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Emotions and entrepreneurial finance: Analysis of venture capitalists' and business angels' digital footprints on Twitter

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Abstract

Emotions are a central concept in previous entrepreneurship research, but this is mainly related to entrepreneurs and their entrepreneurial journey. However, venture capitalists (VCs) and business angels (BAs), two critical investors in the entrepreneurial finance literature, are essential actors in the entrepreneurial process. Still, little is known about investor emotions in this context. Therefore, in this study, we ask how venture capitalists differ from business angels in terms of their expressed emotions. To this end, we use an increasingly familiar research approach by examining the digital footprints of these investors on Twitter. For this purpose, we identify 822 investors from Crunchbase and analyze their 994,969 Tweets with Linguistic Inquiry and Word Count (LIWC) as a text analysis tool. Our results show that venture capitalists display more positive emotions on Twitter than angel investors, meaning that we find an association between VCs and emotional tone. Furthermore, in our post-hoc analysis, we explore further explanations for the differences between VC and BA. In doing so, we show differences in their expressed cognitive processes as well as in their communicated drivers. In both concepts, we find positive associations with the investor type of VC. To conclude this paper, we develop implications for practice and further research based on the results.

Keywords Business angels · Computer-aided text analysis (CATA) · Emotions · Entrepreneurial finance · Venture capital · Twitter

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Introduction

To ensure the survival and growth of their start-up, acquiring external financial resources is a crucial challenge for entrepreneurs (Ferrati & Muffatto, 2021). This is because start-ups in the early stages of their life cycle lack the necessary revenues (Block et al., 2018), and entrepreneurs' own capital is limited (Ferrati & Muffatto, 2021). Given this circumstance, debt financing is usually not an option for entrepreneurs, who consequently turn to equity investors to finance their ventures (Block et al., 2018). Therefore, entrepreneurs must enter into partnerships with other stakeholders with these necessary resources willing to invest them in uncertain and risky scenarios.

In this finance situation, venture capitalists (VCs) and business angels (BAs), in particular, are essential and traditional partners who fill these funding gaps and bring financial and non-financial value to the table (Cohen & Wirtz, 2022; Fairchild, 2011). For example, in the USA, the rising importance of external capital providers' financial resources is also reflected in the National Venture Capital Association's 2020 annual report. In 2020, 164 billion dollars were invested in the US, an increase of 430 percent compared to 2007 (National Venture Capital Association, 2021). In Europe, the investment volume has also increased by 24 percent, from 80.8 billion in 2007 to 100.5 billion in 2020 (Invest Europe, 2022). With the financial support of these investors, entrepreneurs can recruit new employees, increase capacities for marketing activities (Huang & Knight, 2017), and scale their ventures. Cooperation with these investors, therefore, makes an essential economic contribution to the establishment and development of innovative ventures (Gompers et al., 2020).

Both investors, VCs and BAs, are part of the entrepreneurial process of innovative start-ups and, therefore, cooperate with entrepreneurs and start-ups operating in uncertain and risky contexts (Gompers et al., 2020; Huang, 2018). These investors thus face agency risks resulting from information asymmetries between entrepreneur and investor (Cable & Shane, 1997; Kollmann & Kuckertz, 2010). Due to this situation, the individual actors involved in the process are also influenced by their feelings and emotions (Cardon et al., 2012), which may affect their behavior (Baron, 2008; Jing et al., 2013). Emotions can play a role in finding opportunities, evaluating them, and ultimately deciding for or against opportunities (Cardon et al., 2012; Foo, 2011; Huang, 2018). Furthermore, emotions are part of relationship strategies after investment decisions and influence how partners react (Fili, 2014). Overall, emotions influence actions and provide the necessary stimuli for them (Goleman, 2012). The emotional journey of entrepreneurship (Cardon et al., 2012), therefore, also includes investors with their individual emotions because they are often part of entrepreneurial processes.

