesting to study because the same disappointment-eliciting event can be attributed to different causes (Roseman & Smith, 2001), resulting in different outcomes. For example, an entrepreneur could attribute disappointment resulting from a poor funding outcome (as per the introductory quote), to the ignorance of investors, or their own shortcomings when pitching (among other things). According to Abramson et al. (1978), these causal attributions differ meaningfully, such that investors' ignorance is likely to trigger adaptive responses, whereas personal shortcomings can trigger maladaptive responses and lead to depression symptoms (Liu et al., 2015). Because there is no systematic investigation of the causes entrepreneurs attribute their disappointment to, nor the disparate associations those attributions might have with mental health, we do not know the nature of the link between entrepreneurial disappointment and depression. In this study, we specifically focus on entrepreneurial disappointment to examine *what causes entrepreneurs attribute their disappointment to* and *how different attributions of disappointment relate to depression.*

To study disappointment attributions, we draw on a corpus of 27,906 semi-anonymous online posts. We detect entrepreneurial disappointment within this big dataset, inductively identify disappointment attributions, and uncover symptoms of depression from text using machine learning. This article makes the following theoretical and methodological contributions to research on entrepreneurs' affective experiences and mental health.

First, we contribute to the literature on entrepreneurs' affective experiences by offering an initial nomological net of entrepreneurial disappointment. We define entrepreneurial disappointment and draw on the concept of causal attributions (Weiner, 1985) to examine how entrepreneurs explain their disappointment. These attributions challenge the taken-for-granted assumption that entrepreneurs evaluate their disappointment only in relation to firm failure (i.e., Khelil, 2016) to offer a more nuanced perspective. This nuanced perspective also demonstrates how disappointment attributions relate to depression differently, building on learned helplessness (Abramson, Metalsky, & Alloy, 1989; Peterson & Seligman, 1987) as a theoretical framework. Our findings indicate that, on average, depression symptoms are significantly more common in posts disclosing disappointment than those without disclosures of disappointment. However, we find that, when entrepreneurs attribute disappointment to factors that are internal, global, and stable, depression symptoms are significantly higher than when disappointment is attributed to causes that are external, specific, and temporary.

Second, we offer an early example of the usefulness of machine learning in entrepreneurship research. We developed a method to detect entrepreneurial disappointment as a discrete emotion within unstructured textual data, which can help move research on entrepreneurs' affective experience away from broad valence categories (i.e., positive and negative affect) and toward specific emotions that provide nuanced insights for predicting behavior (Foo, Uy, & Murnieks, 2015). Our study also highlights how future entrepreneurship research can leverage the advances in machine learning techniques to explore other aspects of mental health, such as post-traumatic stress disorder, bipolar disorder, and seasonal affective disorder (Coppersmith, Dredze, & Harman, 2014; De Choudhury et al., 2013; Reece & Danforth, 2017).

THEORETICAL BACKGROUND

In this section, we first build on disappointment theory (Bell, 1985) to explain the characteristics of entrepreneurial disappointment, why entrepreneurs might be particularly prone to experiencing disappointment, and why research on this specific topic is warranted. We draw on the wider body of literature on attributional styles and learned helplessness (Abramson et al., 1989; Peterson & Seligman, 1987) to explain how entrepreneurs might explain the causes of entrepreneurial disappointment and how variations in attributional style might relate to depression.

Entrepreneurial disappointment

Disappointment is a prevalent, discrete emotion that is neglected in entrepreneurship research. Disappointment theory (Bell, 1985) states that disappointment is an emotional reaction that arises from the discrepancy between an individual's expectation and a realized outcome. The greater the perceived discrepancy between expectation and outcome, the greater the disappointment. *Unexpectedness* is, therefore, a key dimension of disappointment. When individuals do not expect an outcome, they are ill-prepared to deal with the situation (Frijda, Kuipers, & ter Schure, 1989). *Desirability* and *control potential* over the outcome are also key dimensions of disappointment. This means that when individuals experience disappointment, they do not achieve something highly desirable, yet also feel that there is very little they can do to change the situation (i.e., their control potential is limited: van Dijk & Zeelenberg, 2002a).

Entrepreneurs are poised to experience a discrepancy between their positive perceptions of entrepreneurship and the realized outcomes, making them likely to experience disappointment. Entrepreneurs tend to have highly positive expectations and are considered prone to wishful thinking (Heger & Papageorge, 2018) and overconfidence (Wu, Matthews, & Dagher, 2007). Individual optimism is also exacerbated by steadily increasing collective optimism about entrepreneurship over the last decade (social contagion: Anglin, McKenny, & Short, 2018). Optimistic perspectives toward entrepreneurship have been increasing at national levels (Suàrez et al., 2020), and entrepreneurs are often represented as "victorious warriors" (Torrès & Thurik, 2019). Such positive representations make achieving entrepreneurial expectations highly desirable. By 'setting the bar too high' (Baron, Hmieleski, & Henry, 2012; Graves & Ringuest, 2018; Norem, 2001), the resulting overly optimistic expectations about entrepreneurship are unlikely to accurately reflect objective possibilities (Shepherd, Haynie, & McMullen, 2012). Instead, a discrepancy may arise between the entrepreneur's expectation and the realized outcome, leading to disappointment

Lastly, the uncertainty under which entrepreneurial expectations are formed (Goel & Karri, 2006; Norem, 2001) is also likely to widen the aforementioned discrepancy by increasing the unexpectedness of outcomes while, at the same time, reducing the control potential entrepreneurs have over them. Entrepreneurial expectations are formed in the mind of the entrepreneur as "future-focused subjective interpretations" (Wood, McKelvie, & Haynie, 2014, p. 253), yet uncertainty is at the core of entrepreneurship (McMullen & Shepherd, 2006). Because the outcome of the entrepreneurial experience cannot be known from the outset, expectations are built on incomplete knowledge (Wennberg, Delmar, & Mckelvie, 2016), leaving entrepreneurs ill-prepared to deal with any unexpected outcomes that may arise. While entrepreneurs are generally considered to have a high degree of decisional freedom (Benz & Frey, 2008; Hundley, 2001), their control over the outcome is limited due to constraints posed by customers, suppliers, advisors, business partners, laws, and regulations (van Gelderen, 2016). Entrepreneurs can also be ill-prepared themselves as a result of poor insight or planning (Lahti et al., 2019), lack of abilities and knowledge (Wu et al., 2007), or lack of self-knowledge (Cubico et al., 2010).

The uncertain conditions in which expectations are formed (Goel & Karri, 2006; Norem, 2001) and the limited control entrepreneurs have over desirable outcomes (Kato & Wiklund, 2011; Torrès & Thurik, 2019) suggest that disappointment is an important and potentially prevalent emotional experience in entrepreneurship. Despite its relevance, disappointment has received limited attention to date and we know little about how entrepreneurs explain their disappointment to themselves. Next, we draw on attribution theory and explanatory response styles as conceptual foundations to understand the perceived causes of entrepreneurial disappointment.

Causes of entrepreneurial disappointment

Disappointment is the subjective emotional experience of not meeting personal expectations and potential. While the discrepancy between expectations and outcomes triggers disappointment, people can *attribute* disappointment to different causes. Causal attributions describe how individuals explain outcomes to themselves (Buchanan & Seligman, 1995). For example, failing to negotiate a supply agreement with a large retailer may be disappointing for all entrepreneurs. Yet, the causes entrepreneurs attribute this disappointment to can vary. Some entrepreneurs might attribute the outcome to the “idiotic retailers”, whereas others might view their own lack of entrepreneurial skills as the cause of disappointment.

To explain these kinds of variations in an individual’s responses to negative events, Abramson et al. (1978) drew on attribution theory to postulate that individuals explain negative events along three different dimensions. The *personalization* dimension describes the extent to which people attribute an event to themselves or to external circumstances. The *permanence* dimension describes the extent to which individuals attribute the cause of an event to stable and persistent conditions or to unstable and changeable conditions. Lastly, the *pervasiveness* dimension describes the extent to which individuals attribute the cause of an event to global conditions that exist across contexts or to specific conditions that are relevant to distinct situations only.

In the context of entrepreneurial disappointment, personalization can be interpreted as the extent to which entrepreneurs attribute their disappointment to themselves; for example, their lack of abilities and knowledge (Wu et al., 2007), or to external circumstances such as product or service failures (Kato & Wiklund, 2011). Permanence can be interpreted as the extent to which the cause of entrepreneurial disappointment has been ongoing ever since the entrepreneur started his or her venture and its likelihood of continuing. For example, if entrepreneurs perceive themselves as lacking aptitude (Cubico et al., 2010), this is likely to continue in future entrepreneurial endeavors, whereas venture performance is changeable and may fluctuate (McGrath, 1995). Pervasiveness can be interpreted as the extent to which the cause of entrepreneurial disappointment is attributed to a specific entrepreneurial experience or to entrepreneurship in general. For example, conflicts between co-founders are likely to apply to a specific venture experience, rather than to entrepreneurship in general.

Because entrepreneurial disappointment has not been specifically examined in entrepreneurship research (c.f., McGrath, 1995), our understanding of entrepreneurial disappointment attributions is limited. While entrepreneurial disappointment has been mentioned in research (e.g., Cubico et al., 2010; Kato & Wiklund, 2011), the range of different subjective causes of disappointment has yet to be uncovered. We contend that it is crucial to examine the perceived causes of disappointment among entrepreneurs to elucidate what entrepreneurial disappointment is and the meaning it harbors. Thus, our first research question is: *What causes do entrepreneurs attribute their disappointment to?*

Depression as a correlate of entrepreneurial disappointment

In addition to postulating three dimensions of attributions, Abramson et al. (1978) also argue that individuals develop a particular way in which they explain events to themselves. These individually "*differing yet habitual ways of explaining bad events*" are called explanatory or *attributional styles* (Peterson & Seligman, 1987, p.241). As indicated in the quote, attributional styles are consistent across events and stable over time (Peterson, Luborsky, & Seligman, 1983). While some individuals explain negative events through causes that are external, unstable, and specific, others explain negative events through causes that are internal, stable, and global.

These two causal explanations determine the extent to which individuals experience feelings of helplessness and, subsequently, how they adapt to negative events (Abramson et al., 1989; 1978). When individuals attribute a negative event to internal, stable, and global causes, solutions to negative events might not seem possible. As a result, this style of attribution is associated with feelings of helplessness, which can undermine subsequent behavior, leading to passivity and withdrawal (Peterson & Seligman, 1987). Moreover, it can damage self-esteem (Peterson & Seligman, 1987). Due to the psychologically debilitating nature of this attributional style, it is associated with a *maladaptive response* (Peterson, Buchanan, & Seligman, 1995; Robins

& Hayes, 1995) which may make individuals more prone to developing depression (Liu et al., 2015). On the other hand, if individuals attribute negative events to external, unstable, and specific causes, the resulting helplessness is transient, circumscribed to a specific situation, and leaves the individuals' self-esteem intact (Peterson & Seligman, 1987). This attribution style is associated with an *adaptive response* because it relates to higher levels of motivation, perseverance, and achievement (Schulman, 1995), but lower levels of depressive symptoms (Robins & Hayes, 1995).

