Journal of Business Venturing 40 (2025) 106468

Contents lists available at ScienceDirect

Journal of Business Venturing

journal homepage: www.elsevier.com/locate/jbusvent

# Angel funding and entrepreneurs' well-being: The mediating role of autonomy, competence, and relatedness

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ARTICLE INFO

*Keywords:*
Business angel investors
Entrepreneurs
Well-being
Psychological needs
Tweets
LIWC
Investor–investee relationship

ABSTRACT

While external funding is indispensable for most entrepreneurs to scale their ventures, entrepreneurship literature highlights the additional benefits of investors' continued involvement, such as access to their expertise and network. Angel investors, whose primary value-add often emerges through their relationship with the entrepreneurs, generate particularly pronounced benefits. Entrepreneurship research has established that bringing angel investors on board comes at the cost of relinquishing partial equity, which restricts entrepreneurs' control over their ventures; however, the individual-level consequences of funding for entrepreneurs remain largely unexplored. To address this gap, we study how angels' funding and their post-investment involvement in the venture affect entrepreneurs' eudaimonic well-being in the long term. Drawing on self-determination theory, we explore further how the psychological need for autonomy, competence, and relatedness mediates the relationship between angel funding and entrepreneurs' well-being. Self-determination theory states that individuals' verbalized language reflects their needs; accordingly, we use Linguistic Inquiry and Word Count (LIWC) analysis on a unique dataset of almost 125 million words derived from the tweets of 1667 entrepreneurs on X (formerly Twitter). As hypothesized, we find a positive association between angel funding and entrepreneurs' well-being. Autonomy negatively mediates this relationship, while competence and relatedness mediate it positively. We advance research on entrepreneurs' eudaimonic well-being and extend the literature on self-determination theory and individual-level consequences of angel funding.

*Executive summary:* Entrepreneurs often face a difficult trade-off: They must decide whether to accept funding from angel investors or relinquish some control over their venture. While much research centers on the business implications of this trade-off (Davila et al., 2003; Politis, 2008), the personal impact on entrepreneurs' eudaimonic well-being remains underexplored (Collewaert and Sapienza, 2016). This knowledge gap is concerning because entrepreneurs' well-being closely relates to their ventures' performance (Stephan et al., 2020b; Wach et al., 2016).

Recent calls for research (Stephan et al., 2023) emphasize the need to understand how external factors, like investor involvement, affect entrepreneurs' well-being by influencing the extent to which their psychological needs for autonomy, competence, and relatedness are satisfied, as outlined by self-determination theory (SDT) (Deci and Ryan, 1985, 2000). Despite the recognized importance of these factors, the impact of angel investors, who often form close relationships with

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https://doi.org/10.1016/j.jbusvent.2024.106468
Received 4 September 2023; Received in revised form 3 December 2024; Accepted 9 December 2024
Available online 30 December 2024

entrepreneurs and engage deeply in their ventures (Fairchild, 2011; Politis, 2008), has been largely overlooked.

Our study addresses this gap by examining how angel funding and subsequent involvement influence entrepreneurs' eudaimonic long-term well-being. Using a dataset of 125 million words compiled from 1667 entrepreneurs' tweets on Twitter (now X) from 2006 to 2022, we apply Linguistic Inquiry and Word Count (LIWC) analysis to gain insights into the psychological states of these entrepreneurs (Block et al., 2019; Obschonka et al., 2017). This approach aligns with SDT, which posits that psychological needs fulfillment manifests in communication (Vansteenkiste et al., 2020).

Our findings reveal that angel investor involvement can significantly influence entrepreneurs' eudaimonic well-being—positively and negatively—by affecting entrepreneurs' psychological needs fulfillment. Our study thus complements research on entrepreneurs' well-being with longitudinal insights. First, it extends the literature on entrepreneurial well-being by providing a nuanced understanding of how angel funding and involvement, mediated by autonomy, competence, and relatedness, affect entrepreneurs' well-being over time (Stephan et al., 2023). Second, our study contributes to SDT literature by contextualizing investor involvement as an external factor and using large-scale social media data to assess entrepreneurs' psychological needs (Stephan et al., 2020a). Third, our study highlights the importance of the dynamics between angel investors and entrepreneurs, showing that such relationships significantly shape entrepreneurs' personal outcomes (Collewaert and Sapienza, 2016; Politis, 2008).

Beyond academic contributions, our study offers practical insights for entrepreneurs, angel investors, policy-makers, and universities by emphasizing the importance of understanding and managing the entrepreneurs' personal impacts of bringing angel investors on board.

## 1. Introduction

Establishing their ventures, most entrepreneurs face a trade-off that Wasserman (2008, para. 8) describes as 'The Founder's Dilemma' in a Harvard Business Review article: To finance growth, they "invite […] angel investors, or venture capital firms to invest in their companies. In doing so, they pay a heavy price: They often have to give up total control over the enterprise."

However, so far, the literature has only one-sidedly considered this trade-off between receiving funds and ceding control: While research extensively covers the implications of raising equity funding and investors' subsequent presence on a venture level (Davila et al., 2003; Politis, 2008), it has barely explored the individual-level consequences for entrepreneurs, particularly the impact on their well-being (Collewaert and Sapienza, 2016). This is troublesome, as studies show that entrepreneurs' well-being is directly related to venture performance (Stephan et al., 2020b; Wach et al., 2016). Stephan et al. (2023), in their meta-analysis, thus call for a better contextualization to facilitate our understanding of the specific factors driving or inhibiting an entrepreneur's well-being. According to self-determination theory (SDT), individuals experience well-being to the extent that they have three innate psychological needs satisfied: the need for autonomy, the need for competence, and the need for relatedness (Deci and Ryan, 2000). Indeed, Shir et al. (2019) show that these three needs explain entrepreneurs' well-being. However, research has largely overlooked the individual-level consequences of onboarding external investors (Busenitz et al., 2004), specifically regarding entrepreneurs' three psychological needs. Investigating these consequences is relevant, as the presence of investors likely changes the extent to which entrepreneurs' needs for autonomy, competence, and relatedness are met—which, according to the SDT, influences their well-being (Deci and Ryan, 2000). Consequently, further research must explore how investor involvement affects entrepreneurs' well-being.

In this regard, research has mostly ignored the influence of angel investors, who commit their personal capital to close new ventures' funding gaps (Harrison and Mason, 1991). Angel investors' tendency to build close and long-term personal relationships with entrepreneurs (Fairchild, 2011) makes them particularly interesting to study. Considering themselves "co-entrepreneurs" (Politis, 2008, p. 137), they leverage their human and social capital for nonmonetary contributions and become involved in day-to-day venture operations (Mitteness et al., 2012). For instance, they offer strategic guidance, monitor performance, or establish important connections (Wiltbank et al., 2009). While several scholars find a positive effect of angel investors on venture success (e.g., Bruton et al., 2009; Kerr et al., 2014), there is also contradictory evidence (e.g., Johnson and Sohl, 2012; Tenca et al., 2018): Other studies suggest that angel investors' impact is contingent on their relational dynamics with the entrepreneurs (Bammens and Collewaert, 2014; Collewaert, 2012; Maxwell and Lévesque, 2014). Yet, although we need to understand better how angel investors affect entrepreneurs' psychological needs—and, ultimately, their well-being—over time, the investor–investee dyad is underresearched (Lockett et al., 2006; White and Dumay, 2017): "Despite the robust body of knowledge […] on investor involvement, much of the investor–entrepreneur post-investment relationship still remains a black box" (Collewaert and Sapienza, 2016, p. 588).

We aim to address this gap by assessing the following research questions: *How is angel funding and angels' subsequent involvement related to entrepreneurs' well-being in the long term? How is this relation mediated by the innate psychological needs for autonomy, competence, and relatedness?* To answer these questions, we apply Linguistic Inquiry and Word Count (LIWC) analysis to a unique dataset of 125 million words derived from the tweets of 1667 entrepreneurs recorded on the platform X (formerly Twitter) from 2006 to 2022. These tweets represent the language the entrepreneurs used on this platform and allow insights into psychological dimensions (Block et al., 2019; Obschonka et al., 2017), such as entrepreneurs' innate needs and well-being. This approach is in line with SDT, which states that individuals internalize and integrate psychological needs into their self and behave congruently (Deci et al., 1994; Deci and Ryan,

2000). As such, the "satisfaction and frustration of a basic need manifests through specific behaviors, experiences, and is well represented in natural language" (Vansteenkiste et al., 2020, p. 4). Put differently, individuals verbalize the fulfillment of psychological needs and well-being as part of their communication, which we capture by analyzing entrepreneurs' tweets to assess the long-term consequences of angel funding on well-being, mediated by the three innate psychological needs for autonomy, competence, and relatedness. Moreover, in a post-hoc analysis, we investigate the short-term consequences immediately after entrepreneurs have received angel funding. We thereby also answer a call by Fisch and Block (2021, p. 15) to explore "how the arrival of […] an investor changes an entrepreneur's communication and the professionalization of his or her venture as well as his or her psychological and emotional status."

With our study, we make three contributions to theory: First, we extend literature on entrepreneurial eudaimonic well-being, which so far has mainly been investigated for self-employed entrepreneurs in general (Shir et al., 2019; Stephan et al., 2020a). We provide a contextualized perspective on the impact of external factors, namely angel funding and angels' post-investment involvement. Our findings indicate significant nuanced long-term and short-term consequences of angel funding for entrepreneurs' eudaimonic well-being that are mediated by autonomy, competence, and relatedness. With our longitudinal setting, we expand prior studies relying mostly on cross-sectional data (see Stephan et al., 2023). Second, we contribute to the SDT literature. We add to a more context-specific understanding of SDT by emphasizing investors as an external force influencing the satisfaction of three basic psychological needs and thereby entrepreneurs' well-being (Stephan et al., 2020a). Such a contextualized perspective has been called for in the entrepreneurial well-being literature (Stephan et al., 2023). Beyond that, we are among the first to transfer the theoretical construct of SDT to large-scale secondary data and leverage LIWC analysis to measure psychological proxy variables for innate need fulfillment. We conduct several robustness tests to verify our approach to assessing psychological needs based on entrepreneurs' tweets using LIWC proxies. Hence, our study reveals fruitful research avenues beyond the restrictions inherent to more subjective data sources (Fisch and Block, 2021). While previous research on entrepreneurs' well-being and psychological needs focused mainly on cross-sectional data (e.g., Shir et al., 2019), we respond to scholars' calls (Stephan et al., 2023) and provide a unique approach to studying large-scale, secondary data. Third, we expand research on the angel investor–entrepreneur relationship and the implications of entrepreneurial financing. With our focus on the individual-level consequences of angel funding, we extend prior studies largely concerned with venture-level effects (Collewaert and Sapienza, 2016; Politis, 2008). Beyond our contributions to academic theory, our study offers valuable insights to practitioners, particularly to entrepreneurs and investors: We create awareness that bringing angel investors on board positively affects entrepreneurs' eudaimonic well-being in the long term.