While a large stream of research has already developed in the entrepreneurial finance literature focusing on VCs and BAs (Drover et al., 2017; Ferrati & Muffatto, 2021; Tenca et al., 2018), research on their emotions is less common. Most previous entrepreneurship studies on emotions focus primarily on entrepreneurs' emotions, illustrating how emotions and feelings influence the cognitive abilities of entrepreneurs and, thus also, the evaluation of opportunities (Baron, 2008; Cardon et al., 2012; Foo, 2011; Welppe et al., 2012). Though prior research already considers individual

investors' traits and characteristics (Block et al., 2019; Franić & Drnovšek, 2019; Mitteness et al., 2012), surprisingly, we know little about VCs' and BAs' emotions.

From an entrepreneurial finance perspective, however, understanding investor emotions is essential for three reasons. First, emotions influence the evaluation of information; thus, they are also part of individual cognitive processes (Triberti et al., 2017). This means that emotions affect how risk and information are evaluated and decisions are made (Han et al., 2007). As a result, decision behavior in the context of uncertainty is also emotionally influenced (Prietzl, 2020). Consequently, a deeper understanding of VCs' and BAs' emotions would help research on VCs' and BAs' investment behavior (Cohen & Wirtz, 2022; Ferrati & Muffatto, 2021; Silva, 2004) to further complete this big picture because, ultimately, emotions are an "impulse to act" (Goleman, 2012, p. 6).

Second, after the investors have given their emotional commitment to invest (Wallnöfer & Hacklin, 2013), their emotions are also relevant in the post-investment phase. For example, Fili (2014) shows that investors use different emotional strategies in their post-investment relationships with entrepreneurs. From a process perspective, emotions are thus of great importance for both the pre- and post-investment phases to understand the relationships in different facets. This would open up new practical and theoretical implications for investor relations literature on these investors (Sapienza & Korsgaard, 1996; Kollmann & Kuckertz, 2006; Wallnöfer & Hacklin, 2013).

Third and overall, emotions are an essential research stream for understanding personality. Psychological analyses show that personality and emotions are closely linked, which means that personality also influences emotion control (Morawetz et al., 2017). Thus, emotions are also present in expressions of the Big Five personality traits, such as neuroticism (Obschonka et al., 2017), which recent studies of investor personality also examined (Block et al., 2019).

Since the entrepreneurial finance landscape is becoming increasingly heterogeneous and entrepreneurs need to build relationships with different players (Block et al., 2018; Bonini & Capizzi, 2019), we focus on VCs and BAs, who are at the center of financing opportunities for start-ups (Hellmann et al., 2019). Furthermore, earlier studies have often contrasted these two traditional capital providers (Cohen & Wirtz, 2022; Fairchild, 2011; Hellmann et al., 2019; van Osnabrugge, 2000). From this previous research, we know that VCs and BAs differ regarding where their financial resources come from (De Clercq et al., 2006; Drover et al., 2017). VCs are associated with a VC organization, for example, as a partner or employee, where they manage funds provided by limited partners to invest in new and innovative business models (De Clercq et al., 2006; Gompers & Lerner, 2000). Accordingly, VCs invest their funds on behalf of others (Kuckertz et al., 2015) and represent the VC organization with their stakeholders.

In contrast, BAs are private investors investing their private financial resources (Drover et al., 2017). Moreover, BAs are primarily responsible to themselves and not to a third party in the negative case of a start-up's failure and a loss of investment. In sum, the critical difference between VCs and BAs is that VCs invest with a background of belonging to a VC organization, while BAs are private individuals (Bonini & Capizzi, 2019).

Since previous research shows that individuals' communication signals emotions (Tata et al., 2017), the key difference between VCs and BAs also suggests different behaviors in signaling emotions because of their different roles (professional role vs. private role). In his seminal work on the social relevance of roles, Goffman (1959) explains that individuals take on different social roles depending on circumstances and fulfill the expectations of others concerning those roles, which is why people behave differently depending on their roles. In a similar vein, VCs and BAs take on different roles. For this reason, we investigate the expressed emotions of these two investor types with the following research question: How do the expressed emotions of VCs differ from BAs?

To find an answer to our research question, we operationalize the emotions of VCs and BAs with the support of Linguistic Inquiry and Word Count (LIWC) software, a digital tool for text analysis (Pennebaker et al., 2015). The data for the analysis with LIWC represents the Twitter communication (Tweets) of 822 investors, allowing us to analyze 994,969 Tweets.