If entrepreneurs attribute their disappointment to external, unstable, and specific causes, such as a specific decision by a specific group of angel investors in an investment round, they might persevere and try harder when experiencing disappointment (Ucbasaran et al., 2013; van Dijk & Zeelenberg, 2002b). They are more likely to still believe that their actions influence the outcome, to be motivated, and to invest more energy. This way, disappointment has the potential to be adaptive as individuals pay more attention, try to understand the experience, and adapt (Frijda et al., 1989). As the introductory quote illustrates, an adaptive response might result in the entrepreneur feeling depressed. However, the depressive symptoms are more likely to be mild and temporary (Robins & Hayes, 1995), particularly if the negative outcome (i.e., not raising capital) was related to a specific event with limited implications for the entrepreneur's wider life.

However, if entrepreneurs attribute their disappointment to internal, stable, and global causes, for example, not possessing the necessary entrepreneurial characteristics, their response may be maladaptive. As an individual cannot easily remedy perceived ineptitude, they may feel helpless compared to other, successful entrepreneurs, which can result in lowered self-esteem (Abramson et al., 1989). Due to the iterative nature of the entrepreneurial process, there is ample opportunity for an entrepreneur to be reminded of and ruminate on a disappointment (Weinberger et al., 2018). In fact, if individuals repeatedly perceive a lack of control, the resulting emotional response may become maladaptive over time, resulting in depression (Roseman & Smith, 2001).

Research in affective neuroscience has indeed shown that disappointment activates areas of the brain that are also related to depression (Chua, Gonzalez, Taylor, Welsh, & Liberzon, 2009).

Due to different attributional styles, disappointment may relate heterogeneously to psychological outcomes. Yet, it is currently unclear how various attributions of entrepreneurial disappointment relate to depression. As such, our second research question seeks to probe the association between disappointment and depression: *How do different attributions of entrepreneurial disappointment relate to depression?*

METHOD

The limited prior theoretical and empirical development on entrepreneurial disappointment warrants an exploratory approach, similar to other studies on different attributions in entrepreneurship (e.g., Bullough & Renko, 2017). Our approach considers induction and deduction as complementary processes in theory progress and combines them (Wright, 2017). Inductively, we developed a foundation for conceptual clarity on entrepreneurial disappointment and, building on this foundation, we tested and clarified relationships between entrepreneurial disappointment, disappointment attributions, and entrepreneurs' depression.

Sample

A total of 27,906 semi-anonymous posts in online forums for startups were extracted for this research. The online forums included the Reddit group called "r/startups" (Reddit herein) and "Startups Anonymous" (Anon herein). This data is considered semi-anonymous because in Reddit "registered users can anonymously discuss various topics" (Sekulić, Gjurković, & Šnajder, 2018, p. 73) and Anon posts are advertised as entirely anonymous. While other forums were examined for inclusion in this research, no others were included because they lacked anonymity and/or self-disclosures. Unlike other forms of social media where self-preservation and social desirability biases and image concerns are high, such as Twitter and Facebook, the anonymity of Reddit and

Anon enable the candid self-disclosures of disappointment and mental health issues essential for this study. Numerous posts made on the forums confirmed the importance of utilizing semi-anonymous data for the present study. For example, one entrepreneur stated: “I’m petrified and I feel alone. Most days are spent with my stomach in knots wondering if this is going to work. God forbid I say that out loud or express a negative thought on a social media page though. Thank you guys so much for this place.” This sentiment was widely shared among the contributors to the forums: “it is really great to see you are not alone struggling with a startup, in a world where everyone *appears* to have success come easy”. Our level of analysis is individual posts. An outline of the steps taken in analyzing the data is depicted in Appendix A and is described in the following sections.

Measures

Disappointment. We captured the presence of disappointment with content analysis. Content analysis is a method for categorizing text for quantitative analysis (Krippendorff, 2004), common to the organizational sciences (Williams & Shepherd, 2017). We performed content analysis on a random selection of 14,504 posts from our dataset to detect entrepreneurial disappointment. We treated posts as units of meaning that harbor clues throughout the entirety of its text (Krippendorff, 2004). Our very first step was to ensure that each unit of meaning represented the experience of an entrepreneur. We examined whether the post under analysis was written by an entrepreneur, the intended subject of this research. Clues that the text was written by an entrepreneur were found in self-identifying statements such as “I am the solo founder of a startup that…” and from the context the text described, e.g., “we were pitching our idea…”.

Next, we developed three theory-based criteria (Marcatto & Ferrante, 2008; van Dijk & Zeelenberg, 2002b, 2002a) to detect the presence of disappointment in a post: 1) a negative affective state, 2) unexpectedness of not achieving the desired condition, and 3) perceived low control over the condition. Each post written by an entrepreneur was examined in the following way to determine the presence of disappointment. The first criterion was an unpleasant situational state, which involved evaluating the text to determine whether it disclosed an event or situation with a negative psychological impact on the entrepreneur. For example, the "hurt" mentioned in the following statement is indicative of the negative situational state: "*My family tells me to 'get a job' because they think physical labor = work, I act like I'm taking it as a joke but I know they really think that way and it hurts every time!*". The second criterion was unexpectedness, whereby the event or situation fell short of expectations and desired outcomes in an unanticipated manner. Often this was implied in the information provided in the post. For example, in the following excerpt, the entrepreneur's behavior (using credit) indicated that they had expected a positive outcome, but that reality had unexpectedly fallen short of their previous financial expectations: "*I maxed out my credit cards… Now I'm deep in credit card debt and have no way to build my prototype. My dream of changing the world is dying…*". Third, the text had to indicate that the author viewed the situation as being beyond their control. Perceptions of low control were communicated as powerlessness over key events, such as when other people or situations may be to blame for a negative experience. For example, in the following excerpt, the entrepreneur expressed powerlessness over his own ability to focus on work due to circumstances outside of his control (the things that "hold" him back): "*when you are an entrepreneur [sic], life does not cut you any slack ... I recently got diagnosed with a tumor ... when I sit down to work, I just stare at my computer screen, held back by all the things happening in my life*."

Each criterion received a dichotomous rating. Only posts that satisfied all three inclusion criteria of disappointment and were posted by entrepreneurs were classified as disappointment-related posts. To ensure reliability, a first coder (the first author) and a second coder (the second author) independently analyzed a random selection of 150 posts (over 10% of the corpus of manually-labeled posts). The accuracy of the coding (Cohen's *k*) was 73%, which is considered an acceptable level of interrater agreement (Graffin, Haleblian, & Kiley, 2016). Coding discrepancies were discussed and coding conflicts were resolved by refining and clarifying the criteria. A total of 974 posts met all criteria and were classified as containing entrepreneurial disappointment. Posts that did not meet all criteria are listed in Appendix B.

We detected the presence of entrepreneurial disappointment in the corpus by performing a supervised machine learning classification task. As a first step, we created a training set with the 974 posts containing disappointment and the 13,530 posts without disappointment based on the previously described content analysis. This corpus of 14,504 posts was employed to train a model to detect posts containing entrepreneurial disappointment and those that do not. We used Python's Natural Language Tool Kit and Scikit-learn libraries (Bird, Klein, & Loper, 2009; Pedregosa et al., 2012) to manipulate the text data, and employed a variety of standard machine learning algorithms to calculate the level of accuracy different algorithms achieved (c.f., Li, 1987). To do this, in accordance with best practice, we employed cross-validation techniques to select the best-performing algorithms (c.f., Shao, 1993; Yang, 2007). Specifically, we used a 5-fold cross-validation technique, which is a standard intensive resampling method that partitions the data into sections and tests in a progressive manner (Bengio, 2003). In other words, we partitioned our training set into five, then respectively trained and tested the algorithm on each partition. This technique allowed us to assess how accurately different algorithms predicted disappointment-related posts in relation to the pre-defined labels. Ultimately, the Logit Boost algorithm performed best, detecting disappointment-related posts with 88% accuracy on a hold-out sample. We therefore selected the Logit Boost algorithm (Friedman, Hastie, & Ribshirani, 2000), and later used it to predict the labels of the 13,402 posts not previously labeled. This resulted in the identification of a total of 2,381 posts containing disappointment.

Disappointment attributions is a categorical variable with five discrete types related to: self, norms (maladaptive categories), others, process, and performance (adaptive categories). To arrive at these attribution types the following steps were taken. While we describe this process as linear for readability purposes, the process was iterative, moving between and among the data and relevant literatures to refine the conceptual codes and types (Eisenhardt, 1989). The first author inductively analyzed 51% (n = 1,223) of the posts containing disclosures of disappointment to identify causal statements for the arising disappointment. Coding started by reading each post and assigning an initial conceptual code (Braun & Clarke, 2006) that captured how the entrepreneur explained the cause for their disappointment, for example, the shortcoming of a co-founder, discrimination by a venture capitalist, or financial performance below expectations. Each post was compared to the previous one. Additionally, all posts with a specific conceptual code were compared to each other to refine boundaries. When conceptual boundaries between codes became more established, a second coder (the third author) analyzed 100 hold-out posts (posts not previously viewed). Results of the two coders were compared, and coding differences were discussed until agreement was reached. Another round of double coding on a new hold-out sample (50 posts) followed, which resulted in excellent agreement between the two coders (92%). A single coder (the first author) analyzed the remaining posts. This effort resulted in five emergent types of entrepreneurial disappointment with ten codes: self (personal shortcomings), norms (societal esteem of entrepreneurs, discrimination in entrepreneurship), others (team, personal others, ecosystem others), entrepreneurial process (demands, lack of reward), and venture performance (interest in business, the performance of the business). Codes, frequencies, and emergent types are outlined in Table 1.

[Insert Table 1 About Here]

Next, to distill disappointment attributions that could provide theoretical explanations, emergent types were abstracted and consolidated into *attributional response styles*. To assign attribution styles, we used analytical procedures common in research on attributions to extract naturally-occurring attributions from diverse sources of data, such as interviews, essays, and political speeches (e.g., Henry, 2005; Peterson, Luborsky & Seligman, 1983), which are coded into abstract categories of theoretical interest. At this stage, as a team, we focused not on what exactly the entrepreneurs attributed their disappointment to, but on how we could synthesize these diverse attributions in theoretically-meaningful ways based on three core dimensions: personalization, permanence, and pervasiveness (Abramson et al., 1989). As a team, we reflexively considered how the data in each type described causal explanations that were, 1) attributed to the entrepreneur themselves or to external circumstances, such as others (i.e., personalization); 2) attributed to stable causes that were ongoing since starting this venture/becoming an entrepreneur or unstable causes that had changed over time, fluctuated, or had the potential to change (i.e., permanence); and 3) attributed to causes just to this specific situation or to causes widely applicable across entrepreneurial experiences and contexts (i.e., pervasiveness). Both permanence and pervasiveness refer to the generality of the attribution; however, permanence refers to generality across time, while pervasiveness refers to generality across situations.

We strictly examined all units of meaning within an attribution type to identify robust patterns of how attribution types exhibited the three dimensions of personalization, permanence, and pervasiveness with clear categorical boundaries. We paid careful attention to the language used by the entrepreneurs to discern the dominant dimensions of attribution types (Henry, 2005; Peterson et al., 1983). For example, at this stage, we clarified that some entrepreneurs express disappointment with them not fitting social norms, thus internalizing the cause of their disappointment, instead of being disappointed with social norms, which would indicate an external attribution. At this stage, we also engaged with literatures relevant to the five attribution styles to further clarify their dimensions. For example, research on social norms emphasizes that norms are slow to change (Morris et al., 2015), indicating that norms-related attributions were stable.