## 2. Theoretical foundation

### 2.1. Entrepreneurial well-being: a self-determination theory perspective

According to SDT, individuals repeatedly exhibit self-determination and inherent growth tendencies in their lives. They naturally strive to establish well-being by achieving a unified self and integrating themselves into larger social structures (Deci and Ryan, 2000). SDT, hence, focuses on the social context that supports individuals' inherent tendencies and either promotes or hinders their well-being (Ryan and Deci, 2017). Entrepreneurship scholars investigate how the social context of entrepreneurial self-employment relates to entrepreneurs' well-being: On the one hand, studies highlight potentially negative effects of entrepreneurship on well-being, including extraordinarily high levels of stress (Monsen and Wayne Boss, 2009) or fear (Mitchell et al., 2008) resulting from uncertainty (McMullen and Shepherd, 2006). On the other hand, scholars acknowledge that entrepreneurship, with its highly self-driven nature, offers individuals a unique setting to fulfill their most innate psychological needs, ultimately promoting their well-being (Shir et al., 2019; Stephan et al., 2020a). Following SDT, well-being emerging from innate psychological needs fulfillment is commonly called eudaimonic well-being (Ryan and Deci, 2001; Wiklund et al., 2019). Literature highlights the decisive benefits of eudaimonic well-being for entrepreneurs, including optimal psychological functioning, thriving, and experiencing self-realization (Ryan and Deci, 2001), contributing to improved venture performance (Stephan, 2018). However, despite its beneficial outcomes for entrepreneurs, Stephan et al. (2023, p. 555) infer that there is a need "to adopt context-sensitive approaches in research on entrepreneurs' wellbeing (Stephan, 2018; Wiklund et al., 2019)" to deepen our understanding of the relationship between entrepreneurship—in a specific context—and eudaimonic well-being. We investigate the context of entrepreneurs receiving angel funding.

### 2.2. The context of angel funding and entrepreneurial well-being

Studying the well-being of entrepreneurs who receive angel funding is a valuable context for investigation: Angel investors initially provide funds to entrepreneurs to generate financial gains; however, they remain involved post-investment and maintain a crucial role in their portfolio firms (see Politis, 2008, for an overview). Thus, angel funding is associated with long-term consequences for entrepreneurs and their ventures (Bammens and Collewaert, 2014). Drawing on venture capital literature, we examine such long-term effects and differentiate angels' involvement in the venture formation and evaluation stages (Judge and Zeithaml, 1992). Formation involvement refers to angel investors' participation in devising a venture's business strategy; evaluation involvement describes their monitoring of strategy implementation and assessing of venture performance (Fried et al., 1998). While scholars consider both types of involvement value drivers for venture performance, individual-level consequences for entrepreneurs remain understudied. This gap is surprising, given that research conceptualizes the angel investor–entrepreneur relationship as a "bidirectional exchange process" (Huang and Knight, 2017, p. 97) also influencing the entrepreneur. Thus, while scholars recognize investors as a relevant social context affecting entrepreneurs' eudaimonic well-being (e.g., Stephan, 2018; Stephan et al., 2020b), we lack theoretical justification and

empirical evidence.

### 2.3. Innate psychological needs and self-determination theory

Deci et al. (2017, p. 22) highlight: "Fundamental to SDT is the idea that the impact of varied environmental factors […] on workers' motivations and experiences is largely mediated by a small set of basic psychological needs." Following SDT, this set comprises the three universally applicable psychological needs for autonomy, competence, and relatedness (Ryan and Deci, 2000; Vansteenkiste et al., 2020). Understanding the influence of angel investors on entrepreneurs' eudaimonic well-being is thus contingent on determining how entrepreneurs satisfy their needs for autonomy, competence, and relatedness. As these psychological needs are deeply anchored in the human psyche, contextual factors, such as angel investors' presence in new ventures as external stakeholders, either satisfy or frustrate these needs, influencing an individual's well-being (Deci and Ryan, 2012). Under SDT, Ryan and Deci (2017) consider all three needs equally important, as any of them can be a leading determinant.

Autonomy refers to an individual's need for a free and authentic self-organization of behaviors and actions—in line with the personal sense of self (Sheldon and Elliot, 1998). As such, autonomy stands in direct contrast to feeling constrained (Legault, 2017). Consequently, angel investors' post-investment venture involvement can pressurize entrepreneurs, as it restricts their ability to be authentic. As autonomy influences the experience of integration and freedom (Deci and Ryan, 2000), it affects entrepreneurs' ability to verbalize their emotions freely.

The need for competence expresses a human propensity to affect one's environment directly (White, 1959) and describes the level of achievement and effectance or clout individuals experience to achieve personal growth (Deci and Ryan, 2000; Ryan and Deci, 2017). For entrepreneurs, overcoming the critical challenge of raising sufficient funding in the early stages of their venture doubtlessly represents such an achievement (Sheldon and Hilpert, 2012).

Relatedness describes individuals' need to connect closely and be affiliated with others (Deci and Ryan, 2000; Legault, 2017), be cared for (Baumeister and Leary, 1995), and experience a sense of (social) contact (Sheldon and Hilpert, 2012). With their post-investment presence, angel investors are important stakeholders for entrepreneurs—they provide a sense of affiliation and social connection (Bammens and Collewaert, 2014).

A central aspect of these three psychological needs is that they "refer to innate and life-span tendencies" (Deci and Ryan, 2000, p. 229). While individuals naturally strive to fulfill these needs, this intrinsic tendency is contingent on the social context: If the social context supports the psychological needs for autonomy, competence, and relatedness, individuals internalize and integrate these needs into the self (Deci et al., 1994), which results in self-determination, as individuals behave congruent with their self. "As such, one's behavior emanates from one's self; it is self-determined" (Deci et al., 1994, p. 121). In this vein, SDT postulates that individuals express the satisfaction or frustration of their psychological needs through their behavior and even their language and that the (non-) fulfillment of their needs is hence observable (Deci and Ryan, 2000). Vansteenkiste et al. (2020, p. 6) conclude that "a host of motivational, affective, cognitive, and behavioral outcomes should reliably follow from need satisfactions and frustrations." Indeed, scholars from various disciplines provide evidence that experiencing innate psychological needs leads to observable behaviors. Neuroscience research using brain imaging, for example, shows that experiencing psychological need satisfaction and intrinsic motivation causes neural signals in the brain (Lee and Reeve, 2020; Reeve and Lee, 2019). Lee and Reeve (2020) conclude in their study that the brain processes physical needs (such as hunger) and psychological needs (such as autonomy, competence, or relatedness) in the same way, thereby stimulating subsequent actions since the brain mediates experience and behavior (Di Domenico and Ryan, 2017). Deci and Ryan (2000, p. 235) acknowledge that "during infancy, intrinsic motivation (and hence well-being) is observable as exploratory behavior." Scholars in educational science and pediatrics clearly show that parents and social service professionals can observe and rate the psychological needs fulfillment and motivation expressed by youth (Dieleman et al., 2018; Nagpaul and Chen, 2019). In entrepreneurship research, Allison et al. (2015) find that intrinsic cues, such as specific language referencing the entrepreneur's social environment, support microlenders' need for relatedness during fundraising appeals: Microlenders perceive the entrepreneur's need for relatedness in the communicated narratives and internalize it.

As outlined, the theoretical proposition of SDT and empirical findings indicate that individuals internalize psychological needs, which become observable in their behavior and salient in their language (Deci et al., 1994; Deci and Ryan, 2000; Vansteenkiste et al., 2020). Nevertheless, entrepreneurship scholars so far chiefly rely on self-reported measures of autonomy, competence, and relatedness (e.g., Shir et al., 2019), which often entails biases and limits causal inferences (Fisch and Block, 2021). We, in contrast, scrutinize entrepreneurs' language usage in their online communication on the social media platform X, thereby advancing this research stream. Our focus lies on entrepreneurs' verbalized well-being and psychological needs. Specifically, we propose that the social context of receiving angel funding is observable in entrepreneurs' verbalized well-being in the long term after the funding announcement. To understand this relationship better, we additionally integrate entrepreneurs' verbalized needs for autonomy, competence, and relatedness as mediators in our model. While we examine the long-term effects of the relationship between angel funding and entrepreneurs' eudaimonic well-being as well as of the relationship between angel funding and the three psychological needs, we aim to uncover the mechanisms explaining the relationship between angel funding and entrepreneurs' well-being in general. We thus explore the mediating effects over time, as we expound in the methodology section. Fig. 1 illustrates our conceptual research model.

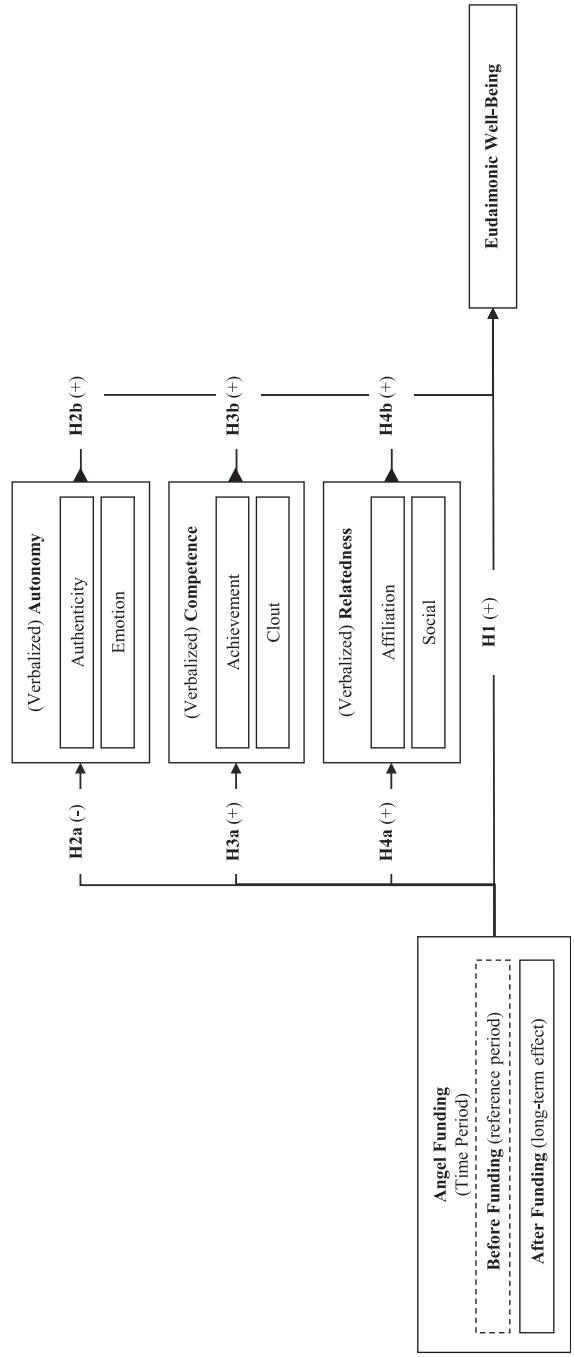


**Fig. 1.** Conceptual research model.

## 3. Hypotheses development

### 3.1. Angel funding and entrepreneurs' well-being

Following SDT, we propose that angel funding provides a social context supporting the natural growth tendencies of entrepreneurs, resulting in an environment that promotes entrepreneurs' well-being in the long run. First, entrepreneurs experience uncertainty and responsibility to ensure their ventures' ongoing (financial) success (McMullen and Shepherd, 2006; Wiltbank et al., 2009). Receiving funding from business angels lessens this burden, providing some leeway for entrepreneurs to develop a long-term strategy for their ventures. More importantly, however, angel investors' continued involvement in a venture has a signaling function: Given angels' selective investment process, their collaboration with a particular venture indicates they believe in its high growth potential (e.g., Becker-Blease and Sohl, 2015). For entrepreneurs, angel funding thus implies a good reputation and (public) recognition for their successful entrepreneurial journey (Ferrary and Granovetter, 2009), which activates their sense of pride and self-realization in the long run (Ryan and Deci, 2001; Wiklund et al., 2019). In a nutshell, angel funding positively relates to entrepreneurs' eudaimonic well-being.