Through this study, we contribute to several research streams. First, we contribute to the overall emotion research in entrepreneurship (Baron, 2008; Cardon et al., 2012; Foo, 2011; Tata et al., 2017; Welpe et al., 2012) by empirically studying the expressed emotions of two critical investors in the entrepreneurial process. Previous research on emotions largely overlooks investors, as the earlier focus was on entrepreneurs and their emotions. With our study, we are thus also bringing investor emotions into the discussion. In this vein, we also address the general requirement from prior research to include emotional aspects in entrepreneurship research (Mitchell et al., 2007). To build a starting point for this new research focus, we follow previous research in similar fields (Obschonka et al., 2017) and compare these two groups with their expressed emotions.

Second, regarding the entrepreneurial finance literature, we contribute to research on VCs (e.g., Gompers and Lerner 2000; Gompers et al., 2020) and BAs (e.g., Maxwell et al. 2011; Paul et al., 2007) by analyzing and comparing the emotions of these investors. Although we already have some insights into the individual characteristics of VCs and BAs, such as financial or collaborative (De Clercq et al., 2006), research on personal characteristics further helps to complete the big picture of investors (Smith & Bergman, 2020). Therefore, as we contrast and compare the emotions of two key investors, this study also shows differences between VCs and BAs and expands this research stream (Chemmanur & Chen, 2014; Cohen & Wirtz, 2022; Fairchild, 2011). Consequently, we support research on the black box of investor psychology in the context of VC and BA research.

Third, we contribute methodically to the growing research stream of big data social media analysis within entrepreneurship (Block et al., 2019; Fisch & Block, 2021; Obschonka et al., 2017; Tata et al., 2017; Winkler et al., 2020) by using investors' digital footprints to investigate their emotions. While traditionally, researchers primarily use self-assessment of individuals to analyze personality characteristics, social media data opens up new opportunities and insights (Altmeier & Fisch, 2023; Block et al., 2019). Moreover, Block et al. (2019) point to the challenge of reaching target groups like those in our study for scientific purposes in other empirical settings.

For this reason, we are using Crunchbase and LIWC to break novel ground in data acquisition and address this challenge.

The remainder of this paper is structured as follows. Section 2 explains the conceptual background of emotions and the differences between VCs and BAs and develops our hypothesis. Section 3 is devoted to the study's methodological approach and describes the data collection process. The analysis of the digital footprints takes place in Sect. 4. Section 5 explains the key findings of the study. Finally, this study ends with Sect. 6 and some concluding remarks.

Conceptual background– emotions in the context of entrepreneurial finance research

Emotions and entrepreneurial finance

Research on emotions is primarily anchored in psychology (Barrett et al., 2007; Ekman, 1992), but has recently been a growing topic of discussion in entrepreneurship research as well (Baron, 2008; Cardon et al., 2012; Tata et al., 2017). Emotions are an overarching concept that explains feelings and moods (Cardon et al., 2012; Williamson et al., 2022a, 2022b). The literature divided emotions into two categories: trait emotion and state emotion. Emotion traits describe how individuals tend to exhibit certain emotional expressions, whereas state emotions follow events and describe the emotion situationally (Foo, 2011). Furthermore, emotions can be distinguished according to their valence, between positive and negative (Lerner & Keltner, 2000). Here, Tata et al. (2017) refer to the independence of both valences and the dominance that negative emotions can have so that they override positive ones. We build on this knowledge and use the distinction between positive and negative emotions as the basis for our study. With this, we also shed light on which emotional propensity VCs and BAs express in their emotions (positive or negative tone).