Examining each attribution type based on these dimensions resulted in two emergent attribution styles. The first style included self-related and norms-related attributions because they shared stable, internal, and global dimensions. Previous research suggests that this attribution style is likely to be associated with a maladaptive attributional response (Peterson et al., 1995; Robins & Hayes, 1995). The second attribution style that emerged from the analysis included others-related, process-related, and performance-related attributions because they shared unstable, external, and specific dimensions. Previous research suggests that this attribution style is likely to be associated with an adaptive attributional response (Peterson et al., 1995; Robins & Hayes, 1995).

Depression. Depression was detected via machine learning techniques. Specifically, we employed depression classifier software developed by Losada and Gamallo (2020). The classifier detects depression in text automatically from the words used (lexica) and the parts of speech. Traditionally, depression is diagnosed by mental health experts via symptom checking using symptom lists (i.e., the Diagnostic and Statistical Manual of Mental Disorders). Such symptom lists have limited application for the detection of depression from human text because a single symptom can be expressed in a wide variety of ways. In order to understand the “whole spectrum of the linguistic means ordinary people use to express depression” (Neuman et al., 2012, p. 20), expanded linguistic representations of symptoms have been created for accurate automatic depression detection in what is called a lexica approach. Losada and Gamallo’s (2020) combined multiple depression-specific lexica and extended them by searching for related synonyms, and complimented it with parts of speech tagging. This is an example of using machine learning to detect depression symptoms from how individuals employ language. The comparison of text from individuals with depression against controls indicates that depression presents in linguistically-distinguishable ways. One example of this is if the text is broken down to its linguist components, such as verbs, nouns, and adjectives, key statistical differences can be detected from speech. One of the linguist features of depression includes a statistically significant increase in the use of interpersonal pronouns, such as “I” (Rude, Gortner, & Pennebaker, 2004), “me”, and “my” (Eichstaedt et al., 2018).

Losada and Gamallo (2020) built on recent advances in data science that allow researchers to integrate lexica and linguist features for accurate detection of depression symptoms in small and large text. By using a lexicon and machine learning approach, Losada and Gamallo’s (2020) classifier achieved high accuracy in detecting signs of depression from Reddit posts (Losada & Gamallo, 2020), which is also one of the data sources in this research, suggesting a comparable context. Therefore, we applied Losada and Gamallo’s (2020) classifier directly to our data[1] to detect depression symptoms in our dataset.

The level of depression in our dataset followed a right-skewed distribution with many posts having no or little depression. To make inferences about the degree of depression in the data, we performed a log transformation to correct for skewness (Frederiksen, Wennberg, & Balachandran, 2016; Schuster, Nicolai, & Covin, 2018). Posts with depression greater than zero were used in this transformation (Draper & Cox, 1969) and observations without depression were not retained. However, in the instance where we examine differences in the presence or absence of depression (such as in the Chi-square test), we converted depression to a binary variable with zero signifying no depression symptoms and one indicating depression symptoms.

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[1] Analyses probing the validity of the measure are included in Appendix D.

Control variables

We included control variables in our regressions. We controlled for the source of the post (Anon and Reddit), and the word count as a precaution (c.f., Williams & Shepherd, 2017). Using the Linguistic Inquiry Word Count automated text analysis program (LIWC; Pennebaker, Booth, & Francis, 2007), which is a validated tool for aiding text analysis, we also controlled for the time orientation in posts (past, present, and future focus) because time perspectives correlate with mental health problems (van Beek et al., 2011).

RESULTS

Attributions of entrepreneurial disappointment

Our first research question asked about the attributions of entrepreneurial disappointment. The analysis of the data revealed five distinct attributions of disappointment from the entrepreneurs' perspective, illustrating the diversity of entrepreneurs' disappointment experiences. The attributions that emerged from our analysis are: *self-related, norms-related, others-related, entrepreneurship-process-related,* and *venture-performance-related* (see Table 1). Self-related and norms-related attributions were internal, stable, and global in their dimensions, while others-related, entrepreneurship-process-related, and venture-performance-related were external, unstable, and specific in their dimensions. These attributions are next explained in detail.

Self-related attributions. Self-related attributions of disappointment represented the *entrepreneur*'s personal ongoing shortcomings that they believed resulted in them not meeting their expectations throughout the venturing process. These internal attributions could trigger entrepreneurs questioning their identities, yet the entrepreneurs also perceived these behaviors, personality traits, and character flaws to be out of their control. One entrepreneur described self-related disappointment in relation to ongoing challenges with personal discipline and motivation applicable to the entire venturing experience:

> *I started my business 3 years ago as a sole proprietor and despite challenges, things are going well. One of my biggest challenges is my energy level - which I have to fight to keep high. Despite being 27, I have big ups and downs day-to-day with my energy. I believe this is a mix of some depression (never quite as busy as I'd like, have had some big downs, life in general), and discipline. I wish I could crank away at work from 8-5, but I often find my self loosing [sic] motivation and feeling sluggish.*

Entrepreneurs perceived their ongoing personal shortcomings as limiting their ability to reach their objectives or to perform the role of entrepreneur under different circumstances, thus driving disappointment:

> *Overcoming Perfection… This issue has stopped me many times from just releasing something that is good enough. Eventually, I'll give up on the product idea and abandon it (this has even happened with products I was making money on).*

Norms-related attributions. Entrepreneurs reported feeling disappointment because they did not fit with norms and, thus, experienced ongoing prejudice in their personal and professional lives across settings. Their role as an entrepreneur created ongoing disappointing experiences in their personal and romantic lives due to negative social perceptions of an entrepreneurial career broadly:

> *… men and women proudly mention they are a lawyers, doctors, etc. [sic] but with startup founders people have preconceived notions before getting to know you… it is best left to only mention once you start hitting it off over messages with someone, so people don't jump to conclusions and write you off before ever getting to that point.*

Norm-related disappointment included not only the *low societal esteem* of entrepreneurship in general but also not fitting the entrepreneur stereotype, both of which could lead to disappointment because they related to entrepreneurs' self-views. Indeed, norms-related disappointment was particularly common amongst entrepreneurs from demographic groups who did not fit the local norm of an entrepreneur, or who were not perceived to belong to the mainstream community of entrepreneurs. For example, female entrepreneurs repeatedly expressed grave disappointment in their romantic life because of the entrepreneurial stigma. As one entrepreneur concluded: "dating is impossible because I intimidate most men I'm attracted to."

These norms-related disappointments were experienced not only in entrepreneurs' personal lives but also in their entrepreneurial pursuits because discrimination in entrepreneurship activities also triggered feelings of disappointment about not fitting the prototypical entrepreneurial description. Entrepreneurs reported feeling disappointment because of discrimination and prejudice experienced in entrepreneurial activities due to a range of factors, such as gender, age, ethnicity, and physical appearance, that signaled "otherness", yet "I can't change my sex or my color". For example:

> *Being an Older Woman creating a Start-Up... In an industry where everyone expects someone running a tech start-up to be a) a guy b) the age Mark Zuckerberg once was when he came up with the idea for Facebook and c) living in the U.S… If you're a 54-year-old women, successful businessperson, who wants to enter a new sector, you can't expect the doors to open for you… why is it when it comes to funding, there's only one winner?*

Disappointment-inducing discrimination was also experienced by all entrepreneurs in relation to experience, education, and social capital. As one entrepreneur lamented:

> *Why is Silicon Valley obsessed with top-tier schools? If you're not from a top-tier school you have no network, no brand, no interest from investors or anyone important, no respect from startup recruiters, nothing… it seems impossible to make a connection or break into this mafia.*

Disappointment that was associated with not fitting norms was particularly noticeable in specific geographical regions (i.e., Silicon Valley) and within technology entrepreneurship, as the quotes above illustrate.

Others-related attributions. Others-related attributions of disappointment represented the failure of individuals to meet the expectations of the entrepreneur. This category of external attributions included disappointment resulting from *the entrepreneurial team, personally significant others,* and *individuals from the entrepreneurship ecosystem,* who no longer met the expectations of the entrepreneur and the needs of the specific venture.

Entrepreneurs were disappointed when team members, including potential team-members, failed to join the venture. More commonly, they were disappointed when current team-members fell short of the entrepreneurs' expectations by violating trust and demonstrating poor behavior or unsatisfactory effort. Numerous entrepreneurs expressed a longing for business failure due to high levels of disappointment in their co-founders and shared details of their changing circumstances:

> *Have you had [a] situation when you started project, were working on it about 2 years and some day [sic] your co-founder stopped to deliver anything valuable? It is [a] tough decision for me, but for [the] last 6 month that guy made just several bug fixes.*

Outside of the venture, entrepreneurs related disappointment to personally-significant others. Close ties are usually portrayed as helping entrepreneurs in their entrepreneurial pursuits, yet our results indicated that significant others were a notable source of entrepreneurial disappointment. Entrepreneurs experienced discord with their close social ties in regards to opportunity beliefs about the venture. The chasm was described as developing over time. For example, one entrepreneur explained that their persistence and tolerance for risk progressively exceeded what their parents deemed appropriate, leading to negative feelings of disappointment:

> *I have great parents … but they no longer believe in my start-up and think it is tearing me apart and this makes me very upset and depressed… They don't realize success takes a while and many iterations.*

Additionally, entrepreneurs related disappointment to the dissonance in others' affective commitment to their ventures. For example, one entrepreneur expressed disappointment in her friends when they failed to celebrate her entrepreneurial milestones:

> *… launched my beta last week. My friends have barely acknowledged it. We're all aspiring business owners & I feel they're so envious they can't be happy for me… it really hurts.*

Significant others also triggered feelings of disappointment by consciously or unconsciously disrupting the entrepreneur's venture efforts in unpredictable ways and generating family-to-work conflict. One entrepreneur, for example, related the lack of venture growth to the substance abuse of her significant other:

> *Trying to Run a Startup When Your Spouse is an Addict… The real primary reason I haven't spent so much as 1 day giving my business 100% is because I haven't had 100%*

> *to give. ... I am stunned at the amount of emotional and physical energy that simply living with an addict can bleed out of a person.*

The final person-related disappointment attribution involved the actors in the entrepreneurial ecosystem. These actors ranged from venture capitalists, to suppliers, government bodies, and consumers. This pattern was primarily underscored by a difference in interests and motivation between the entrepreneur and external agents, which led to what the entrepreneur deemed as disappointing behaviors. For example, one entrepreneur expressed his disappointment with the behavior of his customers by stating:

> *Most of my customers are idiots and I'd rather ignore them. But, I want that recommendation, and payment, so badly.*

Many entrepreneurs expressed disappointment due to less-than-satisfactory input from mentors and failure to gain funding because of a fault on the part of a funding agent. For example, one entrepreneur lamented that funding agents were unwilling to give him a "big break", which sent him into a disappointment-induced depression:

> *18 year old Cofounder of a startup, I've been trying to raise a pre-seed round and the amount of people ignoring us and not giving us decisive answers has thrown me into a pit of depression.*

Entrepreneurship process-related attributions. Aspects of the entrepreneurial process and the entrepreneurial role were also related to disappointment. The demands of entrepreneurship included a difficult and iterative process where entrepreneurs frequently made personal sacrifices and disappointment often resulted. Given this backdrop, the entrepreneurial process was viewed as driving temporary conflict and isolation in the social lives of entrepreneurs, which was also related to producing disappointment. The isolation-induced disappointment that entrepreneurs reported was multifaceted. Some entrepreneurs felt physically and financially isolated from their social groups during periods of their entrepreneurial pursuits. They were not able to socialize like their peers or were physically absent from locations where occupational socializing would be easy.