Second, angel investors participate in formative and evaluative venture processes (Wiltbank et al., 2009). Hence, in line with SDT, angel investors provide a supportive environment (Deci and Ryan, 2000). Entrepreneurs internalize this supportive context, garnering the motivation (Deci et al., 2017) to develop their ventures and realize their capabilities. Engaging in entrepreneurial tasks energizes entrepreneurs psychologically and relates to their well-being, as it enables them to fulfill their innate growth tendencies proactively (Shir et al., 2019). Thus, angel investors provide a context that promotes entrepreneurs' well-being in the long term. In the same vein, research shows that receiving support from managers increases employees' well-being (see Deci et al., 2017).

Third, the long-term involvement of angel investors allows entrepreneurs to establish continuous and meaningful connections (Wiltbank et al., 2009) and receive feedback from a trusted counterpart. Following SDT, obtaining supportive input boosts entrepreneurs' vitality and energy, hence stimulating their well-being (Deci and Ryan, 2000). Overall, we postulate:

**Hypothesis 1.** *(H1). Angel funding is positively related to entrepreneurs' well-being in the long term.*

While we anticipate finding support for this relationship, we add to the literature and SDT by proposing that angel funding relates to the extent to which the entrepreneurs' psychological needs for autonomy, competence, and relatedness are satisfied, with the respective extent of need satisfaction mediating the relationship between angel funding and entrepreneurs' well-being.

### 3.2. Angel funding and entrepreneurs' need for autonomy

In SDT, the social context is theorized to influence the internalization of psychological needs (Deci et al., 1994). Receiving angel funding creates a setting in which entrepreneurs cede partial equity for their venture and angel investors become involved in day-to-day operations and long-term decision-making (Mitteness et al., 2012). Thus, regarding entrepreneurs' need for autonomy, we propose that the social context of angel funding interferes with the extent to which this need is met as the angels' formative and evaluative involvement in the venture limits entrepreneurs' freedom to make self-determined, autonomous decisions.

Formation involvement, such as strategic guidance (Wiltbank et al., 2009), is often understood as a nonvolitional regulation through an external force (Ryan et al., 2008). It negatively relates to the unrestricted self-determination and independence entrepreneurs enjoy before the investor's arrival (Nussbaum and Sen, 1993; Shane et al., 2003). A previous study supports this notion, illustrating that entrepreneurs perceive investors as assuming their ownership (van Dijk et al., 2014). Moreover, reporting duties imposed by investors bind scarce entrepreneurial resources, restricting the extent to which entrepreneurs' need to act freely and authentically is met (Ehrlich et al., 1994). Thus, following SDT, angels' funding and subsequent involvement reshape the social context in which entrepreneurs operate and adversely affect the extent to which entrepreneurs' need for autonomy is fulfilled.

Evaluation involvement, such as performance monitoring (Fried et al., 1998), often results from the angels' aim to achieve congruence between their strategic interests and entrepreneurs' behaviors (e.g., Collewaert, 2012). Therefore, angel investors frequently define a set of recurring reporting duties. Following SDT, experiencing such external control restricts the extent to which entrepreneurs internalize the need for autonomy, hence harming their well-being (Ryan, 1995). The subjective feeling of constant evaluation and surveillance sharply contrasts with the autonomous nature of entrepreneurial undertakings and entrepreneurs' liberty to authentically express their emotions without any inhibition or decide on their venture's course (Nussbaum and Sen, 1993; Shane et al., 2003; Shir et al., 2019). Indeed, prior studies indicate the conflict potential inherent to investors' managerial involvement, which diminishes entrepreneurial autonomy (Yitshaki, 2008). In sum, angel investors' formational and evaluative involvement negatively relates to the extent to which entrepreneurs' need for autonomy is met.

Following SDT, autonomy is a psychological need that facilitates the emergence of well-being (Deci and Ryan, 2000), while externally controlled social contexts constrain the internalization of well-being (Deci et al., 1994). As the social context of angel funding restricts the extent to which the need for autonomy is satisfied, we argue in line with SDT that this limited extent of need satisfaction negatively mediates the relationship between angel funding and entrepreneurs' well-being. Hence, we hypothesize:

**Hypothesis 2.** *(H2). (a) Angel funding is negatively related to the extent to which entrepreneurs' need for autonomy is met. (b) The extent to which the need for autonomy is met mediates the relationship between angel funding and entrepreneurs' well-being.*

### 3.3. Angel funding and entrepreneurs' need for competence

SDT proposes that supportive social contexts facilitate the extent of internalization and satisfaction of the need for competence (Deci et al., 1994). Based on the theory, we argue that the context of angel funding is positively associated with the extent to which entrepreneurs' need for competence is satisfied due to angel investors' formative nonmonetary contributions. The reason is that entrepreneurship is characterized by highly volatile environments (Shepherd and Haynie, 2011) constantly requiring entrepreneurs to adapt their behavior and hone their skills to advance their venture (Shir et al., 2019). Angel investors function as expert counterparts who collaborate with entrepreneurs to develop their skill set and encourage continuous learning, which is essential for individuals to feel effective and satisfy their need for competence (Shir et al., 2019). Literature highlights that angel investors' human and social capital enables them to complement entrepreneurs, among others, through strategic guidance or support in fundraising (Politis, 2008). Since new ventures typically face knowledge deficiencies (Autio et al., 2000), angel investors will likely close entrepreneurs' knowledge and capability gaps (Colombo and Grilli, 2010). We argue that such an involvement fosters knowledge spillovers, stimulating the extent to which entrepreneurs' need for competence is met as they learn from angels' experience.

With the angel investor and the entrepreneur sharing a bidirectional relationship (Huang and Knight, 2017), knowledge also spills over from the entrepreneur to the investor, as entrepreneurs possess inside information about their venture that external angel investors lack. Thus, entrepreneurs help angel investors gain a deeper understanding of the investee firm, underlining their clout and influence over the angel and increasing the extent to which their need for competence is met. The knowledge diversity between the parties also enhances critical thinking—a key skill in entrepreneurship that leads to positive achievements, such as opportunity recognition (Lim et al., 2013). Prior research reinforces our arguments by providing empirical support for the notion that investor involvement contributes to entrepreneurs' ability to run their ventures successfully (Bruton et al., 2009; Kerr et al., 2014). Based on SDT, we thus expect angel funding to stimulate the extent to which entrepreneurs' need for competence is satisfied.

Following SDT, we also recognize that integrating the need for competence is critical to entrepreneurs' optimal functioning and well-being (Deci and Ryan, 2000). Hence, we propose that the extent to which entrepreneurs' need for competence is met mediates the relationship between angel funding and entrepreneurs' well-being and hypothesize:

**Hypothesis 3**. *(H3). (a) Angel funding is positively related to the extent to which entrepreneurs' need for competence is met. (b) The extent to which the need for competence is met mediates the relationship between angel funding and entrepreneurs' well-being.*

### 3.4. Angel funding and entrepreneurs' need for relatedness

Following SDT, we propose that angel funding constitutes a social context that predicts the extent to which entrepreneurs' need for relatedness is met, as angel investors build rapport and trusted relationships with entrepreneurs over time (Bammens and Collewaert, 2014).

Prior research indicates ambiguous effects of entrepreneurial activities on the extent to which individuals' need for relatedness is satisfied: On the positive side, given the self-organizing nature of entrepreneurship, entrepreneurs enjoy the freedom to cultivate their own social networks and relationships—detached from organizational constraints (e.g., Forbes et al., 2006). On the negative side, particularly in the early stages of venture development, literature points to the risks of experiencing loneliness and social isolation (Gumpert and Boyd, 1984). Negative emotions, including stress and fear of failure, can even amplify these feelings, causing an individual to perceive a lack of belonging (Patzelt and Shepherd, 2011). The entrance of an angel investor into the venture helps counteract these emotions: On the surface, angel investors are external stakeholders, yet they often decide to finance a venture based on their fit with the entrepreneur (Mason and Stark, 2004), engage in nurturing and reciprocal relationships with the entrepreneur, and show a high level of hands-on involvement in the ventures (Politis, 2008). As a result, the relationship with an angel investor offers entrepreneurs a source of affiliation and social connection, which they internalize and which increases the extent to which their need for relatedness is met. The positive effects to the benefit of relatedness increasingly unfold in the long term, with entrepreneurs building trusting and caring investor relationships and internalizing their sense of belonging and affiliation (Legault, 2017; Mason and Stark, 2004). In addition, access to angel investors' networks typically enables entrepreneurs to connect to new, valuable external partners (Politis, 2008). In the same vein, as funding signals the quality of a venture, it potentially enhances the entrepreneurs' reputation in the entrepreneurial ecosystem and enriches their social network and professional affiliations (Ferrary and Granovetter, 2009). Therefore, in line with SDT, angel funding provides a social context that positively contributes to the extent to which entrepreneurs' need for relatedness is met.

Relatedness is specified as a necessary condition for psychological growth, integrity, and well-being (Deci and Ryan, 2000). Accordingly, we postulate in line with SDT that the extent to which entrepreneurs' need for relatedness is satisfied mediates the relationship between angel funding and entrepreneurs' well-being. Hence, we hypothesize:

**Hypothesis 4**. *(H4). (a) Angel funding is positively related to the extent to which entrepreneurs' need for relatedness is met. (b) The extent to which the need for relatedness is met mediates the relationship between angel funding and entrepreneurs' well-being.*

## 4. Methodology

### 4.1. Data collection and sample

We assemble a large-scale dataset capturing the digital identities of 1667 angel-backed entrepreneurs over time. We also collect

details on entrepreneurs' and angel investors' human capital characteristics as well as data on the ventures. We construct this sample using a three-step approach and drawing on Crunchbase, LinkedIn, and X (formerly Twitter) as sources.

First, we use Crunchbase to identify (pre-)seed investments of individual or syndicated angel investors from 2007 to 2021, using data as of April 2022. With its global coverage of private companies, Crunchbase is a renowned data source for academia, particularly in entrepreneurship research (Nuscheler et al., 2019), and business practitioners alike (Dalle et al., 2017). We focus on ventures headquartered in the United States, where a highly developed angel market exists (Collewaert and Manigart, 2016) and good-quality data are available. We filter for ventures that publicize the identities of their founding entrepreneurs and angel investors and collect an initial sample of 8177 ventures matching our criteria, including general information (e.g., founding year).

Second, we further restrict our sample to entrepreneurs for whom we can gather public information from their LinkedIn profiles (Ko and McKelvie, 2018). Specifically, we collect data on their educational background and professional experience. We do the same for the ventures' angel investors, resulting in a sample of 7055 entrepreneurs and their respective business angels.

Third, we use Crunchbase's link to entrepreneurs' profiles on X. Due to a lack of X usage, missing links, or profile privacy settings, we were able to access the tweets of 2748 (39 %) entrepreneurs. We leverage the platform X's API for academic research and build a custom Python script to crawl all historic tweets and replies for these accounts as well as basic profile information. In line with prior research (e.g., Block et al., 2019), we exclude retweets, as these contain other authors' written words—a potential source of distortion—and ensure we have at least 50 processable English words in each temporal segment. We retrieved the tweets between November 2022 and January 2023, resulting in a panel-structure dataset of roughly 10.1 million tweets, posted between 2006 and 2022. Based on these data, our final sample consists of 1667 entrepreneurs who received angel funding and used X before, during, and after the investment.