While entrepreneurial finance research uses various concepts to explain investors and their start-up relationships, it appears that emotion is an overarching concept here, but one that is linked to multiple other concepts. It takes place in evaluation decisions and is part of cognitive processes. Thus, although a variety of investor evaluation criteria are available (Ferrati & Muffatto, 2021), Huang (2018) describes the decision situation as complex due to the resulting equally diverse possibilities for analyzing an investment (e.g., economic, market). Consequently, the analysis and evaluation of investments require analytical and cognitive abilities on the part of investors. These cognitive processes, in turn, are influenced by the emotions of the respective person (Seo & Barrett, 2007). Above that, decision-making processes and investor relationships are linked to trust (Middelhoff et al., 2014; Schwarzkopf et al., 2010; Shepherd & Zacharakis, 2001), which includes emotions as a component (Middelhoff et al., 2014). Moreover, in the theoretical background of emotion research, trust is considered an emotion (Plutchnik, 1980). Furthermore, investors communicate with their entrepreneurs' (Middelhoff et al., 2014; Shepherd & Zacharakis, 2001) and emotions are, in turn, expressed through communication. Finally, emotions also appear in investors' personalities and illustrate how neurotic they might be (Block et

al., 2019). In sum, these examples show the importance and the cross-sectional function of emotions for understanding investors and their behavior.

At the intersection of finance and psychology issues, emotions are mainly discussed as an influencing factor when considering decision-making processes or investors' behavior (Chun et al., 2021; Jing et al., 2013; Lerner & Keltner, 2000). However, in the context of entrepreneurial finance, the evidence regarding investors' emotions is so far sparse. Jing et al. (2013) examine emotions in VC investment decisions from the perspective of a double-sided moral hazard relationship. Their study shows that negativity can also have a negative impact on the VC's decision-making behavior. Further studies in the context of angel investments are conducted by Huang and Pearce (2015) and Huang (2018). Both studies examine gut feelings and their influence on business angel investment behavior. The findings of Huang and Pearce (2015) indicate that angel investors use a combination of intuition and analysis to decide what shows that feelings (intuition) influence their behavior. Huang (2018) developed a model to provide an overarching concept for the gut feel of BAs. In this context, these results also indicate that investors adopt different attitudes toward risk. Another study on gut feeling of investors came from Levie and Gimmon (2008) and also shows that, in addition to rational reasons, emotions play a role in their decisions. Against the background of relationship management between entrepreneur and investor, Fili (2014) analyzes the negotiation strategies of investors. Different emotions are addressed by distinguishing between two strategies (good cop vs. bad cop). In this context, the results indicate that the emotion trust is an essential prerequisite for investors acting as good cops and, therefore, influences the choice of psychological behaviors (Fili, 2014). In sum, we find that little research captures investor emotions and that existing knowledge tends to focus primarily on BAs while neglecting other essential investors, such as VCs.

The research goals of previous studies on VCs and BAs have been to compare these two investors and uncover differences between them. In doing so, these studies examine differences in the screening of business plans (Mason & Stark, 2004), different decision and investment behaviors (Cohen & Wirtz, 2022; van Osnabrugge, 2000), the decision criteria (Granz et al., 2020), and also in relationship contracts (Chemmanur & Chen, 2014). So, we know to what extent these two investor types can differ in economic factors and behavior (De Clercq et al., 2006; Fairchild, 2011). What little is known about, however, are the personal characteristics of VCs and BAs, especially in comparison. Therefore, we examine VCs and BAs regarding their emotions and how they differ. Nevertheless, previous findings on VCs and BAs suggest that there are also emotional differences, which we argue for below in the hypothesis development.

Hypothesis development

The investor types VC and BA are two widely used capital providers for young innovative companies, which have already met with a broad interest in research in the past (Drover et al., 2017; Ferrati & Muffatto, 2021). In addition, both investor types have shown in practice that they significantly contribute to building successful innovative companies, such as Facebook or Dropbox. Even though VCs and BAs support start-

ups, there are critical differences between them, such as their investment behavior and their involvement. Therefore, due to these characteristic differences, we expect differences in their expressed emotions, especially in the expression of positive and negative emotions.