Other entrepreneurs expressed not feeling as if they had the time or energy to tend to social connections and contribute to meaningful relationships during their venture's busy periods, which made them feel disappointed with the entrepreneurial process. Entrepreneurs with families sometimes felt disappointed with having to maintain both roles and perceived that family and entrepreneurial success were mutually exclusive. Beyond disappointment with physical, occupational, and social isolation due to the entrepreneurial process, posts also expressed disappointment resulting from affective, interpersonal disconnection. Some entrepreneurs did not feel able to share their authentic emotions with others and felt emotionally isolated, leading to feelings of disappointment attributed to the entrepreneurial process. One entrepreneur described his disappointment with having to engage in surface acting as a means to retain the support and energy of others during the entrepreneurial process:

> *Am a struggling founder. Trying to screen my feelings and desperation from:– my wife (who is increasingly frustrated by lack of success, and concerned we don't have enough money for our new baby boy),– my cofounder (who I keep pushing and staying 'pretend positive' for),– my professional contacts…my family… myself.*

The entrepreneurial process was also related to a surprising lack of personal rewards, which entrepreneurs expressed with a sense of disappointment. This involved expressions of feeling increasingly weary of the difficulties or demands of entrepreneurship in relation to its rewards: surprise at the lack of fulfillment or loss of passion and motivation that occurred during the process. One entrepreneur reflected this sentiment of entrepreneurial-process-related disappointment in relation to the opportunity cost of the entrepreneurial endeavor:

> *Doubting if Startup life is worth the effort and mental pressure […] I loved the startup life[…] Now I have a team, product and small success. But now I'm looking at growing the company and realizing it is lot more commitment then I realized. Not just that I now have family, kids and other monthly expenses, but it seems like now I am on an emotional roller coaster. One part of me says to pull the plug and go back to secure job lifestyle.*

Venture-performance-related attribution. The final disappointment attribution was related to the (subjective) performance of the specific venture, which could fluctuate over time.

On the one hand, these attributions related to a lack of product-market fit and thus potential for failure. For example, one entrepreneur explained that they were "solving a big problem that no one would pay for*"*, which meant it was not sustainable in its current form. On the other hand, disappointment related to venture performance also included financial characteristics of the venture. For example, one entrepreneur explained that the financial return-on-investment from selling her profitable venture was less than what she could have earned as an employee:

> *After developing a good quality product, I started getting some revenue… I … sadly realized that, in the most plausible scenario, in 3 years from now… If I manage to sell the company… I'm left, after taxes, with not enough money to retire and I'd be looking for a job as I approach my 50's.*

However, these attributions to external factors were not only based on objective performance characteristics but also to not meeting subjective indicators of performance: "I'm making more money than ever but not growing … It's not satisfying at all."

In summary, the disappointment attributions expressed by entrepreneurs were phenomenologically diverse. Entrepreneurs attributed disappointment as self-related, norms-related, others-related, process-related, and venture-performance-related misalignments with expectations. These five disappointment types differed in their dominant causal explanation dimensions, representing two emergent attribution styles (outlined in the measures section). Our coding indicated that self- and norms-related disappointment types predominantly featured internal, stable, and global dimensions, which are characteristics of a maladaptive attributional response. Others-related, process-related, and venture-performance-related misalignments generally featured external, unstable, and specific causal explanation dimensions, which are characteristics of an adaptive attributional response (Peterson et al., 1995; Robins & Hayes, 1995).

Disappointment and depression

Statistical analysis

The second research question asked how different attributions of entrepreneurial disappointment related to depression[2]. We answered this question in two steps. First, we examined if there were indeed systematic differences in the distribution of depression symptoms (absence/presence) in posts that disclosed disappointment and other posts in our dataset (disappointment/not-disappointment) to understand if disappointment attributions relate to depression in the first place. Because these aforementioned variables include dichotomous categories, we estimated distribution differences with chi-square analysis, using the *gmodels* package in R. The 11,159 promotional and advertising-based posts were excluded from this calculation to produce a fair comparison within the dataset.

Second, we analyzed differences *between* disappointment attributions in the extent of depression symptoms they had by fitting a linear regression in R (OLS assumptions were met). We entered depression as the dependent variable and five controls in our model (the null model). Next, we included our independent variable so that each disappointment attribution was represented with binary vectors and firm performance served as a reference category.

Third, building on the null model, we included attributional response style as the independent variable. We empirically examined if the extent of depression symptoms differed significantly *between* the two overarching attributional response styles: internal-stable-global (associated with maladaptive response) and external-unstable-specific (associated with adaptive response). Attributional response was entered as a dummy variable whereby adaptive response was used as the reference category.

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[2] Descriptive statistics of study variables and a plot illustrating differences between disappointment attributions is provided in Appendix E and Appendix F respectively.

Statistical results

The chi-squared test indicated that there was a significant association between the presence/absence of depression symptoms and disappointment/not disappointment posts, $\chi 2(1, N = 14{,}336) = 29.19$, $p < .001$. Based on the odds ratio, the odds of an anonymous post containing symptoms of depression were 1.33(1.19,1.52) times higher when disappointment was disclosed. This means that, on average, depression symptoms were significantly more common in posts disclosing disappointment.

Regarding differences in the extent of depression between disappointment attributions, we found that compared to the control variables alone (Model 1, Table 2), adding disappointment significantly improved the fit of the model to the data and explained an additional 2.4% variance in the extent of depression, $F(4, 941) = 6.35$, $p < .001$. Compared to the reference group (performance), posts with disappointment attributed to norms ($\beta = 0.37$, $p < 0.01$) and to self ($\beta = 0.18$, $p < 0.05$), on average, had a greater extent of depression symptoms, $F(9, 941) = 18.87$, $p < 0.00$, Adj. $R^2 = 0.14$, as illustrated in Model 2. This indicates that the extent of depression differs significantly between disappointment attributions.

[Insert Table 2 Here]

Finally, compared to posts with disappointment featuring an adaptive attributional response style, posts with disappointment which featured a maladaptive attributional response style were significantly higher in the extent of depression ($\beta = 0.20$, $p < 0.01$), $F(6, 944) = 26.99$, $p < 0.01$, Adj. $R^2 = 0.14$. This model did not significantly worsen the fit from Model 2 (disappointment attributed to self, norms, others, process, and performance), indicating that our pattern of findings, based on the attributions that were inductively derived from the experiences shared in posts, is supported through the theoretical lens of attributions and attributional responses.

DISCUSSION

The results of the research suggest that entrepreneurs attribute their disappointment to the self, norms, others, the entrepreneurship process, and venture performance. Entrepreneurial disappointment was associated with a greater odds of presenting depression symptoms, and the extent of depression symptoms varied between disappointment attributions. The extent of depression symptoms was comparatively greater when entrepreneurs attributed the cause of disappointment to broadly internal, global, and stable attributions (self and norms), which is associated with a maladaptive response (Robins & Hayes, 1995). Depression symptoms were comparatively lower when disappointment was attributed to causes that were generally external, specific, and temporary (others, the process, or venture performance), which is associated with an adaptive response (Robins & Hayes, 1995). Figure 1 presents an overview of our framework of entrepreneurial disappointment attributions, relationships between attribution patterns and depression, and theory regarding the mechanisms behind these relationships.

[Insert Figure 1 Here]

Implications for research

This study has conceptual implications for research on entrepreneurs' affective experiences and methodological implications for broader entrepreneurship research on mental health and stigmatized topics.

Toward a nomological net of entrepreneurial disappointment

We extend research on entrepreneurs' affective experiences by offering an initial foundation for a nomological net of entrepreneurial disappointment, as a neglected discrete affective experience. We do this by defining entrepreneurial disappointment and explicating how it arises and with what it correlates. From this perspective, disappointment, disappointment attributions, and the correlates of disappointment can help us to more accurately portray entrepreneurs and entrepreneurship as a process.

Based on psychological research on disappointment, we define entrepreneurial disappointment as *an entrepreneur's negative emotions and feelings of limited control concerning the unexpected disconfirmation of a desired condition*. Despite its emergence in previous entrepreneurship research (e.g., Wu et al., 2007; Lahti et al., 2019), disappointment has until now been used without an explicit definition. Our definition allows scholars to distinguish entrepreneurial disappointment from other negative affective experiences that may have different effects on cognition and behavior. For example, grief arises from the discrete loss of something valued and, thus, unlike disappointment, it can be an emotionally extreme experience that is difficult to overcome psychologically or learn from (Shepherd, 2003). Consequently, by defining entrepreneurial disappointment, we enable construct clarity, which is important for examining the role and impact of different affective experiences in entrepreneurship moving forward.

This article offers a nuanced understanding of entrepreneurial disappointment's causal explanations, challenging assumptions of when disappointment occurs. Our study demonstrates that disappointment can arise from a wide range of attributions, ranging from the shortcomings of the self and others to discrepancies between expectations and experiences related to the entrepreneurship process, venture performance, and norms. In this regard, we challenge the taken-for-granted assumption that disappointment arises when ventures are not performing well (e.g., McGrath, 1995). Even when disappointment does relate to the performance of the venture, it is not exclusively because of *poor performance*. In fact, disappointment can arise even under conditions of objective financial success. For example, many entrepreneurs reported that their venture was performing well, but that they held expectations of grandeur (i.e., "…to be the next Steve Jobs"). Additionally, entrepreneurial disappointment arises not only at work but also in entrepreneurs' personal lives, for example from the lack of support from personally significant others or role conflict at work and in the personal domain.

These emergent disappointment attributions also challenge how entrepreneurs are portrayed. Entrepreneurs are often portrayed as proactive (e.g., Glaub et al., 2014), overly optimistic (Wu et al., 2007), wishful thinkers (Heger & Papageorge, 2018) or heroic figures (Torrès & Thurik, 2019). Our findings demonstrate that entrepreneurs can also be aware of their shortcomings as multidimensional human beings. Not only are they sometimes aware of their deficiencies, but when they attribute unexpected disconfirmation of a desired condition to their shortcomings, intense depression symptoms can arise because this challenges their self-views and can catalyze maladaptive responses (Peterson et al., 1995; Robins & Hayes, 1995). Thus, a more nuanced research approach could investigate entrepreneurs' shortcomings and valuable characteristics together to explore their interactions.

While previous research demonstrates the importance of norms that value and accept entrepreneurship (entrepreneurship rates; Stephan & Uhlaner, 2010), our findings further extend what we know about the role of norms by highlighting the challenges presented by norms for individuals who do not embody the characteristics of a prototypical entrepreneur. Aligned with research on norms and sanctions for not adhering to them (Morris et al., 2015), individuals in our study who did not fit the stereotype, particularly women, shared instances of discrimination within the entrepreneurship ecosystem, as well as in their personal lives in terms of establishing new (romantic) relationships. Norms are stable and pervasive in their impact (Morris et al., 2015), while individuals may have limited opportunities to change the aspects of the self that make fitting norms possible, such as gender (see Table 1). This is aligned with attribution theories suggesting that when individuals repeatedly perceive a lack of control, the resulting emotional response may become maladaptive over time, leading to mental health issues, such as depression (Roseman &

Smith, 2001). Our findings indicate that to cope with and to prevent further disappointment, entrepreneurs may detach socially and induce their own isolation. Ironically, entrepreneurs also expressed disappointment in the loneliness of entrepreneurship and from the perceived need to engage in surface acting around others to maintain personally and professionally important relationships (e.g., impression management). While entrepreneurs may change their behavior to cope with norms-related disappointment, this change is not necessarily productive for their mental health.