### 4.2. Leveraging entrepreneurs' tweets to capture psychological needs and well-being

Using the platform X to infer entrepreneurs' psychological needs based on their tweets represents a novel yet validated approach (e.g., Block et al., 2019; Fisch and Block, 2021; Obschonka et al., 2017; Obschonka and Fisch, 2018; Tata et al., 2017), given the large amount of publicly available textual data and the rising importance of X for entrepreneurs (Schwartz et al., 2013). Entrepreneurs typically use X to communicate their personal and professional opinions (Yarkoni, 2010; Youyou et al., 2015). Studies rely on X as a data source because, unlike survey data, it helps avoid response and recall biases, with data being collected unobtrusively and offering longitudinal real-time insights into individuals' thoughts (Seigner et al., 2023; Wang et al., 2016). Further, Fisch and Block (2021, p. 15) conclude that "because of Twitter's [now X's] immediate and quick nature, Tweets may be a rather unreflective and authentic data source (e.g., Lee et al., 2017; Obschonka et al., 2017)." Lee et al. (2017, p. 766) also view the nature of communication on X as "unfiltered, personal, and spontaneous." Accordingly, scholars refer to tweets as a person's digital footprint that encompasses their digital self-representation (e.g., Obschonka et al., 2017). Prior research underlines the notably accurate information tweets provide on a person's real-world offline self, particularly when studied over time (Back et al., 2010; Fisch and Block, 2021; Kosinski et al., 2013). Thus, analyzing tweets to make inferences on individuals' self addresses prior methodological shortfalls inherent in a heavy reliance on primary data from subjective self-reports or questionnaires (Obschonka et al., 2017). We build on prior research leveraging entrepreneurs' tweets and language analysis using LIWC (e.g., Tata et al., 2017; Wang et al., 2016) to assess entrepreneurs' psychological needs and well-being as verbalized in their tweets and verify our approach with several robustness tests.

### 4.3. Empirical approach using LIWC

We rely on LIWC software (Pennebaker et al., 2015) to analyze entrepreneurs' unfiltered language retrieved from their tweets on X over time. Research shows that language reliably reflects individuals' thoughts and emotions, conveying information about their cognitive styles, personality, and social behavior (Tausczik and Pennebaker, 2010). Based on this logic, LIWC functions as a scientific instrument for the automated analysis of large text files (Boyd, 2017). First, input text is coded against the >100 dictionaries referring to a collection of words pertinent to a linguistic or psychological category derived from prior research and validated by independent judges. Then, the frequency at which each category is represented is determined. Thereby, LIWC detects the main concerns of individuals in a sample (Tausczik and Pennebaker, 2010) and identifies a reliable indicator for their underlying psychological needs. For example, the dictionary for the psychological construct of affiliation, which plays a role in the need for relatedness, measures individuals' need to connect with others; it contains over 350 proxy words, such as *community* or *together*. Over the past years, LIWC has been established as the gold standard for computerized language analysis and enjoys increasing prominence in entrepreneurship research. Specifically, "the combination of Twitter [now X] data and language analysis enables fresh insights into research questions that were previously difficult to assess" (Fisch and Block, 2021, p. 4).

### 4.4. Measures

#### 4.4.1. Independent variables

As we capture changes in the fulfillment of entrepreneurs' basic psychological needs in response to angel funding, we observe these needs in the long term. To operationalize this, we focus on the period *after funding* (i.e., >90 days after the funding announcement in Crunchbase, used as reference date) in which long-term effects relevant to our main analysis emerge. However, a start-up funding round usually spans several weeks, including investor due diligence, negotiations, and official deal closing (Maxwell and Lévesque, 2014). Furthermore, entrepreneurs typically know about an investment into their venture before it is publicly announced. Hence, we

expect slight effects of the successful fundraising round on entrepreneurs' well-being to materialize even prior to the official announcement. To operationalize this process and construct the panel structure needed for our analysis, we distinguish three periods: *before funding* (i.e.,>90 days before the funding announcement); *during funding* (i.e., the 90 days before and after the funding announcement), representing any short-term effects; and *after funding* (i.e., >90 days after the funding announcement), representing any long-term effects. On that basis, in line with Fisch and Block (2021), we construct dummy variables for each period, which we use as independent variables. While we investigate long-term effects of angel funding on entrepreneurs' well-being (after funding) in our main analysis, we examine short-term effects (during funding) in our post-hoc analysis.

#### 4.4.2. Mediating variables

Following SDT, we measure three mediating variables that capture entrepreneurs' innate psychological needs for autonomy, competence, and relatedness (Ryan and Deci, 2017). To operationalize these needs, we use psychological proxies derived from prior research, which we obtain through LIWC analysis. We leverage the balanced measure of psychological needs (BMPN) scale (Deci and Ryan, 2000; Gagné, 2003; Sheldon and Hilpert, 2012) from primary research as a guiding construct in selecting adequate proxies.

First, to measure *autonomy*, we use the LIWC proxies 'authentic' and 'emotion.' 'Authentic' is a summary variable, capturing the honesty and genuineness of individuals (Boyd et al., 2022). This is in line with literature showing that autonomy is higher when individuals feel free in their choices and are able to verbalize their 'true self' without external constraints (Sheldon and Hilpert, 2012). Research also finds a positive association with emotional experiences for individuals who can autonomously regulate their extrinsic motivation without feeling pressured or controlled (Deci and Ryan, 2000). Therefore, our second LIWC proxy 'emotion' captures individuals' emotional processes, both positive (e.g., 'good,' 'happy') and negative (e.g., 'bad,' 'hurt') (Boyd et al., 2022; Jaidka et al., 2020).

Second, to measure *competence*, we use the LIWC proxies 'achievement' and 'clout.' As competence describes the basic need to feel effectance and mastery (Ryan and Deci, 2017), it is higher when individuals do well on hard challenges (Sheldon and Hilpert, 2012). The LIWC proxy 'achievement' (Murray, 1938) is "to a substantial degree based in what we consider the innate need for competence" (Deci and Ryan, 2000, p. 250) and, thus, resembles individuals' drive to achieve desired outcomes (Legault, 2017). The second LIWC proxy, 'clout,' reflects language of leadership and status (Boyd et al., 2022). It encompasses individuals' confidence and mastery and is hence linked to entrepreneurs' competence.

Third, to measure *relatedness*, we use the LIWC proxies 'affiliation' and 'social.' 'Affiliation' measures individuals' drive to socialize with others, "emphasizing teamwork, helpfulness, communication, compassion, and empathy" (Li et al., 2017, p. 338). Prior research considers the affiliation motive (Murray, 1938) to be directly based in the need for relatedness as defined in SDT (Deci and Ryan, 2000). The second LIWC proxy, 'social,' is expressed through language hinting at social processes, based both in behavior and social referents, such as verbs for human interaction (Boyd et al., 2022). Hence, it directly captures the dimensions of social connectedness and feeling significant within groups, which research has revealed as crucial for individuals to satisfy their innate need for relatedness as defined in SDT (Ryan and Deci, 2017).

#### 4.4.3. Dependent variable

In line with recent literature (Shir et al., 2019; Wiklund et al., 2019), we measure entrepreneurs' eudaimonic well-being as a multidimensional construct. We build on Ryff's (1989, 2014, 2019) conceptualization of eudaimonic well-being, which identifies and validates six dimensions: self-acceptance, personal growth, positive relations with others, purpose in life, environmental mastery, and autonomy. As we already consider autonomy as one of entrepreneurs' three psychological needs, following SDT (Deci and Ryan, 2000), we make a relevant distinction (Ryff, 2019) and focus only on the remaining five dimensions. Accordingly, we operationalize our well-being measure using the corresponding five-dimensional scale of Seligman (2018). We leverage the publicly available lexicon for language analysis developed by the World Well-Being Project (https://www.wwbp.org), which research has already applied to X data (Jaidka et al., 2020; Smith et al., 2016). Each word in the lexicon is associated with one of the five well-being dimensions. To apply the weighted lexicon to our sample of >10 million entrepreneur tweets and evaluate their content against the lexicon, we build a custom Python code. Our Python code scrutinizes the tweets and identifies the frequency of the target words' occurrence, assigns the according weights, and sums up the weighted relative frequencies for each dimension. Based on the resulting well-being scores for each of the five dimensions (per entrepreneur and period), we then use Stata to calculate a higher-order construct for well-being and rescale the resulting variable to a scale from 1 to 100 for easier interpretation.

#### 4.4.4. Control variables

For our analyses of the direct effects (H1, H2a, H3a, and H4a), we use a linear panel regression model with fixed effects (detailed in the discussion of our analytical procedure). Hence, we implicitly control for any unobserved time-invariant controls on the entrepreneur and venture levels. Additionally, we include the *number of words* analyzed for each period (in logarithmic form due to skewness) as a time-variant control to account for potentially confounding effects due to differences in the number of words available for processing.

In our analyses of the mediating effects (H2b, H3b, and H4b), we use regression analysis and a bootstrapping procedure to estimate indirect effects (detailed in the discussion of our analytical procedure) and thus include several time-invariant controls. We follow prior research in including controls for X and on the individual, venture, and industry levels (e.g., Block et al., 2019). For X, we control for the *number of followers*, *number of followees*, and *number of tweets* to avert potentially confounding effects resulting from distinct usage. We also control for the *number of words* and the *share of words readable by LIWC*, that is, those in the English language that could be processed (e.g., Fisch and Block, 2021). On an individual level, we account for entrepreneur- and angel investor-specific factors that

might influence entrepreneurs' well-being. For entrepreneurs, we control for *prior entrepreneurial experience* and *gender*. Entrepreneurial experience might lead to more transparent expectation management with investors. Gender influences individual characteristics such as risk aversion, thus shaping the interaction with investors, which drives well-being (Block et al., 2019; Jianakoplos and Bernasek, 1998). For investors, we follow Block et al. (2019) and control for *prior investment experience* and *gender*. Moreover, we control for investors' *number of board seats*, as angels sitting on multiple boards might become less involved in a single venture. On a venture level, we control for the *amount raised* (in logarithmic form), as the volume of initial angel funding might reflect differing startup conditions (following Ter Wal et al., 2016) and influence investor expectations, which, in turn, affect entrepreneurs' well-being. For similar reasons, we control for the *number of angel investors* and the *share of angels* (vs. other investors). To account for ventures' maturity, we control for *venture age* (e.g., Zahra et al., 2006) at the time of funding. Next, we include a *location* dummy for the US state of ventures' headquarters (Cumming et al., 2010), which is in line with prior research indicating economic, political, and social implications of regional environments (e.g., Brown and Mason, 2014). Moreover, we include dummies for *investment stage* and *year* to account for potentially changing market conditions (e.g., Ter Wal et al., 2016). Last, we control for macroeconomic factors, specifically *inflation* and *GDP growth* (Stephan et al., 2020a), as well as for industry by including *industry dynamism* (volatility), *technological turbulence* (average industry ratio of research and development spending compared to firm sales), and *market growth* (ten-year compound annual revenues growth rate). These dynamics might be associated with a change in entrepreneurs' psychological needs and well-being. As not all control variables are available for the entire final sample, we perform the analytical tests with a subsample of 1287 entrepreneurs (77 %). However, we obtain similar results when excluding the affected controls and using the entire sample, lending further support for the robustness of our model.