While BAs are individuals who contribute their private assets to the start-up (Drover et al., 2017), VCs are professional investors who draw on funds raised from limited partners (Kollmann et al., 2014). Accordingly, BAs invest their own funds while VCs manage the capital of others (e.g., large corporations or pension funds). BAs include, for instance, former entrepreneurs, wealthy celebrities, or experienced managers from established companies, which is where their financial resources come from (Block et al., 2019; De Clercq et al., 2006; Drover et al., 2017). For VC investors, this means that in addition to the entrepreneurs of their portfolio companies, they have other stakeholders in the form of limited partners whose interests they must take into account (Kollmann et al., 2014). In recent years, the opportunities for start-up financing have become more diverse due to the emergence of new resource providers (Block et al., 2018; Bonini & Capizzi, 2019; Drover et al., 2017), which also makes it challenging to characterize investment volumes of traditional investors such as VCs and BAs as these have also evolved.

Nevertheless, the literature suggests differences in investment volume between both types. While VCs typically invest sums averaging more than one million Dollars (De Clercq et al., 2006; National Venture Capital Association, 2021), the typical investment size of BAs is smaller with 50–100 K Dollars (De Clercq et al., 2006). Both types of investors also differ in the investment phase, as BAs invest in the early stage (De Clercq et al., 2006) in particular, and VCs tend to invest between the middle and late stages (National Venture Capital Association, 2021).

Besides these financial differences, VCs and BAs can also be distinguished in terms of collaboration and motives. In the contractual form of the relationship, angel investors show themselves to be less formal, just as in the performance of due diligence (Drover et al., 2017). BAs rely more on soft control than VCs, which are stricter in implementing control mechanisms (Bonini & Capizzi, 2019). Moreover, the drive of an angel investor is, besides the growth potential of a start-up, also the mentoring aspect in the relationship with the entrepreneur (De Clercq et al., 2006). For angel investors, emotional aspects (e.g., fun), therefore, play an essential role in their investments (Mason & Harrison, 1996), while VCs focus on financial reasons in particular (De Clercq et al., 2006).

Since both angel investors and VCs bring further value to the relationship (e.g., network, marketing know-how), entrepreneurs also benefit from them (De Clercq et al., 2006; Rosenbusch et al., 2013). However, Fairchild (2011) argues that these capabilities are more pronounced among VCs. In contrast, the relationship between BAs and entrepreneurs shows stronger empathy than VC relationships (Fairchild, 2011).

In summary, these results show that VCs and BAs differ on diverse criteria (De Clercq et al., 2006; Drover et al., 2017; Fairchild, 2011), so we expect this will also be evident through the communication of their emotions. Since emotions can be expressed through words towards others (Tata et al., 2017; Williamson et al., 2022a, 2022b), the literature on different roles and settings with varying styles of communication provides a possible explanation for this (Baldwin, 1992; Goffman, 1959; San-

chez-Burks et al., 2003). The findings of Hastings and Payne (2013) suggest that in the context of professional communication, equally professional emotion management is needed, which can be seen, for example, in the avoidance of signaling negative feelings. This suggests that professional communication should contain fewer negative emotions. Furthermore, it is known that the setting in which communication takes place influences emotional behavior (Baldwin, 1992). For example, the results of Sanchez-Burks et al. (2003) show that in-work communication differs from nonwork communication. Since VCs act on behalf of their VC organization and its stakeholders (e.g., limited partners) (De Clercq et al., 2006; Drover et al., 2017), professional communication is part of their job since they also represent their organization. As part of an organization, people are also brand ambassadors for it and influence its external perception (Dreher, 2014). Moreover, BAs are ascribed to having an entrepreneurial background as a former entrepreneur, while VCs are employed managers in charge of a VC fund (De Clercq et al., 2006), which links to previous findings of Obschonka et al. (2017) and their entrepreneur-manager comparison. They find stronger expressions of entrepreneurs' negative emotions in contrast to managers'.