In our data, perceptions of not fitting norms were often linked to technology entrepreneurship and specific geographical regions (i.e., Silicon Valley). One potential explanation for this finding is the role of tight social norms in these environments (Gelfand et al., 2011). This type of entrepreneurship and these types of regions may have strong social norms in relation to what it means to be an entrepreneur and, as such, are less welcoming to those who do not conform to these norms, limiting diversity. The implication of this is that locations and types of entrepreneurship with loose social norms might be more welcoming to entrepreneurs of diverse backgrounds due to lower norms-related disappointment attributions.

We investigate depression as only one correlate of entrepreneurial disappointment. To extend this nomological net, additional mechanisms need to be examined to explicate relationships between entrepreneurial disappointment and other indicators of poor mental health, such as sleeplessness or suicidal thoughts. Furthermore, while we examine the relationship between entrepreneurial disappointment and depression through the lens of attributions and learned helplessness (Abramson et al., 1978), other mechanisms can also explain how disappointment and other indicators of poor mental health can be related. These include resource depletion and hindered recovery. On the one hand, entrepreneurial disappointment can increase resource depletion because entrepreneurs' self-views are closely aligned with their ventures (Fauchart &

Gruber, 2011), thus disappointment can be a threat to self-views. According to models of stress and coping (e.g., Lazarus, 1991), threats to self-views motivate individuals to suppress or regulate the negative emotions associated with such threats (Avero et al., 2003; Skinner & Brewer, 2002), which depletes resources (Baumeister et al., 1998). On the other hand, prolonged and repeated experiences of disappointment are likely to impair recovery because recovery of normal psychological and physiological resources occurs during respite from negative affective experiences (Meijman & Mulder, 1998). Thus, disappointment can potentially enhance resource expenditure while also hindering resource recovery, which jeopardizes health (Horwitz, 2015; Meijman & Mulder, 1998). Exploring these mechanisms in the future would further extend the nomological net of entrepreneurial disappointment.

Another way of extending our nomological net of entrepreneurial disappointment is to explore person-level differences and temporal factors that influence the relationship between entrepreneurial disappointment and depression. For example, dark personality traits may help individuals avoid depression amidst episodes of entrepreneurial disappointment. Individuals with narcissistic personality traits, for example, are more likely than others to attribute negative events to unstable and external causes (Ladd et al., 1997). The results of our study indicate that this kind of response style (adaptive) is related to fewer depressive symptoms amidst episodes of entrepreneurial disappointment. Further, our initial nomological net of entrepreneurial disappointment implies that investigating the factors that relate to more severe indicators of poor mental health, by examining how and when some entrepreneurs lack the resources to recover from cumulative episodes of disappointment (Vasumathi et al., 2003), would make a worthwhile contribution.

Our nomological net of entrepreneurial disappointment may also be extended to include learning. Arguably, the discrepancy between expectations and outcomes that catalyzes disappointment provides feedback to entrepreneurs that challenges their assumptions, leads to new insights, and highlights areas for improvement, thereby enabling learning (Carver & Scheier, 2001; Lerner et al., 2015). While disappointment is a negative emotion that is experienced as unpleasant, learning from the discrepancy that disappointment signals can enable adaptation and protect against other negative affective and depressive experiences. Indeed, entrepreneurial disappointment indicates that the entrepreneur has allowed their beliefs to be influenced by new information that has the potential to counterbalance the escalation of commitment and to encourage a change of direction, thus leading to better future performance (McGrath, 1995). These learning and development experiences resulting from disappointment are at least partially different from the learning associated with grief (e.g., Cope, 2011) because grief, in the entrepreneurship context, usually occurs after firm failure (Cope, 2011; Mantere et al., 2013). Disappointment can enable learning when the entrepreneur is still engaged in the process and can make changes based on learning in the current venture, thus potentially reducing the risk of firm failure and the associated grief.

Overall, by providing an initial nomological net of entrepreneurial disappointment as an emotional response that is prevalent during the entrepreneurial journey, we hope that future research can more accurately reflect entrepreneurs' experiences and allow them to balance the intense positive feelings of entrepreneurial passion and the experience of grief after a business failure. By focusing on entrepreneurial disappointment as a discrete emotion, we hope to stimulate future research that examines the outcomes of affect in more nuanced ways than possible with the current dominant approach. Research tends to focus on broad categories exploring "positive" or "negative" valence (e.g., Foo et al., 2015), yet affective experiences of the same valence do not drive entrepreneurial behavior in the same way (e.g., Williamson et al., 2019). For example, future research can examine how entrepreneurial disappointment relates to diminishing entrepreneurial passion through the increase of other negative emotions, such as sadness and anger (Levine, 1996; van Dijk & Zeelenberg, 2002a) and decrease of intense positive emotions (Collewaert et al., 2016), or limited creativity through depleted resources (Williamson et al., 2019). Future research can also build on our conceptual clarification of entrepreneurial disappointment as a discrete affective experience to examine when entrepreneurial disappointment occurs, what sequences of entrepreneurial disappointments lead to entrepreneurs exiting the venture creation process, and how entrepreneurs learn while still engaged in the process (Cope, 2011; Mantere et al., 2013).

Toward novel methods for studying mental health and stigmatized topics in entrepreneurship

We contribute to the broader entrepreneurship literature by opening up new avenues for future research on mental health and other stigmatized topics through novel techniques and data sources. As an iterative process (Bhave, 1994; Dimov, 2007), entrepreneurship is a difficult phenomenon to study due to the importance of social desirability and image protection for developing and maintaining legitimacy and accessing resources (Suchman, 1995). Thus, new and innovative research methods are required to investigate the entrepreneurship process, particularly in relation to mental health (Hill & Wright, 2001; Stephan, 2018) and other stigmatized topics because of the challenges "in gaining access to the empirical setting" (Biniari, 2012, p. 164).

This research detects entrepreneurial disappointment in textual data (see Appendix C for list of unique words for disappointment disclosure in textual data) and how it relates to depression through machine learning techniques from online posts that include candid self-disclosures on stigmatized topics (Saha & De Choudhury, 2017), which would otherwise be difficult to capture. As machine learning is only emerging in entrepreneurship research, we offer an early example of the usefulness of this novel method, particularly in relation to mental health. While our focus is on depression as one indicator of poor mental health, future entrepreneurship studies can leverage advances in data science to explore multiple other aspects of mental health. For example, established research in data science has demonstrated not only how depression, but also post-traumatic stress disorder, bipolar disorder, and seasonal affective disorder, can be accurately detected with data from social networks (Coppersmith et al., 2014; De Choudhury et al., 2013; Reece & Danforth, 2017). Instead of relying on disclosure of sensitive and stigmatized information through traditional methods, such as questionnaires, established machine learning techniques can analyze patterns of language use, user engagement, color, metadata components, and algorithmic face detection. Such techniques can be applied to data from online textual and image posts on diverse social networks, including Twitter, Facebook, Instagram, and Reddit, to detect emotions and mental health indicators. Thus, machine learning allows entrepreneurship scholars to examine mental health in new ways that are closer to the experiences of entrepreneurs.

Our findings indicate that online forums can also be used for interventions. Forums can serve as psychologically safe spaces and social support to enhance wellbeing due to their anonymity and the reduction of stigma. The online posts we analyzed suggest that entrepreneurs find it helpful to have a supportive online community to safely share mental health issues without the need to protect their image, to fit certain norms, or to protect relationships. This can include safely sharing issues related to depression, anxiety, and addiction to receive emotional support as well as access relevant information, as demonstrated by #DisabilityTwitter and other online communities (Hemsley & Palmer, 2016). Indeed, such interventions may be particularly relevant for social contexts with tight social norms that, as discussed above, may be less welcoming of diversity and thus enhance the severity of stigma and norms-related disappointment (e.g., Airhihenbuwa, Ford, & Iwelunmor, 2014). The impact of online forums on improving entrepreneurs' mental health across different contexts should be tested with future research to "reduce the suffering associated with" entrepreneurship (Shepherd, 2019, p. 217).

Implications for practice

The practical implications of this research are pertinent to media practitioners, educators, and entrepreneur role models who are responsible for transmitting the realities of the entrepreneurial career because beliefs about entrepreneurship held at the collective level influence entrepreneurs' expectations (Anglin et al., 2018). These professionals could help entrepreneurs to craft more realistic expectations, better manage their expectations, as well as offer accessible mental health support. While scholars have made progress in transmitting the low probability of entrepreneurship success, our research indicates that disappointment and poor mental health can be reduced by bridging the expectations-outcomes gap (van Dijk & Zeelenberg, 2002b) in relation to other aspects of entrepreneurship. This may be achieved by conferring the affective realities of entrepreneurship to entrepreneurship students (Jones & Underwood, 2017) and nascent entrepreneurs, and by engaging in affective preparation for the entrepreneurial experience (Shepherd, 2004). The above suggestions might help address the large majority of disappointment related to self, others, process and performance. To address norms-related disappointment, which occurred less frequently in our sample but with a significantly negative effect on entrepreneurs' mental health, the explicit and implicit rules about what is normal, desirable, and acceptable (Green, 2016) in entrepreneurship need to be challenged. Researchers and educators can contribute to this change by embracing the diversity among entrepreneurs (Davidsson, 2016) while also highlighting the darker sides of entrepreneurship. The findings of this research also imply that an adaptive response style may be beneficial for mental health when experiencing entrepreneurial disappointment. Interventions aimed at helping entrepreneurs reframe disappointment and identify external, unstable, and specific causes for disappointment (instead of internal, stable, and global causes) could be useful for reducing depression in entrepreneurship. Such efforts can contribute to preventing future mental health issues and reducing the global burden of mental health (WHO, 2014).

Limitations and future research

The findings of our exploratory study and its limitations offer a platform for fruitful future research in entrepreneurship. Regarding the link with disappointment and depression symptoms, the research design does not provide insight on causation. While entrepreneurs have been shown to be up to 30% more likely to experience depression than comparison groups (Freeman et al., 2018), the causal relation is not yet clear. Entrepreneurship may drive mental health issues (Stephan, 2018), but it is also possible that individuals with poor mental health are more likely to select into entrepreneurship (Johnson, Madole, & Freeman, 2018). Thus, the association between disappointment and depression could be in the opposite direction of what is proposed in this research, i.e., entrepreneurs experiencing depression may be more susceptible to disappointment. Future research is required to specifically test this relationship as well as the potential positive effects of disappointment for entrepreneurs' mental health. For example, future research is needed to explore how entrepreneurs may engage in sense-making, constructively grow (Funken, Gielnik, & Foo, 2018), and build resilience following disappointment in a self-curative manner.

While we offer an early example of the usefulness of machine learning for entrepreneurship research, we also acknowledge the limitations of the data and analyses used in this study. First, machine learning insights cannot yet replace analyses by clinical psychologists, and thus the depression measure employed in this research must be considered exploratory. Moreover, Reddit users are not representative of the general population and the data corpus does not allow us to describe the participants in detail. Pew Research Center report shows that, at least in the USA, Reddit users are predominantly male (67% of users), young (64% of users are under 29 years old), white (70% of users) and, by default, have high levels of digital literacy and internet access (Pew

Research Center, 2016). Thus, the experiences of entrepreneurs with different characteristics from Reddit users may not be fully captured in our analysis. At the same time, dominant discourses often describe entrepreneurship in masculine and youthful terms where women, minorities, and older individuals may not fit in (e.g., Gupta et al., 2009; Kautonen, Tornikoski, & Kibler, 2011). Our data potentially represents the experiences of individuals who more closely align with dominant norms of who is an entrepreneur. The link between norms-related disappointment and indicators of poor mental health may be stronger when investigating more representative samples. The potential that our data may represent the experiences of individuals who more closely align with dominant norms of who is an entrepreneur also explains why norms-related attributions appear less frequently in our corpus, compared to the other emergent attributions.