### 4.5. Analytical procedure

For each of the 1667 entrepreneurs in our final sample, we assemble longitudinal data in the form of LIWC scores across the three temporal segments. This yields a unique balanced panel dataset comprising a total of 5001 observations. For our analyses of the direct effects (H1, H2a, H3a, and H4a), we follow Fisch and Block (2021) and employ a two-step approach. First, for initial insights into potential changes over time, we compare the mean values for all three periods and assess the statistical significance of any differences with an analysis of variance (ANOVA). We report the results in our Web Appendix A. In a second step, our main analysis, we use a fixed effects panel regression model in line with our dataset's characteristics (i.e., our focus on intrapersonal changes in response to angel funding). This model allows us to control for all aspects of entrepreneur-level heterogeneity, such as unobserved or time-invariant variables (e.g., human capital characteristics), and to focus on variations within each entrepreneur. We validate our choice of a fixed effects (within) estimator as the most unbiased and consistent method through a Wald test (finding it to be superior to a random effects model). For all calculations, we use robust standard errors to control for unobserved heterogeneity (Wooldridge, 2020). For our analyses of our mediating effects (H2b, H3b, and H4b), we first regress the three psychological needs on well-being. Next, we employ the 'sgmediation2' command in Stata and estimate the indirect effects (Preacher and Hayes, 2004; Zhao et al., 2010). We use a bootstrapping procedure based on 1000 samples with 95 % bias-corrected confidence intervals.

## 5. Results

We report the descriptive statistics and correlation coefficients for all unstandardized variables including the controls used for our mediation analyses in Table 1. Following the three-step approach by Kalnins (2018) and validating the results using the variance inflation factors (Cohen et al., 2003), we infer that multicollinearity is not an issue in our study.

### 5.1. Multivariate regression analysis

We estimate our hypotheses through linear fixed effect (within) estimator panel regressions. As independent variables, we include the dummies segmenting the tweets over time—before, during, and after funding. As dependent variable, we include well-being to investigate H1; we run a total of six regressions, that is, one for each LIWC proxy as dependent variable, to investigate H2a, H3a, and H4a. We report the results in Table 2.

H1 proposes that angel funding is positively related to entrepreneurs' well-being in the long term. This relationship is positive and significant ($\beta = 0.37$, $p = .04$), supporting H1.

H2a proposes that angel funding is negatively related to the extent to which entrepreneurs' need for autonomy is met. Both proxies for autonomy—authenticity and emotion—have negative and significant coefficients ($\beta_{authenticity} = -2.08$, $p_{authenticity} < 0.01$; $\beta_{emotion} = -0.38$, $p_{emotion} < 0.01$). H2a is supported.

H3a proposes that angel funding is positively related to the extent to which entrepreneurs' need for competence is met. Both proxies for competence—achievement and clout—have positive and significant coefficients ($\beta_{achievement} = 0.18$, $p_{achievement} < 0.01$; $\beta_{clout} = 7.58$, $p_{clout} < 0.01$). H3a is supported.

H4a proposes that angel funding is positively related to the extent to which entrepreneurs' need for relatedness is met. Both proxies for relatedness—affiliation and social—have positive and significant coefficients ($\beta_{affiliation} = 0.63$, $p_{affiliation} < 0.01$; $\beta_{social} = 0.86$, $p_{social} < 0.01$). H4a is supported.

**Table 1**
Descriptive statistics and pearson correlations.

| Variable | | M | SD | Min | Max | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Authenticity (Autonomy) | 22.43 | 14.64 | 1.00 | 97.22 | 1.00 | | | | | | | | | | | | | | | | | | | | |
| 2 | Emotion (Autonomy) | 5.03 | 1.62 | .00 | 18.56 | **-.50** | 1.00 | | | | | | | | | | | | | | | | | | | |
| 3 | Achievement (Competence) | 1.36 | .61 | .00 | 6.67 | **-.05** | **-.14** | 1.00 | | | | | | | | | | | | | | | | | | |
| 4 | Clout (Competence) | 53.13 | 16.68 | 1.71 | 99.00 | **-.44** | **.18** | **.24** | 1.00 | | | | | | | | | | | | | | | | | |
| 5 | Affiliation (Relatedness) | 1.84 | 1.09 | .00 | 11.67 | **-.10** | **-.05** | **.19** | **.63** | 1.00 | | | | | | | | | | | | | | | | |
| 6 | Social (Relatedness) | 8.96 | 2.59 | .85 | 31.40 | .01 | **-.17** | **.20** | **.64** | **.58** | 1.00 | | | | | | | | | | | | | | | |
| 7 | Well-being | 49.50 | 7.72 | .69 | 99.86 | **.06** | **.19** | **.08** | **.22** | **.33** | **.24** | 1.00 | | | | | | | | | | | | | | |
| 8 | Before funding | .33 | .47 | .00 | 1.00 | **.08** | .02 | **-.08** | **-.20** | **-.22** | **-.15** | -.02 | 1.00 | | | | | | | | | | | | | |
| 9 | During funding (short-term) | .33 | .47 | .00 | 1.00 | **-.07** | **.14** | **-.04** | **.09** | **.04** | **.07** | .02 | **-.50** | 1.00 | | | | | | | | | | | | |
| 10 | After funding (long-term) | .33 | .47 | .00 | 1.00 | -.01 | **-.16** | **.12** | **.11** | **.18** | **.08** | .00 | **-.50** | **-.50** | 1.00 | | | | | | | | | | | |
| 11 | Number of words (in thousands) | 24.92 | 82.45 | .05 | 2,515.52 | **.06** | **-.10** | **-.05** | **-.09** | **-.08** | -.01 | **-.09** | .03 | **-.17** | **.14** | 1.00 | | | | | | | | | | |
| 12 | Share of words readable by LIWC | 74.09 | 5.12 | 50.35 | 92.01 | **.62** | **-.50** | **.22** | **-.05** | **.17** | **.41** | **.07** | -.04 | **-.08** | **.13** | **.07** | 1.00 | | | | | | | | | |
| 13 | Number of followers (in thousands) | 20.01 | 409.63 | .03 | 16,600.00 | .02 | .00 | .00 | .01 | .03 | .01 | **.07** | .00 | .00 | .00 | .02 | .02 | 1.00 | | | | | | | | |
| 14 | Number of followees (in thousands) | 1.27 | 2.91 | .00 | 48.06 | **-.06** | .02 | -.02 | **.06** | -.02 | .03 | -.03 | .00 | .00 | .00 | **.29** | **-.05** | .01 | 1.00 | | | | | | | |
| 15 | Number of tweets (in thousands) | 6.03 | 13.73 | .03 | 280.48 | **.05** | **-.07** | **-.08** | **-.09** | **-.09** | .01 | **-.09** | .00 | .00 | .00 | **.75** | **.04** | .03 | **.40** | 1.00 | | | | | | |
| 16 | Amount raised (in USD millions) | 1.85 | 1.85 | .01 | 17.00 | .03 | **-.07** | **.09** | **.05** | **.11** | **.05** | **.07** | .00 | .00 | .00 | **-.05** | **.07** | -.01 | **-.07** | **.07** | 1.00 | | | | | |
| 17 | Number of angel investors | 3.25 | 3.28 | 1.00 | 57.00 | **.06** | -.02 | -.01 | .00 | **.04** | **.08** | .01 | .00 | .00 | .00 | .02 | **.05** | -.01 | -.01 | .03 | **.21** | 1.00 | | | | |
| 18 | Share of angels (vs. other investors) | .53 | .27 | .06 | 1.00 | **-.03** | **.06** | **-.03** | -.02 | **-.06** | **-.04** | **-.05** | .00 | .00 | .00 | **.05** | **-.09** | -.02 | **.08** | **.07** | **-.42** | **.23** | 1.00 | | | |
| 19 | Venture age (in days) | 543.09 | 505.30 | -1,858.00 | 5,122.00 | **-.04** | .01 | **.04** | **.04** | **.04** | .01 | .01 | .00 | .00 | .00 | **-.05** | **-.03** | .01 | -.02 | **-.07** | **.11** | **-.03** | -.02 | 1.00 | | |
| 20 | Prior investment experience (angel(s)) | 24.17 | 34.03 | 1.00 | 174.00 | **.05** | -.02 | .00 | -.02 | .00 | **.04** | .00 | .00 | .00 | .00 | -.02 | **.07** | **.11** | -.02 | -.01 | **.12** | -.02 | **-.21** | .02 | 1.00 | |
| 21 | Number of board seats (angel(s)) | 1.02 | 2.59 | .00 | 44.00 | **-.04** | .02 | .00 | **.05** | .02 | -.01 | .03 | .00 | .00 | .00 | -.01 | -.03 | -.01 | -.02 | -.01 | **.10** | .00 | **-.05** | .01 | **.16** | 1.00 |
| 22 | Gender (angel(s)) | .95 | .18 | .00 | 1.00 | -.02 | .01 | -.02 | **-.07** | **-.05** | **-.10** | **-.07** | .00 | .00 | .00 | .00 | **-.03** | .01 | **-.03** | -.01 | **-.05** | **-.04** | .00 | .01 | **.06** | **-.03** |
| 23 | Prior entrepreneurial experience | 3.20 | 5.22 | .00 | 59.00 | **-.05** | .00 | -.01 | .00 | -.01 | **-.06** | **-.04** | .00 | .00 | .00 | **.06** | **-.05** | -.01 | **.04** | **.09** | .00 | .02 | **.06** | **-.08** | -.01 | **.04** |
| 24 | Gender (entrepreneurs) | .87 | .33 | .00 | 1.00 | .03 | **-.12** | -.02 | **-.16** | **-.11** | **-.20** | **-.18** | .00 | .00 | .00 | .01 | -.04 | .01 | -.02 | .02 | -.02 | -.01 | .01 | -.02 | .00 | -.01 |
| 25 | Inflation | 1.63 | .79 | -.36 | 3.16 | **.06** | **-.04** | -.01 | **-.05** | **-.04** | .02 | .02 | .00 | .00 | .00 | .00 | **.07** | .02 | .01 | -.01 | **-.09** | -.01 | **-.04** | **-.08** | **-.07** | **-.09** |
| 26 | GDP growth | 1.82 | 1.47 | -3.40 | 2.92 | **-.08** | **.13** | **-.06** | **-.04** | **-.10** | **-.05** | **-.06** | .00 | .00 | .00 | .02 | **-.10** | .01 | .01 | **.03** | **-.10** | .01 | .02 | .01 | **.06** | -.01 |
| 27 | Market growth | .06 | .03 | -.02 | .16 | -.01 | -.02 | .00 | -.02 | .00 | **-.04** | .00 | .00 | .00 | .00 | **-.03** | -.02 | **-.03** | **-.07** | **-.03** | **.06** | .01 | **-.04** | .03 | .02 | **.04** |
| 28 | Market turbulence | .26 | .05 | .13 | .50 | **-.03** | **-.07** | **-.04** | -.03 | -.02 | .01 | **-.05** | .00 | .00 | .00 | .00 | .00 | -.01 | .00 | .00 | **.04** | -.03 | **-.08** | .02 | **.03** | -.01 |
| 29 | Technological turbulence | .06 | .02 | .00 | .10 | .01 | **-.03** | **.05** | **-.06** | **-.05** | **-.06** | **-.08** | .00 | .00 | .00 | -.02 | -.01 | .03 | .01 | **-.04** | **.05** | -.02 | **.05** | **-.06** | -.03 | .00 |