In his seminal book on *The presentation of self*, Goffman (1959) explains a theory that people adapt their behavior, such as their communication, to the situation and the thereby associated social role to their person. Since other people are also involved in this situation and have expectations toward this role, people aim to fulfill the expectations of their role. However, the consequence of this is that although people aim to fulfill the expectations of the role, they are not necessarily themselves, e.g., authentic (Goffman, 1959). This theory thus builds a bridge to the impression management of people (Thompson-Whiteside et al., 2018), where it is argued that self-presentation is used when the image it creates is vital to realize goals (Bolino et al., 2016). Moreover, we know from VC research that the image of the VC organization is an important value that they bring to the relationship (Lee et al., 2011). For the context of our study, we build on the theory from Goffman (1959), which suggests that VCs belong to an organization (VC firm) they also represent, while BAs, as individuals, merely speak for themselves and, therefore, assume a different role. Because of this, VCs will tend to behave more professionally than BAs. In detail, we expect that the VC has professional emotion management with their VC organization in the background compared to the BA, who acts for personal reasons. Based on these considerations, we hypothesize that there is a difference between VCs and BAs in how they express their emotions:

Hypothesis: Investors who communicate more professionally with a higher degree of positive emotions are more likely to be venture capitalists than investors expressing more negative emotions.

Methods

Computerized emotion analysis with Twitter data

Today, there is big data of text available that can be studied with the support of computers (Obschonka et al., 2017; Prüfer & Prüfer, 2020; Schwab & Zhang, 2019). This form of analysis is called computer-aided text analysis (CATA) and makes it possible for researchers to identify structures within the communication (Short et al., 2010). Therefore, CATA is suitable for analyzing concepts that are rather difficult to study in traditional approaches (Röhm et al., 2018), such as emotions in the context of the present research. Obschonka et al. (2017), for example, criticize that analysis of personal characteristics with traditional approaches has mainly occurred through the self-assessment of the individuals concerned (e.g., with questionnaires). With the support of CATA, it is possible to explore psychological aspects, such as positive and negative emotions, with the words that individuals use in a text (Pennebaker et al., 2015). Accordingly, CATA allows studying the expressed emotions of people through their own words (Pennebaker et al., 2015; Schwartz et al., 2013).

In psychology as well as in entrepreneurship, LIWC has proven to be a powerful tool for analyzing psychological concepts with CATA (Fisch & Block, 2021; Schwartz et al., 2013; Tata et al., 2017). LIWC is a closed dictionary developed by Tausczik and Pennebaker (2010) and overall contains 93 psychological concepts, including emotions. Accordingly, LIWC is a software that uses dictionaries for CATA. In doing so, every dictionary includes words that represent an overarching topic (e.g., positive emotions), and then these words are used to search in a given text bundle (e.g., Tweets) to calculate how present this overarching topic is. For example, the LIWC dictionary to measure emotions in a text has a dictionary list of 620 words (e.g., love, sweet) (Pennebaker et al., 2015). The result of such a calculation process shows a number that can take a value of a minimum of 0 or a maximum of 99. The closer the text is to the maximum value, the more pronounced it is in this dictionary (LIWC, 2023).

Previous studies illustrate that LIWC is suitable for operationalizing positive and negative emotions because behind each of these concepts are dictionaries that make analysis possible (Block et al., 2023; Kaiser & Kuckertz, 2023; Tata et al., 2017). Furthermore, for an analysis to compare these two emotional dimensions, LIWC also offers a concept that shows the expression of the emotional tone in summary (Pennebaker et al., 2015).

As social networks encompass millions of users and produce large amounts of text daily, analyzing digital footprints with CATA has proven to be a fruitful source for exploring emotions. In this regard, Twitter, in particular, a microblogging service with a maximum of 280 characters, has emerged as a data source for research, as previous studies have shown (Block et al., 2019; Fisch & Block, 2021; Tata et al., 2017; Tumasjan et al., 2021; Winkler et al., 2020). On the one hand, entrepreneurs use this channel to maintain their business relationships (Fischer & Rebecca Reuber, 2014), and on the other, start-up investors are also an active part of the Twitter community (Block et al., 2019; Tumasjan et al., 2021). The latter shows that data from social networks can also provide insights into the personal characteristics of business

angels and venture capitalists—areas that are otherwise difficult to investigate. Furthermore, Pennebaker et al. (2015) report on the development process of the LIWC dictionaries, and in doing so, they show that in this process, they test the dictionaries with different text sources (e.g., Twitter, Blogs, NY Times). The various text sources show that the emotional words were more pronounced on Twitter than on the other sources. This suggests that the combination of Twitter and LIWC may prove to be valuable as CATA is developed and tested in this environment. Therefore, we built on this approach and used CATA with LIWC software and Twitter to analyze investor emotions.