Second, while the anonymity provided by online forums, such as Reddit and Startups Anonymous, makes it possible to research stigmatized topics with potentially less social desirability and image protection bias, it also means that we cannot describe the participants in detail in relation to their industry, previous startup experience, and other background information nor can we gather self-reported insights that are theory-driven. This limitation is partially related to ethical challenges in internet research and how we addressed them. This research sought to minimize the risk of identity capture and disclosure, informed by the ethical considerations of respect (Wiles et al., 2008), harm, and valid ethical consent with data in the public domain (Snee, 2013; Stanford Encyclopedia of Philosophy, 2019). To protect the privacy of participants in this study, we anonymized the primary identity of participants at source. This means that at the point when data was obtained, the only information collected was the text excerpt in the post (i.e., not the pseudo-usernames, nor other activity made by the author that could reveal their identity). Therefore, no other pieces of data were collected (i.e., the source or date of the data). This conforms to the ethical suggestions put forward for best practice in internet research and scraping of personally identifiable information (c.f., Stanford Encyclopedia of Philosophy, 2019).

Additionally, we did not explicitly measure all attribution styles with their associated dimensions but, instead, synthesized emergent attributions based on three core dimensions as they were presented in the posts that entrepreneurs had shared for non-research purposes. Thus, not all attribution styles that are theoretically possible emerged robustly in our data. Instead, only two attribution styles emerged with theoretical saturation to be presented as robust patterns with theoretically significant meaning (Strauss & Corbin, 1997). For example, while it is theoretically possible for entrepreneurs to attribute their disappointment to internal, specific, and temporary causes, such as a night of poor sleep due to a cold, this attribution type emerged very rarely in our corpus of data, while internal, global, and stable attributions dominated disappointment related to the self. Thus, future research with more traditional methods can be useful to replicate and extend our findings by probing further into causal attribution styles with different dimensions. Additionally, future research can test the theorized explanatory mechanisms for the relationship between disappointment and mental health and their boundary conditions, and identify differences between entrepreneurs.

This research examined disappointment experience by an individual entrepreneur, yet disappointment can be felt within a team, or even by stakeholders. Investigating how disappointment attributions differ from different vantage points and how they interact is an interesting area for future research. For example, Garud et al. (2014) highlight that entrepreneurs are required to project the potential of their new venture idea and develop public expectations to build legitimacy and acquire resources. Yet, collective disappointment can form in the minds of stakeholders due to the entrepreneur's (perceived or objective) failure to meet these public expectations, leading to the withholding of resources, creating a negative spiral effect of entrepreneurial and stakeholder disappointment (Garud et al., 2014). An interesting extension of the present research in concert with that of Garud et al.'s (2014) is to explore the interactive effects in the manifestation of disappointment between entrepreneurs and different stakeholder groups.

We hope that our foundation for a nomological net of entrepreneurial disappointment will ignite nuanced research on the role of disappointment in the entrepreneurship process across levels of analysis. Future research is required to investigate the relationships between different attributions and individual plus venture correlates to extend the nomological net. For example, future research can further our understanding of entrepreneurial exit and failure by examining what series of disappointments with different attributions trigger loss of affective commitment and business exit. Ultimately, more research focusing on disappointment is required to examine the effects of different disappointment attributions across levels of analysis, recognizing that disappointment might have conflicting effects for the individual entrepreneur and the venture. For example, when does disappointment (and different disappointment attributions) positively influence the venture but negatively impact the life of the individual entrepreneur and vice versa?

Finally, we hope that our findings spark more research on the role of norm-related entrepreneurial disappointment and norms more generally in entrepreneurship not only within entrepreneurship ecosystems but also in entrepreneurs' personal lives. Norms-related entrepreneurial disappointment was most strongly linked with indicators of depression in posts[3], potentially due to the stable and global dimension of the attribution in a way that challenges self-views. Additionally, the entrepreneurs in our study shared instances of perceived discrimination based on their age, nationality, gender, and education within entrepreneurship ecosystems with potentially tight social norms (Gelfand et al., 2011). This finding calls for more research on the strength of social norms in entrepreneurship ecosystems and the potential solutions for individuals who do not fit the stereotype of who is an entrepreneur. For example, different ecosystems and types of entrepreneurship with loose social norms and more diverse entrepreneurs (e.g., social entrepreneurship; Estrin, Mickiewicz, & Stephan, 2016) may offer healthier and more positive pathways for entrepreneurial pursuits. More broadly, these disappointing experiences of discrimination call for broader research on the inclusiveness, diversity, and stigma within entrepreneurship ecosystems. Our findings that experiences of perceived discrimination are not confined to entrepreneurship ecosystems, but also occur in entrepreneurs' personal lives also call for more research on the personal implications of social norms and stereotypes in relation to entrepreneurship.

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[3] For example, the regression weight of norms is significantly higher than the weight of self, in relation to depression ($F_{1,941} = 4.76$, $p < 0.05$).

CONCLUSION

While entrepreneurship can bring satisfaction, it can also negatively influence entrepreneurs' mental health due to discrepancies between expectations and outcomes. In this study, we used 27,906 semi-anonymous online posts and machine learning techniques to define entrepreneurial disappointment, explicate its attributions, and examine the relationship between entrepreneurial disappointment and depression. We found that, on average, depression symptoms are significantly more common in posts disclosing disappointment than those without disclosures of disappointment. However, the extent of depression differs significantly according to what causes disappointment is attributed to. When disappointment is attributed to internal, global and stable causes (related to the self and norms), depression is significantly higher than when disappointment is attributed to causes that are external, specific and temporary (related to others, process, and performance). Building on our findings and novel use of data sources and machine learning techniques, we offer novel directions for future research on entrepreneurs' affective experience and mental health.

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TABLE 1
Emergent disappointment attribution types and dimensions

	Causal attribution of entrepreneurial disappointment			**Dominant attribution style**			**Associated attributional response**
Types	**Conceptual code**	**Description of code**	**Example quote**	**Pervasiveness (specific vs global)**	**Permanence (stable vs unstable)**	**Personalization (internal vs external)**	Type of attributional response
Self *n* = 131	Personal shortcomings *n* = 131	I realized that I have personal shortcomings that I did not expect, but that I cannot change either (e.g., personality traits)	*“My start-up is going well, but the more progress we make the more I learn my weaknesses and limitations as a human and a solo founder. I am not sure I’ll be cut out for this for the long term…I am too flawed.”*	Global	Stable	Internal	Maladaptive
Norms *n* = 70	Societal esteem *n* = 9	The ongoing prejudice I felt toward entrepreneurs (e.g., after telling someone I am an entrepreneur) was worse than I expected	*“Why are guys no longer interested in potentially dating you when they find out you are a startup founder? I’m a female founder… when interested guys find out that I’m a founder… it is like a light switch flicked off, and the interest is gone.”*	Global	Stable	Internal	Maladaptive
	Discrimination *n* = 61	The ongoing discrimination I experienced while doing business (e.g., discrimination toward my gender, ethnicity, physical appearance etc.) was worse than I expected	*“ I am a sole non-technical female founder. I could be shitting rainbows and unicorns out my ass (which I do, daily) and investors still won’t touch me with a stick.”*	Global	Stable	Internal	

	Causal attribution of entrepreneurial disappointment			**Dominant attribution style**			**Associated attributional response**
Types	**Conceptual code**	**Description of code**	**Example quote**	**Pervasiveness (specific vs global)**	**Permanence (stable vs unstable)**	**Personalization (internal vs external)**	Type of attributional response
Others *n* = 497	Team *n* = 319	My team (e.g., cofounders/employees) is no longer meeting my expectations	*"… boy does it pain me to fire people! Why do people bother to come work if they are going to treat it like an after school club?"*	Specific	Unstable	External	Adaptive
	Personal others *n* = 28	My family, close-friends and loved ones no longer support me as I expected	*"I have great parents … but they no longer believe in my start-up and think it is tearing me apart and this makes me very upset and depressed… They don't realize success takes a while and many iterations."*	Specific	Unstable	External	
	Ecosystem others *n* = 150	Agents in the business ecosystem (e.g., accountants, mentors, competitors, the government) no longer meet my expectations	*"If you're going to say you're going to help with fundraising, but don't reach out to any of your contacts… then you're just an asshole."*	Specific	Unstable	External	

	Causal attribution of entrepreneurial disappointment			Dominant attribution style			Associated attributional response
Types	**Conceptual code**	**Description of code**	**Example quote**	**Pervasiveness (specific vs global)**	**Permanence (stable vs unstable)**	**Personalization (internal vs external)**	Type of attributional response
Entrepreneurial process *n* = 235	Demands *n* = 184	The work demands of entrepreneurship (e.g., the workload, pace, working hours) were at times worse than I expected	*"My startup is killing my marriage.. we have a new son too.. and I am completely and utterly consumed by my startup. Every waking moment, every single thought, every single amount of brain space is occupied by how we can be successful."*	Specific	Unstable	External	Adaptive
	Lack of reward *n* = 51	The reward I get from entrepreneurial activities (e.g., satisfaction from being an entrepreneur) is no longer what I expected	*"What would I get out of it? Daily stress and sitting in front of a computer every day? Pride and reputation? Money? ... Is this really how I want to spend the rest of my life?!?? How is that at all fulfilling??"*	Specific	Unstable	External	
Venture performance *n* = 290	Interest in business *n* = 259	The interest in my business (e.g., customer demand for my product) is less than I expected	*"I raised a round 6 months ago and my startup is not picking up. The New York Fucking Times wrote favourably about it and users are still only trickling in… go crawl under a rock and die?"*	Specific	Unstable	External	Adaptive
	Performance of business *n* = 31	The financial performance of my business (e.g., turnover) is worse than I expected	*"A company I built went from making 1-2 million a year for eight years to 30k this year. I'm letting the company fold…."*	Specific	Unstable	External	

TABLE 2
Regression results for the extent of depression contrasted between disappointment attributions

Dependent variable	Depression extent					
Model number	Model 1		Model 2		Model 3	
	Estimate	*SE*	*Estimate*	*SE*	*Estimate*	*SE*
Intercept	-4.64 ***	(0.09)	-4.79 ***	(0.10)	-4.71 ***	(0.09)
Control variables						
Source (anon)[a]	0.17 ***	(0.04)	0.16 ***	(0.04)	0.17 ***	(0.04)
Word Count	-0.00 ***	(0.00)	-0.00 ***	(0.00)	-0.00 ***	(0.00)
Past focus	0.02 **	(0.01)	0.03 ***	(0.01)	0.03 ***	(0.01)
Present focus	0.04 ***	(0.01)	0.04 ***	(0.01)	0.04 ***	(0.01)
Future focus	-0.02	(0.02)	-0.01	(0.02)	-0.01	(0.02)
Disappointment attribution[b]						
Self			0.18 **	(0.07)		
Norms			0.37 ***	(0.08)		
Others			0.07	(0.05)		
Process			0.06	(0.05)		
Performance						
Attributional response style[c]						
Maladaptive response					0.20 ***	(0.05)
Adaptive response						
df (N)	945 (951)		941 (951)		944 (951)	
F-statistic	28.25***		18.87***		26.99***	
Adj. R^2	0.12		0.14		0.14	

This sample is comprised of human-classified disappointment posts only.