***Table continued***

| Variable | | M | SD | Min | Max | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 22 | Gender (angel(s)) | .95 | .18 | .00 | 1.00 | 1.00 | | | | | | | |
| 23 | Prior entrepreneurial experience | 3.20 | 5.22 | .00 | 59.00 | .01 | 1.00 | | | | | | |
| 24 | Gender (entrepreneur) | .87 | .33 | .00 | 1.00 | **.18** | **.09** | 1.00 | | | | | |
| 25 | Inflation | 1.63 | .79 | -.36 | 3.16 | .02 | .01 | -.02 | 1.00 | | | | |
| 26 | GDP growth | 1.82 | 1.47 | -3.40 | 2.92 | **.07** | **-.05** | -.01 | **.14** | 1.00 | | | |
| 27 | Market growth | .06 | .03 | -.02 | .16 | .00 | .01 | .03 | -.01 | -.02 | 1.00 | | |
| 28 | Market turbulence | .26 | .05 | .13 | .50 | -.01 | **-.05** | .00 | **.03** | **-.04** | **.17** | 1.00 | |
| 29 | Technological turbulence | .06 | .02 | .00 | .10 | .04 | **-.06** | **.05** | .02 | .00 | .00 | **.06** | 1.00 |

*Notes.* Table shows Pearson correlation coefficients between sample variables, including DV (eudaimonic well-being), mediators (LIWC proxies), IVs (temporal segmentation), and control variables (for mediation analysis). The control variable venture age is specified in days (from official venture founding date to the day of angel funding)—negative values imply that a venture was only officially founded after having previously already raised funding from angel investors (e.g., in "stealth mode"); the control variable gender (entrepreneurs) is coded as 1 = male, 0 = female; correlations significant at $p \leq .05$ are displayed in bold.

**Table 2**
Multivariate fixed effects panel regression results.

| | A: Short term (during funding) vs. before | B: Long term (after funding) vs. before | A vs. B | Interpretation of results | | |
|---|---|---|---|---|---|---|
| Dep. variables | *Coefficient p-value* | *Standard error [95 % CI]* | *Coefficient p-value* | *Standard error [95 % CI]* | *p-value (short vs. long term)* | |
| Well-being | −0.69 | 0.30 | 0.37 | 0.18 | 0.00 | Decreasing during funding (short term); Increasing after funding (long term) |
| | 0.02 | [−1.273; −0.109] | 0.04 | [0.010; 0.724] | | |
| Autonomy | | | | | | |
| Authenticity | −3.18 | 0.53 | −2.08 | 0.36 | 0.04 | Decreasing both during and after funding (short and long term) |
| | 0.00 | [−4.213; −2.147] | 0.00 | [−2.781; −1.386] | | |
| Emotion | 0.04 | 0.06 | −0.38 | 0.04 | 0.00 | No significant change during (short term); decreasing after funding (long term) |
| | 0.53 | [−0.077; 0.151] | 0.00 | [−0.460; −0.304] | | |
| Competence | | | | | | |
| Achievement | −0.03 | 0.03 | 0.18 | 0.02 | 0.00 | No significant change during (short term); increasing after funding (long term) |
| | 0.35 | [−0.077; 0.028] | 0.00 | [0.145; 0.205] | | |
| Clout | 4.19 | 0.59 | 7.58 | 0.36 | 0.00 | Increasing both during and after funding (short and long term) |
| | 0.00 | [3.046; 5.340] | 0.00 | [6.864; 8.287] | | |
| Relatedness | | | | | | |
| Affiliation | 0.25 | 0.04 | 0.63 | 0.03 | 0.00 | Increasing both during and after funding (short and long term) |
| | 0.00 | [0.171; 0.332] | 0.00 | [0.575; 0.681] | | |
| Social | 0.54 | 0.10 | 0.86 | 0.06 | 0.00 | Increasing both during and after funding (short and long term) |
| | 0.00 | [0.347; 0.735] | 0.00 | [0.745; 0.982] | | |

*Notes.* Results of the multivariate fixed effects panel regression (within-estimator) performed at the level of the entrepreneurs. The dependent variables, i.e., well-being, as well as the LIWC proxies for the psychological needs autonomy, competence, and relatedness are shown on the left-hand side—each row summarizes the results of the according fixed effects regression for this dependent variable. The columns differentiate between the (1) short-term effect (i.e., during vs. before funding), (2) long-term effect (i.e., after vs. before funding), and (3) difference between the short- and long-term effect (results of a Wald test on the coefficients of (1) and (2)). To facilitate the interpretation of the results, we provide a descriptive summary in the last column on the right-hand side (Kaish and Gilad, 1991).

### 5.2. Mediation analyses

Before estimating the mediation models, we show that the six LIWC proxies significantly relate to entrepreneurs' eudaimonic well-being ($\beta_{authenticity} = 0.04$, $p_{authenticity} = 0.00$; $\beta_{emotion} = 0.46$, $p_{emotion} = 0.00$; $\beta_{achievement} = 0.97$, $p_{achievement} = 0.00$; $\beta_{clout} = 0.04$, $p_{clout} = 0.00$; $\beta_{affiliation} = 1.50$, $p_{affiliation} = 0.00$; $\beta_{social} = 0.37$, $p_{social} = 0.00$). As this is the case, we proceed with our analysis. We report results of the indirect effects in Table 3.

H2b proposes that the extent to which entrepreneurs' need for autonomy is met mediates the relationship between angel funding and entrepreneurs' well-being. As hypothesized, the indirect effects of angel funding on well-being through the two proxies for autonomy have a negative point estimate and are significant, thus supporting H2b.

H3b proposes that the extent to which entrepreneurs' need for autonomy is met mediates the relationship between angel funding and entrepreneurs' well-being. The results show that the indirect effect of angel funding on well-being has a positive point estimate and is significant for the proxy 'clout,' while it shows a tendency to significance ($p \leq .10$) for the proxy 'achievement,' thus partially supporting H3b.

H4b proposes that the extent to which entrepreneurs' need for relatedness is met mediates the relationship between angel funding and entrepreneurs' well-being. As hypothesized, the indirect effects of angel funding on well-being through the two proxies for

**Table 3**
Bootstrapped indirect results for mediation analysis.

| | Model: Angel funding effect (via mediation variable) on entrepreneurs' eudaimonic well-being | | | |
|---|---|---|---|---|
| Mediation variables | Boot indirect effect | Boot standard error | [95 % bias-corrected CI] | Boot p-value |
| Autonomy | | | | |
| Authenticity | −0.07 | 0.03 | [−0.128; −0.016] | 0.03 |
| Emotion | −0.14 | 0.03 | [−0.206; −0.074] | 0.00 |
| Competence | | | | |
| Achievement | 0.04 | 0.02 | [−0.003; 0.084] | 0.10 |
| Clout | 0.29 | 0.05 | [0.201; 0.390] | 0.00 |
| Relatedness | | | | |
| Affiliation | 0.18 | 0.03 | [0.116; 0.246] | 0.00 |
| Social | 0.61 | 0.06 | [0.494; 0.746] | 0.00 |

*Notes.* CI = Confidence Interval; Bootstrap sample size = 1000. Controlling for variables described in method section.

relatedness have a positive point estimate and are significant, thus supporting H4b.

### 5.3. Robustness tests

#### 5.3.1. Verifying the usage of proxies to capture psychological needs

As we are among the first to assess psychological needs based on large-scale secondary data using language analysis, we verify the usage of our proxies for autonomy (i.e., authenticity, emotion), competence (i.e., achievement, clout), and relatedness (i.e., affiliation, social) by two means.

*5.3.1.1. Interviews with entrepreneurs.* First, we conducted 18 semi-structured interviews with entrepreneurs, as "qualitative studies are ideally suited to examine whether needs-based experiences naturally emerge as part of individuals' narratives" (Vansteenkiste et al., 2020, p. 6). We asked entrepreneurs to reflect on the three psychological needs for autonomy, competence, and relatedness and describe how they would communicate if they felt their needs were met. The results show that entrepreneurs associate their psychological needs with the respective proxies, which supports our choice of proxies based on SDT and the literature. Due to the limited space, we detail our interview findings in Web Appendix B.

*5.3.1.2. Human ratings of tweets.* Second, we compare humans' evaluations of the tweets regarding the three psychological needs with the results of our language analysis using the LIWC proxies. To do so, we presented a subsample of tweets to 240 Prolific users. The Prolific platform is highly suitable for research purposes, as it attracts diverse and attentive users and has been used in disciplines such as economics and psychology (Mochkabadi et al., 2024; Palan and Schitter, 2018). To form the subsample, we randomly chose 150 entrepreneurs (9 %) from our sample and selected their first and last post-investment tweets as well as eight randomly selected post-investment tweets. To ease interpretation for human raters, we excluded tweets that only contained links (i.e., http//:…). After the survey, we excluded raters who took <60 s for the survey or failed the attention check, resulting in a final sample of 231 raters. Each participant rated the tweets of three different entrepreneurs regarding the associated respective entrepreneur's degree of autonomy, competence, and relatedness on a 5-point Likert scale (e.g., this individual has a high level of autonomy: 1 = strongly disagree, 5 = strongly agree). Next, we calibrated the answers of human raters along with our LIWC proxies in 100th percentiles and assessed whether the human ratings of the three psychological needs differed from the results of our proxies for the same needs. Conducting an ANOVA, we find no significant differences between the human rating of the three psychological needs and our LIWC proxies.[1] Put differently, the human rater score for the need fulfillment of entrepreneurs, as verbalized in entrepreneurs' tweets, is similar to the scores we obtained using LIWC proxies. This result supports the robustness of our approach to measuring entrepreneurs' psychological needs for autonomy, competence, and relatedness based on tweets using LIWC proxies.

Given these two robustness tests, we overall conclude that our analytical procedure is robust and that our proxies represent the three psychological needs well.

#### 5.3.2. Validating the usage of tweets to assess entrepreneurs' fulfillment of psychological needs

Tweets analysis has previously been applied to gather (psychological) insights into entrepreneurs (e.g., Block et al., 2019; Fisch and Block, 2021; Obschonka et al., 2017). We, however, aim to validate that assessing tweets is a reliable approach to analyzing entrepreneurs' fulfillment of psychological needs—in other words, that tweets represent a less deliberate communication when compared to an entrepreneur's intentional impression management. Moreover, we analyze tweets entrepreneurs posted on their official X accounts, assuming they wrote those tweets themselves—which we aim to verify with three robustness tests. Conducting our robustness tests, we follow recommendations by Xu et al. (2020) to avoid threats prevalent in organic data (i.e., data documenting naturally occurring activities on platforms such as X). These recommendations are to include human experts, as explained above, investigate data from multiple samples, and vary operationalizations.

*5.3.2.1. Comparison with podcast data.* First, we manually collected and analyzed podcast data for a randomly selected subsample of 152 entrepreneurs and compared personality traits (i.e., openness to experience) and cognitive styles (i.e., memory) with the entrepreneurs' tweets prior to funding. The reason is that entrepreneurs likely reveal their true personality and preferences in a podcast, as scholars show that impression management loses its impact over time and is difficult to maintain in spoken language (e.g., Bolino et al., 2014). We selected podcasts from one of the three main podcast providers (i.e., Spotify, Apple, YouTube). The podcast recordings take an interview format, with the interviewer asking questions that the entrepreneur answers spontaneously. As these podcasts last 45 min on average, it is likely that entrepreneurs represent themselves in an unfiltered, authentic way and use natural language.