Data

The sample in this study is based on BAs and VCs identified by Crunchbase (Crunchbase, 2022). It provides comprehensive information on various individuals from the start-up scene, such as entrepreneurs, BAs, and VCs (Block et al., 2019; Fisch & Block, 2021; Kuckertz, 2021; Kuckertz & Scheu, 2024). This information also includes links to the social media profiles of the investors (Block et al., 2019; Fisch & Block, 2021), as well as information on investment behavior (Wal et al., 2016). Therefore, this database contains all the relevant information necessary to create the sample for this study.

To identify BAs and VCs from Crunchbase, we relied on the *Crunchbase Hubs* for BAs and VCs. *Crunchbase Hubs* group organizations or people with similar characteristics (in our context, BAs and VCs) and provide information about these groups (e.g., social media profiles of the people) (Crunchbase, 2021). For our study, we used, on the one hand, the group *Angel Investors with Investments in the United States* with 638 BAs and, on the other hand, the group *Venture Capital Investors with Investments in United States* with 1,000 VCs. In this way, we identified and downloaded a total of 1,638 investors (638 BAs; 1,000 VCs) from the United States. Since only those with a social media profile on Twitter were relevant for our analysis, the sample was reduced to 872 people (162 BAs; 710 VCs). Twitter allows users to download the last 3,200 tweets of a timeline via its application programming interface (Obschonka & Fisch, 2018). Therefore, the last 3,200 tweets were downloaded from each of the 822 investors (677 VCs; 145 BAs) via R's *rtweet* package in November 2021. The final sample was reduced from 872 to 822 investors because some Twitter profiles, for example, are not active and do not send tweets. After we excluded the re-tweets, we had a total of 994,969 Tweets from 822 investors. With this dataset, we also cover a period of over 15 years of investor tweets from April 1, 2006 (the first tweet in our sample) to November 19, 2021 (the last tweet in our sample).

After downloading the 994,969 Tweets, we needed to clean up the words in this dataset to prepare it for analysis with LIWC. For example, person links were reduced from this sample so that the LIWC software could process the data, as well as website links (Obschonka et al., 2017).

Dependent variable (Investor type)

In a previous study, Obschonka et al. (2017) used Twitter for personality analysis to compare two groups (superstar manager vs. superstar entrepreneur). The authors use the two groups of people as the dependent variable in their study. We build on this and use our investor types as our dependent variable. Via the data obtained from Crunchbase, we are able to distinguish individuals by VC and BA. Therefore, we use a dummy variable to distinguish between VC (1) and BA (0). This procedure allows us to preserve the emotional differences between these two investor types.

Independent variables (Emotions)

In our analysis, we investigate the emotions expressed by VCs and BAs via their communication behavior on Twitter. To get the broadest possible overview of investor emotions, we use LIWC software version 1.6.0 and the core emotional concept it contains. LIWC clusters the 93 concepts into different categories, such as psychological processes, which include the affective processes that deal with emotional words (Pennebaker et al., 2015), which builds the context for our research. This software tool offers dictionaries to measure *positive* and *negative emotions* in a given text corpus. Moreover, to compare these concepts, LIWC also provides the summary algorithm *emotional tone*. The results of *emotional tone* show a value between 1 and 99 and calculate the emotional expression of the analyzed text. If a value is calculated that is above 50, the emotions expressed are positive. With a value under 50, the emotional tone is driven by negative emotions (LIWC, 2023). In this vein, the level of the value indicates how positively or negatively someone expresses emotions. This summary variable represents no dictionary but rather an algorithm that LIWC does not make publicly available (Pennebaker et al., 2015). However, LIWC refers to the study of Cohn et al. (2004) and built this internal algorithm for emotional tone based on their findings. Accordingly, *emotional tone* represents a standardized score that is used in LIWC to calculate a percentile as output (LIWC, 2023; Pennebaker et al., 2015). Furthermore, in previous entrepreneurship research, this summary variable has been seen as helpful in analyzing emotions from Tweets, such as during start-up closing (Fisch & Block, 2021) or an exogenous shock (Kaiser & Kuckertz, 2023). Against this background, the concept of *emotional tone* builds the independent variable for our study.