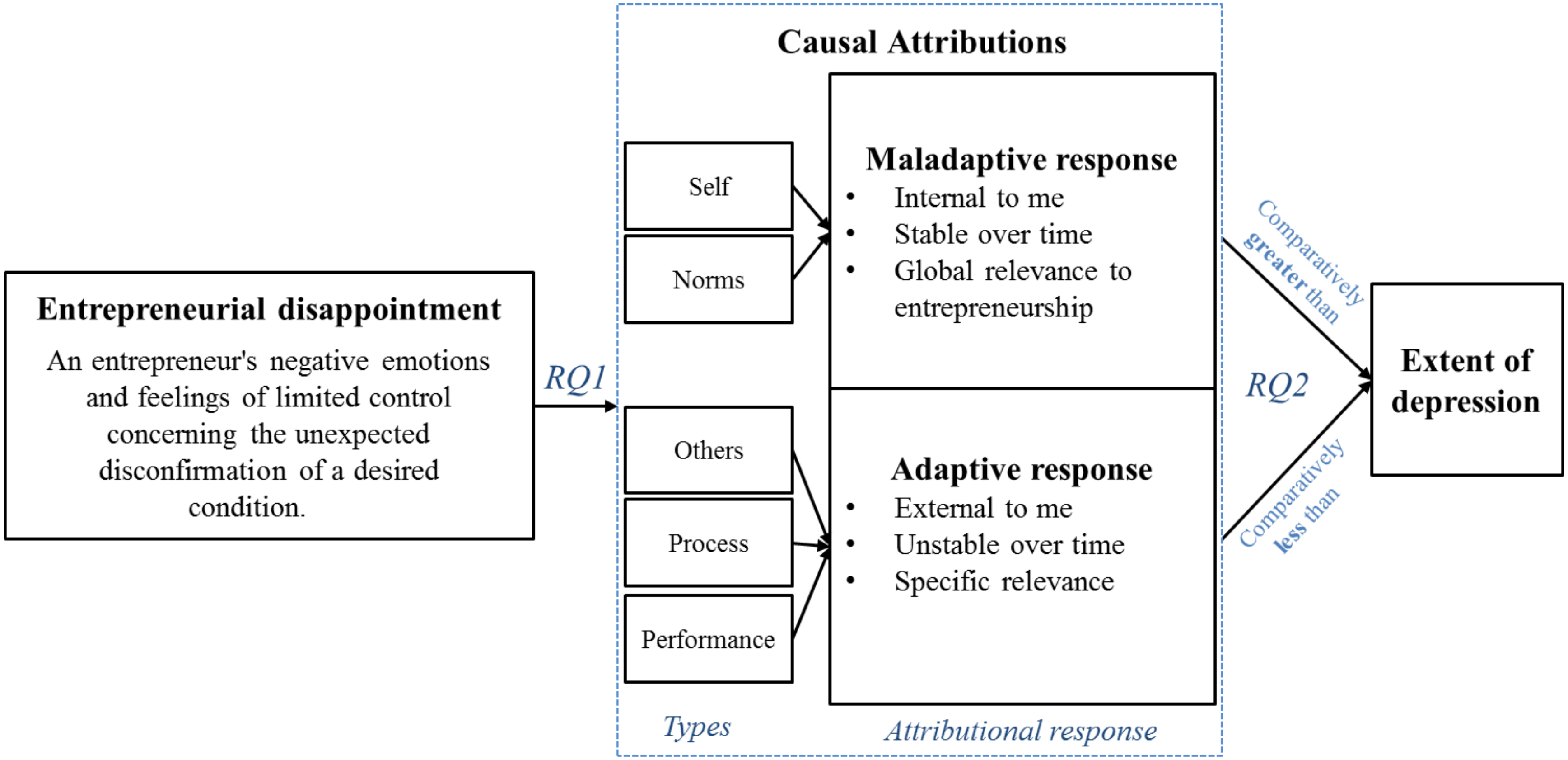
*Note. *, **, and *** indicate statistical significance at the 5%, 1% and 0.1% level, respectively. Estimates represent unstandardized regression weights.*

[a] *Reference category is Reddit.*

[b] *Reference category is performance.*

[c] *Reference category is adaptive response.*

FIGURE 1
Model of entrepreneurial disappointment, attributions and depression

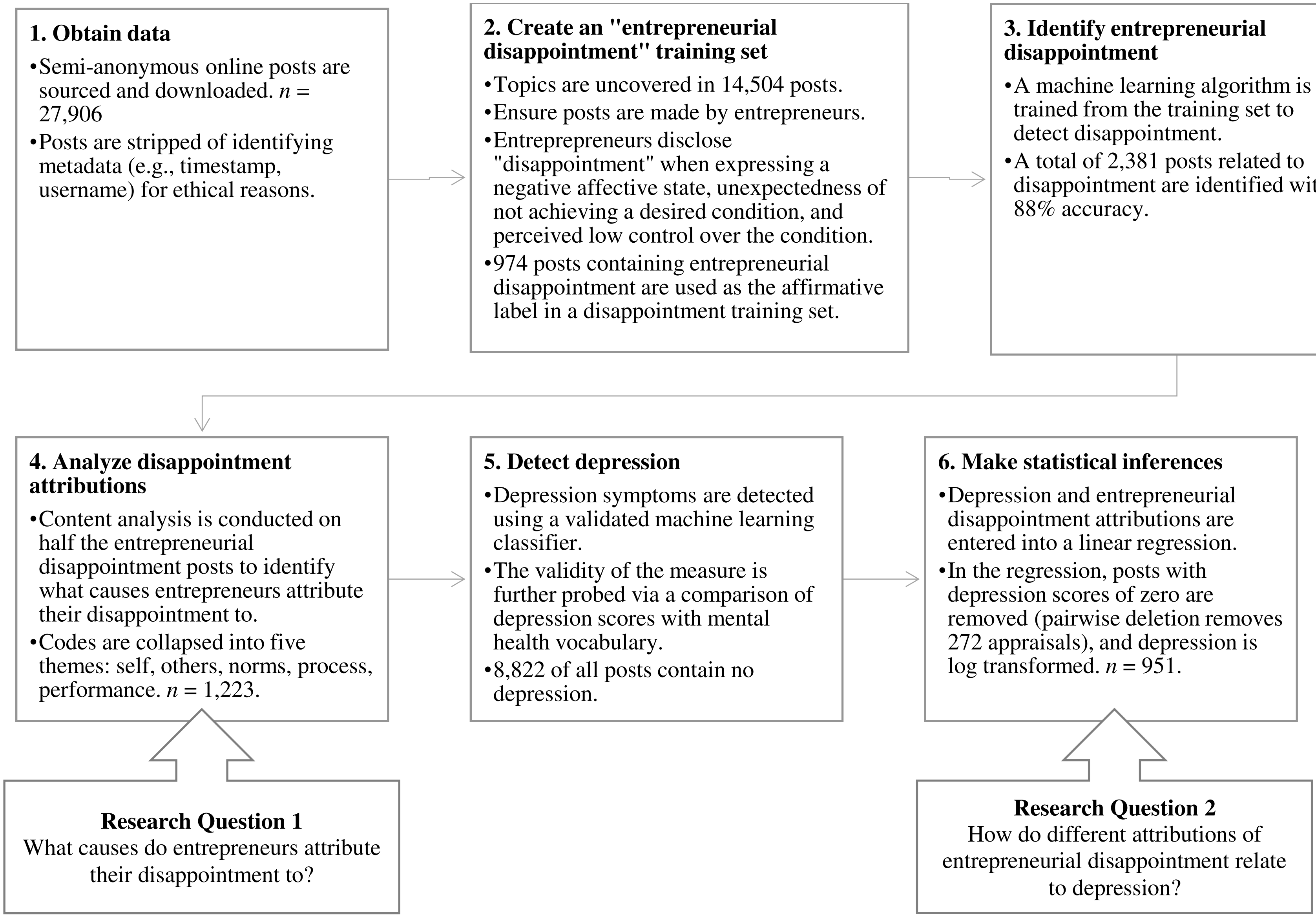


Causal Attributions
Entrepreneurial disappointment
An entrepreneur's negative emotions and feelings of limited control concerning the unexpected disconfirmation of a desired condition.
RQ1
Self
Norms
Others
Process
Performance
Maladaptive response
Internal to me
Stable over time
Global relevance to entrepreneurship
Adaptive response
External to me
Unstable over time
Specific relevance
Types
Attributional response
RQ2
Comparatively greater than
Comparatively less than
Extent of depression

-- APPENDICES --

APPENDIX A

Model of data analysis steps



1. Obtain data

- Semi-anonymous online posts are sourced and downloaded. *n* = 27,906
- Posts are stripped of identifying metadata (e.g., timestamp, username) for ethical reasons.

2. Create an "entrepreneurial disappointment" training set

- Topics are uncovered in 14,504 posts.
- Ensure posts are made by entrepreneurs.
- Entreprepreneurs disclose "disappointment" when expressing a negative affective state, unexpectedness of not achieving a desired condition, and perceived low control over the condition.
- 974 posts containing entrepreneurial disappointment are used as the affirmative label in a disappointment training set.

3. Identify entrepreneurial disappointment

- A machine learning algorithm is trained from the training set to detect disappointment.
- A total of 2,381 posts related to disappointment are identified with 88% accuracy.

4. Analyze disappointment attributions

- Content analysis is conducted on half the entrepreneurial disappointment posts to identify what causes entrepreneurs attribute their disappointment to.
- Codes are collapsed into five themes: self, others, norms, process, performance. *n* = 1,223.

5. Detect depression

- Depression symptoms are detected using a validated machine learning classifier.
- The validity of the measure is further probed via a comparison of depression scores with mental health vocabulary.
- 8,822 of all posts contain no depression.

6. Make statistical inferences

- Depression and entrepreneurial disappointment attributions are entered into a linear regression.
- In the regression, posts with depression scores of zero are removed (pairwise deletion removes 272 appraisals), and depression is log transformed. *n* = 951.

Research Question 1
What causes do entrepreneurs attribute their disappointment to?

Research Question 2
How do different attributions of entrepreneurial disappointment relate to depression?

APPENDIX B

Topics in corpus

Codes for non-disappointment posts related to three themes[4]. The first theme, most similar to disappointment, is “disclosing experiences”, which accounts for 1,630 posts. “Disclosing experiences” contains some of the attributes of the disappointment posts (but do not meet all criteria). For example, posts in this theme were made by non-entrepreneurs (such as by entrepreneurs’ loved ones, employees sharing a start-up experience), included the sharing of feelings that were not necessarily disappointment (e.g., regret), and a collection of other personal topics, such as broadcasting small wins. The second theme is promoting and advertising products and services, which related to a total of 11,159 posts. These posts often include links to external websites and clear marketing information. Finally, 741 posts related to basic feedback seeking around entrepreneurial activities and events. In these posts, entrepreneurs or aspiring entrepreneurs asked for feedback or advice from the community about entrepreneurial activities, rarely disclosing anything personal or emotional. Examples of these themes, together with an example of disclosing disappointment, are provided in Table B1.