If the results of our podcast data analysis over two periods indicate no significant differences in personality traits and cognitive styles when compared to entrepreneurs' pre-funding tweets, we can conclude that the tweets posted on the entrepreneurs' X accounts were indeed issued by the entrepreneurs themselves and thus reflect their true self. Tweets analysis would hence be a reasonable approach to assessing entrepreneurs' innate psychological needs. We transcribe the podcast audio files and retain only the text spoken

[1] Human rating of autonomy versus LIWC proxies (authenticity; emotion): $F(2,441) = 0.56$, $p = .57$); human rating of competence versus LIWC proxies (achievement; clout): $F(2,441) = 0.30$, $p = .74$); human rating of relatedness versus LIWC proxies (affiliation; social): $F(2,441) = 0.45$, $p = .64$)

by the entrepreneur, which we analyze using LIWC. Regarding the personality traits, we compare entrepreneurs' openness to experience using the LIWC proxy 'curiosity,' which captures an individual's interest in new knowledge or experiences. Openness to experience is considered an important personality trait that is stable over time (Ciavarella et al., 2004; DeNisi, 2015). In addition, we compare entrepreneurs' cognitive styles—their preferred way of thinking, making assessments, and decisions (Mitchell et al., 2002)—across both communication formats, as cognitive style is, to a certain degree, determined by individual-level characteristics (see Schade and Schuhmacher, 2022). In line with the literature, we assess entrepreneurs' cognitive styles by measuring their memory (Baron and Ward, 2004) with the LIWC proxy 'memory,' which reflects individuals' references and attention to their memories and the preferred processes of recall. We report the results in Table 4.

*5.3.2.2. Investigating early-stage ventures.* Second, building on Fisch and Block (2021), we split our sample and investigate only early-stage ventures that were founded less than one year before. The reasoning is that early-stage ventures face resource constraints (Soto-Simeone et al., 2020) and are thus less likely to have a dedicated person managing the entrepreneurs' tweets; instead, the entrepreneurs tweet themselves. Moreover, entrepreneurs of early-stage ventures use X personally (Fisch and Block, 2021) and might thus communicate authentically and naturally on social media, such as X, as the number of followers is initially limited, with few external stakeholders present. All long-term results remain robust compared to our main analyses including ventures in various development stages. This finding supports our assumption that the tweets in our sample were written by the entrepreneurs themselves, are authentic, and thus express their innate psychological needs. We detail these results in our Web Appendix C.

*5.3.2.3. Comparing tweets before and after receiving funding.* Third, we compare communication patterns (i.e., number of words used in one sentence), personality traits (i.e., openness to experience), and cognitive styles (i.e., memory) in entrepreneurs' tweets before and after receiving funding. Entrepreneurs frequently begin tweeting on a personal note (Fisch and Block, 2021) before receiving funding, and these dimensions (i.e., patterns, traits, and styles) remain stable over time (e.g., Ciavarella et al., 2004; DeNisi, 2015). Our LIWC analysis results show no difference in entrepreneurs' communication patterns, personality traits, and cognitive styles before and after receiving funding, indicating that the same person (i.e., the entrepreneur) sent the tweets. Similarly, the consistent results also indicate that the entrepreneur communicates in a natural, less deliberate way, as impression management is difficult to maintain over a longer period of time (Bolino et al., 2014). We detail our results in Web Appendix D.

Overall, these three robustness tests provide support that our approach to analyzing entrepreneurs' innate psychological needs based on entrepreneurs' tweets is suitable and ensure the proper use of our organic data, as suggested by Xu et al. (2020).

### 5.3.3. Endogeneity

Finally, we validate the robustness of our results against sources of potential endogeneity. We filter our sample for the availability of detailed information on entrepreneurs' human capital and sufficient textual data for all three temporal segments, which poses a potential risk for sample-induced endogeneity. We address this concern two-fold: First, we compare mean values of individual-, venture-, and investment-level characteristics of the initial and final samples (7055 vs. 1667 entrepreneurs). As significant differences are generally of rather limited magnitude, we do not expect these to unduly bias our results. Second, given the possibility that we exclude some entrepreneurs from the final sample due to a partial lack of tweets for all three time periods, we investigate this dropout; however, there is no indication that this might bias our results. In Web Appendix E, we detail our two approaches to addressing sample-induced endogeneity and also describe our measures to mitigate reverse causality and measurement error.

## 5.4. Post-hoc analyses

In our main analysis, we investigate the impact of angel funding—via autonomy, competence, and relatedness—on entrepreneurs' well-being in the long term (>90 days after funding). However, there might be short-term effects on the entrepreneurs' psychological needs—and, hence, their well-being—that occur during funding (90 days before and 90 days after the funding event). Accordingly, we also analyze these short-term effects and report them in Table 3. Interestingly, we find that angel funding negatively relates to well-being in the short term ($\beta = -0.69$, $p < .02$), which is contrary to the positive long-term effect we find for H1. Regarding the relationship between angel funding and the extent to which entrepreneurs' psychological needs are met, we find that the short-term effects remain relatively robust when compared to the long-term effects we show for H2a, H3a, and H4a. We detail the short-term effects in

**Table 4**
Multivariate fixed effects panel regression results comparing podcast data with tweets prior to funding.

| Dep. variables | Coefficient | p-value | Standard error | [95 % CI] | Interpretation of results |
|---|---|---|---|---|---|
| Personality trait | | | | | |
| Openness to experience | −0.03 | 0.36 | 0.03 | [−0.092; 0.033] | No significant difference in personality traits between podcast data and tweets before funding |
| Cognitive style | | | | | |
| Memory | −0.01 | 0.34 | 0.01 | [−0.022; 0.008] | No significant difference in cognitive style between podcast data and tweets before funding |

*Notes.* Results of the multivariate fixed effects panel regression (within-estimator) performed at the level of the entrepreneurs. Baseline for comparison is the temporal segment before funding.

Web Appendix F.

## 6. Discussion

Raising funds from angel investors is a critical step in the entrepreneurial journey. While literature agrees on angels' significant post-investment contributions on a venture level, their individual-level impact on entrepreneurs, particularly their eudaimonic well-being, remains understudied (e.g., Collewaert and Sapienza, 2016). We leverage a relatively novel yet validated methodological approach and, applying an SDT perspective, use entrepreneurs' tweets to explore the long-term effects of angel funding on entrepreneurs' well-being. Our results extend research on eudaimonic well-being and SDT and the interplay between entrepreneurs and investors.

### 6.1. Theoretical implications

First, we advance research on entrepreneurs' eudaimonic well-being (Ryan and Deci, 2001; Wiklund et al., 2019). Taking a more nuanced, contextualized perspective, we expand prior studies investigating the effect of self-employment on eudaimonic well-being in general (Shir et al., 2019; Stephan et al., 2020a). Specifically, we explore how external factors, such as angel funding and angel investors' continued presence, stimulate or hinder entrepreneurs' eudaimonic well-being, thereby answering research calls to uncover important antecedents to eudaimonic well-being (Stephan, 2018). Our results show that angel funding positively relates to entrepreneurs' eudaimonic well-being in the long term. Thus, from an SDT perspective, angel funding provides a social context that enables the entrepreneur to feel vital and intrinsically motivated (Deci and Ryan, 2000). Interestingly, however, our post-hoc analysis reveals that this positive effect only unfolds in the long term. In the short term (i.e., in the first 90 days after receiving funding), angel funding adversely affects entrepreneurs' eudaimonic well-being. One explanation for this initial negative relation might be that the downsides of angel investor involvement prevail in the short term—even though angel funding is a positive signal in the long run, implying the recognition of ventures' growth potential and ultimately improving entrepreneurs' reputation (Ferrary and Granovetter, 2009). However, at the outset, investors need to learn about the venture, which is time-consuming, and they might impose specific reporting standards and demand involvement in decision-making—an unfamiliar situation requiring entrepreneurs to adapt (Bammens and Collewaert, 2014), which might impair their well-being. Yet, over time, entrepreneurs get used to the angel investors' continued presence; the downsides fade while the benefits prevail, increasing entrepreneurs' well-being. Our finding that the short-term effects of angel funding on entrepreneurs' eudaimonic well-being differ from its long-term effects might help explain the discordant past results that entrepreneurs experience both higher and lower well-being (Shir et al., 2019; Stephan et al., 2020a, 2023). Our study thus sheds light on the need to examine contextual circumstances when investigating the interplay between entrepreneurship and eudaimonic well-being (Shir and Ryff, 2022).

Moreover, we contribute to research on eudaimonic well-being by explaining and empirically estimating the mediating effects of the three psychological needs for autonomy, competence, and relatedness, which scholars demand (Nikolaev et al., 2020; Shir et al., 2019). We also directly respond to Stephan (2018, p. 312), who encourages research to illuminate "how and when constraints on entrepreneurs' autonomy [as one of three innate psychological needs driving well-being] may arise (e.g., in response to […] investments from a particular investor)." Our results indeed reveal a negative association between angel funding and autonomy in the long term, manifesting in reduced authenticity and decreased emotion. This appears to be a consequence of an external source—the angel investors' monitoring of entrepreneurs through their involvement in venture formation and evaluation. The external regulation entrepreneurs experience due to the investors' presence (Ryan et al., 2008) diminishes their autonomy and seems to constrain publicly expressed emotions. Interestingly, however, the net effect of angel funding on entrepreneurs' well-being is positive, even though the extent of the satisfaction of entrepreneurs' need for autonomy is lower. One explanation might be that we investigate the extent of need satisfaction rather than need strength, which is in line with SDT and most studies examining basic psychological needs (Deci and Ryan, 2000; van den Broeck et al., 2016; Vansteenkiste et al., 2020). Research shows that entrepreneurs report a higher level of autonomy than nonentrepreneurs (Lange, 2012; Stephan et al., 2020a). Thus, while business angel involvement reduces the extent to which entrepreneurs' need for autonomy is satisfied, it seems that this need fulfillment suffices for entrepreneurs to experience a high level of entrepreneurial autonomy. Furthermore, the strength of entrepreneurs' need for autonomy—in line with the increased extent to which their needs for competence and relatedness are met— might result in a positive overall effect of business angel involvement on entrepreneurs' well-being. Indeed, we find a positive association between angel funding and the extent of satisfaction of entrepreneurs' needs for competence and relatedness, corresponding to the notion that entrepreneurs' ventures are a central part of their identity (e.g., Cardon et al., 2005). Hence, successful fundraising appears to translate into the recognition of individual-level efforts, which also manifests in entrepreneurs' well-being, as the net effect of angel funding on well-being is positive. In sum, our empirical evidence underscores the criticality of examining entrepreneurs' social context and stakeholders to understand differences in psychological need fulfillment and well-being (Stephan et al., 2020a). Moreover, our findings underline that research should consider the three basic psychological needs separately rather than a global measure (Deci and Ryan, 2000; van den Broeck et al., 2016), given that the social context—in our study business angel involvement—can have divergent effects on the satisfaction or frustration of these needs, which highlights their respective, distinctive roles. In addition, we are among the first to build on the work of Fisch and Block (2021) and use a longitudinal research design to differentiate short- and long-term effects of angel funding on entrepreneurs' eudaimonic well-being. We expand existing research on eudaimonic well-being by focusing on cross-sectional data (e.g., Nikolaev et al., 2020; Shir et al., 2019) and answer a call by Stephan et al. (2023, p. 580) to "explore the mechanisms through which entrepreneurship is related to wellbeing [*sic*] over time."

Second, we theoretically and methodologically advance SDT literature. From a theoretical point, we add to the knowledge about the role social contexts play for eudaimonic well-being and how the extent of psychological needs satisfaction mediates this relationship. While literature so far considers proximal levels of contexts (e.g., family or supervisor support), we examine the more distal context of external stakeholders, namely the (long-term) involvement of angel investors (Deci et al., 2017; Deci and Ryan, 2012). Thus, by using SDT as an overarching theoretical framework, we respond to calls for more theory- and context-sensitive research in entrepreneurship (e.g., Shepherd et al., 2019; Stephan et al., 2023). At the same time, we extend SDT methodologically: While previous research heavily relies on primary data (Deci and Ryan, 2000), we apply a novel approach by using LIWC analysis to measure psychological proxy variables for innate need fulfillment derived from secondary data sources. Thus, on the one hand, we leverage a new data source in well-being research by drawing on unique large-scale textual data from X, comprising over 125 million words. While existing literature highlights the timeliness and relevance of studying tweets, this medium remains underused as a means to assess underlying psychological factors (Fisch and Block, 2021; Fischer and Reuber, 2014). We address this research gap by showing that angel funding affects entrepreneurs' well-being with nuanced consequences for their psychological needs (Ryan and Deci, 2000).

On the other hand, we are among the first to derive and verify proxy variables to measure individuals' fulfillment of their innate psychological needs. SDT postulates that needs are internalized and observable in behavior and communication (Deci and Ryan, 2000; Vansteenkiste et al., 2020). Building on this theory, we conduct various robustness tests to verify our unique approach empirically and validate the selection of our proxies through qualitative interviews and human expert ratings. Moreover, we verify the validity of using entrepreneurs' X tweets by comparing entrepreneurs' language usage on X with their language usage in podcasts. We further examine their language usage before and after the angel investment and conduct another analysis where we include only early-stage ventures. All robustness tests support our unique approach of using LIWC proxies to assess entrepreneurs' psychological needs based on their tweets. We thus directly respond to Shir and Ryff (2022, p. 1676), who state that "alongside action- and context- specific longitudinal data collection, we advocate mixed methodological approaches […] of how entrepreneurship and well-being relate to one another over time." We also address calls by Ryan and Deci (2019) to refine the methods and measures in SDT research and by Stephan et al. (2023), who encourage scholars to study large-scale, secondary data. Moreover, as our LIWC analysis explores observations over time, we respond to an editorial prompting the application of alternative analytical techniques in longitudinal settings (Wiklund et al., 2019).

Third, we enhance the understanding of the angel investor–entrepreneur relationship and the consequences of entrepreneurial financing. Our work directly addresses existing gaps on the individual-level implications of funding (Collewaert and Sapienza, 2016) and provides empirical evidence for how investments affect entrepreneurs. The results underline that angel funding influences entrepreneurs' well-being not only momentarily but over time, as the angel investors maintain their presence in the venture. These insights enhance the understanding of the investor–investee dyad beyond its financial component. We also present empirical evidence for the value-destroying potential of investor presence, as called for by Huang and Knight (2017). For instance, we show that entrepreneurs can feel constrained by overly present angel investors, leading to decreased autonomy and, ultimately, lower well-being. This opens up avenues for further research on the investor–investee dyad (Lockett et al., 2006), such as exploring contextual factors mitigating or amplifying the effects on entrepreneurial well-being.

### 6.2. Practical implications

Our results offer valuable insights for practitioners, especially for entrepreneurs, (angel) investors, universities, and policy-makers. With our study, we draw attention to the little discussed personal implications of bringing investors on board, which yields several benefits for entrepreneurs: First, being aware of potential consequences helps entrepreneurs make an informed decision when it comes to accepting (angel) investor funding. Entrepreneurs should carefully weigh their loss of autonomy against the monetary benefit of funding and associated increases in competence and relatedness. This is in line with Wasserman's (2008) description of the trade-off between capital and control. We find that the most significant impact of angel funding on entrepreneurs' well-being emerges in the long term and depends on angels' post-investment behavior; the magnitude of the impact is likely contingent on the relationship between angel investor and entrepreneur (e.g., Collewaert, 2012). Second, based on our findings, entrepreneurs can learn to counteract the negative effects of a decreasing autonomy: They could, for example, give up only limited equity or establish a clear governance structure restricting investors' evaluation involvement. Angel investors may leverage our insights to adapt their involvement and coach entrepreneurs to improve their relationship. In this vein, previous research finds a clear association between entrepreneurial well-being and venture success (Stephan, 2018) and highlights the risks of dysfunctional relational dynamics (Collewaert, 2012). Last, universities and policy-makers aiming to increase entrepreneurial well-being—which might motivate individuals to consider starting a new venture—can leverage our insights to devise training programs or host fairs and networking events that facilitate the relationship-building between entrepreneurs and angel investors, thereby improving entrepreneurs' well-being.

### 6.3. Limitations and opportunities for future research

Our study provides multiple fruitful avenues for research and is subject to some limitations that future works could address. First, while SDT claims that all individuals benefit or suffer from the extent to which their needs are satisfied or frustrated (Deci and Ryan, 2000), Chen et al. (2015, p. 233) state that "the universality of this psychological process does not exclude the possibility that there could be important individual and cultural differences in how people get the needs satisfied and how people perceive need satisfaction and frustration from a contextual event." Our results show that while the context of angel funding reduces the extent to which entrepreneurs' need for autonomy is met, it overall increases entrepreneurs' well-being in the long term. Hence, our results seem to

indicate that need strength might be relevant to explain why entrepreneurs experience well-being although one of their three universal needs is frustrated. While this seems plausible, further SDT research is needed that investigates need strengths (see also van den Broeck et al., 2016; Vansteenkiste et al., 2020). Such research could add to a rather moderate view on the STD claim that needs are universal (Chen et al., 2015). Scholars also emphasize that psychological needs such as autonomy might change over time or fluctuate depending on the venture stage (e.g., Frese and Gielnik, 2014; Vallerand and Houlfort, 2003). Hence, future research should expand our study and investigate the short-term and long-term impacts angel funding has on psychological needs, which was beyond our study's scope. Yet another avenue for future research lies in explicitly addressing the heterogeneity inherent in angel investors and entrepreneurs. Beyond human or social capital differences, dimensions such as social identities (Sieger et al., 2016), (dark) personality types (Schmidt et al., 2024) or entrepreneurial orientation (Kindermann et al., 2022) might shape how funding affects entrepreneurs' well-being.

Second, our mediating variables for the psychological needs following SDT are based on LIWC proxies. While research has established LIWC analysis as the gold standard for computerized language analysis (Pennebaker et al., 2015), it is a closed-vocabulary approach that takes words at face value based on the underlying dictionaries (Boyd et al., 2022). Moreover, our results draw on entrepreneurs' tweets, which might not comprehensively reflect their actual personalities, as they could strategically leverage X to portray a desired self-image or filter their public communication to present themselves in a certain way (Fisch and Block, 2021). Thus, using X as a data source might not capture the full complexity of entrepreneurs' psychological states (González-Bailón et al., 2014; Stieglitz et al., 2018). In addition, researchers—for example, Tufekci (2014) and Ruths and Pfeffer (2014)—highlight potential biases, such as selection biases, in social media data, as individuals using platforms such as X might not always represent the broader entrepreneurial population. Thus, while tweets are a valuable data source that is undirected, rich, and timely, they likewise require scholars to verify the proper use of the data collected due to "the difficulty of accessing data sources (e.g., individual human users of Twitter)" (Xu et al., 2020, p. 1268). We conduct five robustness tests that support the use of our LIWC proxies and entrepreneurs' tweets to assess their psychological needs. In addition, our approach is in line with various works investigating entrepreneurs' psychological needs based on tweets (e.g., Block et al., 2019; Fisch and Block, 2021; Obschonka et al., 2017; Obschonka and Fisch, 2018; Tata et al., 2017). Future research could build on these insights and complement our study with a multi-method approach combining social media data with survey or interview data (see Creswell and Clark, 2017), for example, manual content analysis by human experts or in-depth interviews. Such additional approaches could help extend our findings beyond the robustness tests we conducted, thereby providing a richer understanding of entrepreneurs' psychological states and increasing the trust in organic data even further, as Xu et al. (2020) suggest.

Third, for our independent variable, we follow Fisch and Block (2021) and segment the time around angel funding into three periods to investigate both short- and long-term effects. While this enables a longitudinal research design (superior to cross-sectional studies and called for by, e.g., van den Broeck et al., 2016), it still simplifies the development of need fulfillment. Scholars might address this through a more granular temporal segmentation, enabling a more fine-tuned perspective of ups and downs along the way. In addition, while we control for various factors on the levels of the entrepreneur, angel investor, venture, industry, and macro-economy, other dynamics might explain our relationship, such as an increased media attention after an investor's arrival. Future studies could explore this. In the same vein, we encourage future research to look beyond the number of board seats held by angel investors and include other potential indicators of investor involvement, such as angel investors' advisory roles, mentoring, or operational input (Sapienza and Korsgaard, 1996; Wiltbank et al., 2009).

Fourth, relating to our dependent variable, we investigate eudaimonic well-being, as it entails optimal psychological functioning and thriving (Ryan and Deci, 2001). In contrast, hedonic well-being focuses on individuals' happiness and concerns the attainment of pleasure versus pain (Ryan and Deci, 2001). We concentrate on entrepreneurs' eudaimonic well-being, as it is more critical for firm performance than its hedonic counterpart (Stephan, 2018). However, as eudaimonic and hedonic well-being capture different facets of well-being (Seligman, 2002; Waterman, 2007), future research should expand our model to investigate the effect of angel involvement on entrepreneurs' hedonic well-being. Unfortunately, this was beyond our study's scope. Likewise, while we measure eudaimonic well-being using Ryff's (1989, 2014, 2019) framework, we encourage scholars to include different well-being proxies (e.g., psychological vs. emotional well-being) to gain insights into the various facets of well-being.

Finally, we focus on ventures headquartered in the United States and hence analyze a specific culture. According to SDT, psychological needs are universal (Deci and Ryan, 2000); however, the literature likewise acknowledges that culture plays a role in the fulfillment of needs and well-being (Deci et al., 2017; Deci and Ryan, 2012). Thus, we call on scholars to investigate our research model in different cultures to assess its generalizability.

## CRediT authorship contribution statement

**Corinna Vera Hedwig Schmidt:** Writing – review & editing, Writing – original draft, Project administration, Conceptualization. **Patrick Sven Gaßmann:** Writing – original draft, Software, Methodology, Data curation, Conceptualization. **Nele McElvany:** Writing – review & editing. **Tessa Christina Flatten:** Writing – review & editing, Writing – original draft, Supervision, Conceptualization.

## Declaration of competing interest

None.

## Acknowledgements

We thank Field Editor Veronique Collewaert for her thoughtful feedback and guidance during the review process and the three anonymous reviewers for their constructive comments.

## Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jbusvent.2024.106468.

## Data availability

Data will be made available on request.

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