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[4] Posts that were not written by entrepreneurs and did not meet the criteria of disappointment were classified as not containing entrepreneurial disappointment. The topics of these posts were identified using open coding techniques (Braun & Clarke, 2006) which involves freely coding text according to the themes that arise.

Table Appendix B1: Topics in corpus

High-level theme	Number of posts	Example post
Disclosing disappointment	974	First hire: close friend, turns out to be useless. What to do? After a long search we finally found what looked to be the perfect hire. A friend, (and the bf of my girlfriend's best friend), with a great resume. MBA and several AM-positions in tech…. he has pretty much failed in every task he has been given… Every single time me and my cofounder has have to step in and do what he was supposed to do, putting enormous pressure on us, … for our first hire we absolutely needed someone to take some load off us so that we could have room to grow… Had high hopes, turns out to be disaster…."
Disclosing experiences	1,630	"An angel investor approached me out of the blue and asked to invest in my bootstrapped startup… Through the grape vine, I guess an angel investor who has a significant background in the industry heard about the project/startup I'm working on and wants to invest. All my plans had revolved around bootstrapping the startup and working on it nights/evenings until it could comfortably sustain me. I now find myself in unfamiliar territory: thinking about investors, ownership and all that entails. The potential investor is generally very highly regarded in the industry and wants to invest $250K so that I can work on the project full time. He also said that he would use his connections to help me get some facetime with industry players that I might not otherwise have access to…. I'm a little lost.
Promoting and advertising	11,159	"Awesome deals at [site].com for startups. (Free $1000 in [Brand] payment processing…".
Seeking business feedback and advice	741	"Tips for Launching? I've been working on a subscription based tea service for the past couple of months and I'm ready to launch it but I've never launched a company before. What kind of things should I do to market it, get traffic and look out for?".

APPENDIX C

Keywords in disappointment posts

Disappointment keywords

Fail*
Hustler*
Minor*
Ringer*
Kill*
Tire*
Negoti*
Satisfi*
Gonna*
Deliveri*
Space*
Chore *
Shop*
Mentor*
Date*
Procrastin*
Failur*
Loner*
Uber*
Reject*
Firm*
Acceler*
Hindsight*
Patent*

Note. Top words were identified with a term frequency-inverse document frequency calculation (TF-IDF). TF-IDF calculates how often a word appears in disappointment posts, controlling for how common it is among the entire corpus of non-disappointment posts. Put another way, these top words are rare in the corpus while being common to disappointment attribution posts.

APPENDIX D

Mental health measure probing: Pattern of change

Background

To ascertain whether the depression score accurately follows the same pattern of change as related variables, we examined the relationship between the depression scores and sadness, the use of first-person singular pronouns, and similarity with posts found in depression-related forums. Sadness and first-person singular pronouns should have a positive relationship with depression because sadness often accompanies depression and depressed individuals use slightly more first-person singular pronouns (i.e., “I” and “me”) than non-depressed individuals. Similarly, posts written by depressed individuals should share vocabulary that is not found in posts written by non-depressed individuals. To examine the relationship between the depression score with the first two variables, we ran the data through the Linguistic Inquiry Word Count automated text analysis program (LIWC; Pennebaker, Booth, & Francis, 2007). LIWC is a validated tool for aiding text analysis. First-person singular pronouns and sadness words are counted and divided by the total number of words, resulting in an output between 0 and 1.

To compare the relationship between the depression score and depressed vocabulary, we created a classifier to identify vocabulary in Reddit posts related to poor mental health.

Analytical Procedure

We downloaded 7,962 posts from eight subreddits related to mental health disclosures (identified as “mental health subreddits” in research by Choudhury & De, 2014), and controlled for words found in subreddits that are not related to mental health, with 10,768 posts (full list found in Table D1). From these 18,730 posts, we were able to determine if a given post came from a mental health subedit or not with 80% accuracy using a Multinomial Naive Bayes Classifier. We applied this classifier to our data, and assigned a probability of the post to contain vocabulary similar to the mental health-related subreddits.

Table Appendix D1: Mental health vocabulary builder

SubReddits	
Mental health-related	*Not mental health-related*
Alcoholism	Askscience
Anxiety	Relationships
Bipolarreddit	Healthanxiety
Depression	Writingprompts
Mentalhealth	Teaching
MMFB	Socialanxiety
Socialanxiety	Writing
SuicideWatch	Parenting
	Panicparty
	Atheism
	Christianity
	Showerthoughts
	Jokes
	Lifeprotips
	Writing
	Personalfinance
	Talesfromretail
	Theoryofreddit
	Talesfromtechsupport
	Randomkindness
	Talesfromcallcenters
	Books
	Fitness
	Askdocs
	Frugal
	Legaladvice
	Youshouldknow
	Nostupidquestions

These three variables were entered into a regression with the depression score as the dependent variable, as illustrated in Table D2. To correct for the right skew of sadness, we conducted a log transformation on sadness before running the regression. The pairwise removal of sadness variables with zero values from the dataset resulted in a reduced sample size for this analysis (*n* = 4,970).

Results

The coefficients of vocabulary similarity, sadness, and first-person pronouns were all significant, F(3,4966) = 184.93, p = 0.00. This indicates that as depression-forum vocabulary similarity, expressed sadness, or first-person pronoun percentage increase, the depression score also increases, thus suggesting the depression score follows a similar pattern of change to related variables.

Table Appendix D2: Regression results for depression measure pattern consistency test

Depression measure	β	95% CI [LL, UL]	r	Fit
(Intercept)	-4.42**	[-4.47, -4.37]		
Vocabulary similarity	0.27**	[0.18, 0.37]	.01	
Sadness words	0.18**	[0.16, 0.20]	.28**	
First person singular pronoun	0.02**	[0.02, 0.03]	.20**	
				Adj. R^2 = .100 95% CI[.09,.12]

Note. Dependent Variable: Degree of depression, with a log transformation, only retaining non-zero values. *n* = 4970. *LL* and *UL* = lower and upper confidence interval limits. Significance denoted by * and ** at the < .05 and < .01 level. *r* signifies the zero-order correlation.

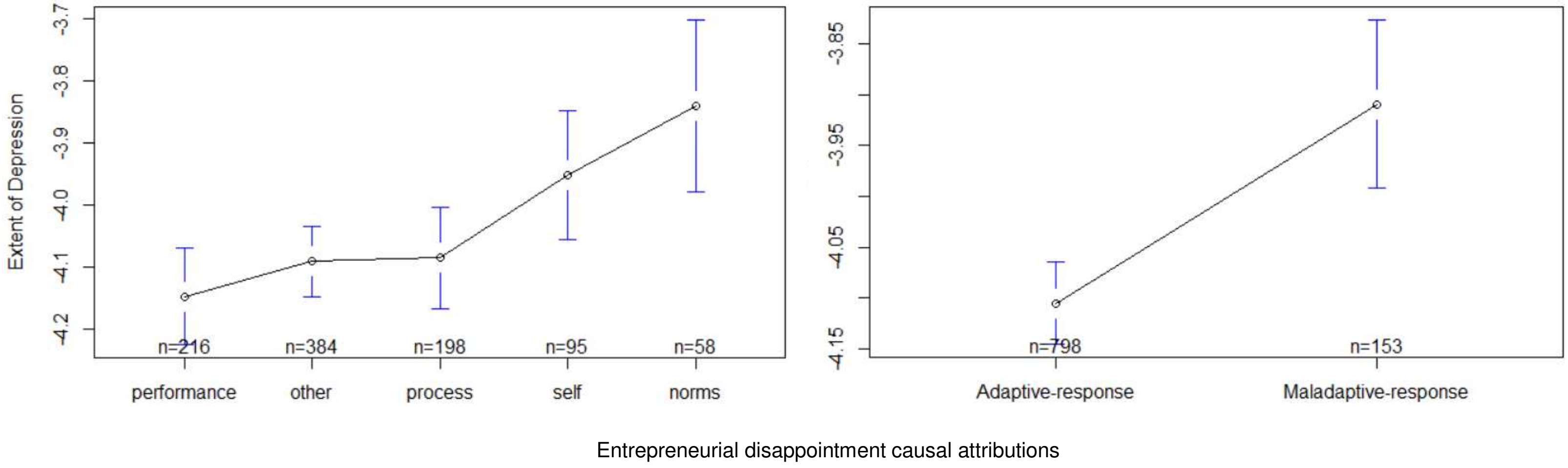
APPENDIX E

Descriptive statistics and correlations

		M	SD	min	max	1	2	3	4	5	6
1	Depression	-4.07	0.57	-6.17	-2.01						
2	Word count	398.70	490.36	13	4919	-0.24***					
3	Past focus	3.56	2.61	0	18.75	-0.03	0.08*				
4	Present focus	12.52	3.90	0	30.77	0.23***	-0.24***	-0.51***			
5	Future focus	1.18	1.04	0	9.09	-0.03	0.07*	-0.16***	0.12**		
6	Source: Reddit†	0.50	0.50	0	1	-0.24***	0.30***	-0.07*	-0.13**	0.02	
7	Maladaptive disappointment attributions†	0.16	0.37	0	1	0.13**	-0.05	-0.12***	0.01	-0.08*	-0.01

† Represents dummy coded variable. Past, present, and future focus, and word count is estimated from LIWC calculations. Total number of words in the dataset is 5,374,432, or approximately 7,000 pages of A4 single-spaced text.
*, **, *** signify significance at the 10%, 5%, and <1% level. Data-subset used for correlation matrix, n = 951.

APPENDIX F
Differences in means of depression extent, by causal attribution groupings



Note. Disappointment attributions are discrete categories, such that each post (n = 951) is assigned only one causal attribution. The figure presents the mean scores in the extent of depression among the respective disappointment causal attributions with 95% confidence intervals. The left plot shows differences in the extent of depression between disappointment attribution *types*, and the right plot illustrates differences according to *attributional responses*. Depression is log-transformed. Non-positive scores of depression were removed during log transformation, accounting for 272 posts balanced over the different attributions.

APPENDIX G

Detailed regression results for the extent of depression contrasted between disappointment attributions

Predictor	*b*	*b* 95% CI [LL, UL]	sr^2	sr^2 95% CI [LL, UL]	Tolerance	VIF	Fit
Intercept	-4.79**	[-4.98, -4.60]					
Source (anon)	0.16**	[0.09, 0.23]	.02	[.00, .03]	.88	1.14	
Word count	-0.00**	[-0.00, -0.00]	.01	[.00, .03]	.86	1.17	
Past focus	0.03**	[0.02, 0.05]	.01	[-.00, .03]	.69	1.45	
Present focus	0.04**	[0.03, 0.05]	.05	[.03, .08]	.67	1.49	
Future focus	-0.01	[-0.04, 0.02]	.00	[-.00, .00]	.95	1.05	
Disappointment attributions[a]							
Self	0.18**	[0.05, 0.31]	.01	[-.00, .02]	.76	1.31	
Norms	0.37**	[0.22, 0.53]	.02	[.00, .04]	.81	1.24	
Others	0.07	[-0.02, 0.16]	.00	[-.00, .01]	.6	1.67	
Process	0.06	[-0.04, 0.17]	.00	[-.00, .01]	.65	1.53	
							Adj. R^2 = .145 95% CI[.11,.19]

Note. A significant *b*-weight indicates the semi-partial correlation is also significant. *b* represents unstandardized regression weights. sr^2 represents the semi-partial correlation squared. *LL* and *UL* indicate the lower and upper limits of a confidence interval, respectively. [a] indicates reference category is *performance*.

* indicates p < .05. ** indicates p < .01.