Control variables

Both the investment behavior of investors and their behavior on Twitter can influence the likelihood of investor types. Therefore, we use further data from Crunchbase and Twitter to control their influence.

First, we control for the gender of the investors, whether they are female (1) or male (0). We use it to take into account that the investor landscape is very heavily populated by male investors (Dempsey, 2021). Furthermore, previous research has shown that there are gender differences in the expression of emotions (Chaplin, 2015). Next, we control for whether the investors themselves have already started

a business (1) or not (0). Previous findings highlight that BAs have often started a business themselves, which is where their financial resources originate from (De Clercq et al., 2006). In addition, we obtain information about investors' investment behavior via Crunchbase. This data allows us to take into account that VCs and BAs differ in their investment activity (Fairchild, 2011). BAs tend to invest for personal reasons to mentor and VCs primarily with an exit goal, e.g., in the form of an initial public offering (IPO) (De Clercq et al., 2006). Therefore, we control for the number of IPOs ($\log 1p$) that an investor has made with their investments. Another control variable captures whether an investor is located in a VC hotspot (1) or outside these hotspots (0). Here, we are guided by the three VC clusters from the study by Röhms et al. (2018), i.e., California with Silicon Valley, Massachusetts with Route 128, and New York. With this, we consider that investors may behave differently due to location and region-specific differences.

In addition, we obtain other information relevant to control via Twitter, as each individual has a different Twitter activity (Obschonka et al., 2017). Therefore, as in previous studies (Block et al., 2019; Obschonka et al., 2017), we also control for Twitter behavior using the number of followers ($\log 1p$), as well as the number of people an investor follows, i.e., friends ($\log 1p$). A third variable that emerges from previous studies (Block et al., 2019) is the number of tweets ($\log 1p$) that are used to communicate with followers.

Results

Descriptive statistics and univariate analysis

The descriptive statistics with means, standard deviations, and the correlation matrix for our variables are presented in Table 1. 82% of the 822 investors are VCs, and the emotional tone of the overall sample reaches a mean of 88,32%. Furthermore, 16% of the people in our sample are female investors, 86% are in a US start-up hotspot, and 74% are founders themselves. The means for the logged variables show 0.52 for IPOs, 8.44 for followers, 6.30 for friends, and 6.39 for Tweets.

Table 1 Descriptive statistics and correlation matrix

	Mean	SD	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
(1) Type	0.82	0.38	—								
(2) Emotional tone	88.32	14.98	.07*	—							
(3) Gender	0.16	0.37	-.18**	.11**	—						
(4) Founder	0.74	0.44	.18**	-.03	-.15**	—					
(5) Log1p (IPO)	0.52	0.84	.18**	-.12**	-.14**	.23**	—				
(6) Hotspot	0.86	0.35	.28**	-.04	.03	-.05	.06	—			
(7) Log1p (followers)	8.44	2.16	.32**	.01	.04	.15**	.29**	.16**	—		
(8) Log1p(friends)	6.30	1.44	.11**	.08*	.09**	.04	.02	.05	.45**	—	
(9) log1p (Tweets)	6.39	1.63	.09**	.08*	.00	.10**	.08*	.05	.61**	.55**	—

n=822; * $p < .05$; ** $p < .01$

Table 2 Univariate analysis: *t*-test

Variables	Venture Capitalist=1 (n=677)		Business Angel=0 (n=145)		t-test	
	Mean	SD	Mean	SD	t	p-value
<i>Emotions</i>						
Emotional tone	88.822	14.485	85.982	16.975	-1.874	0.062

Our first initial analysis to identify differences between the expressed emotions of VCs and BAs is a *t*-test, which is presented in Table 2. For this, we compare the sample of 677 VCs with the 145 BAs and analyze their positive and negative emotions with the summary variable *emotional tone*. At the significance level of 0.1, the analysis shows significant differences between these two investor types.

Logistic regression to show the association between investor type and emotions

To show how the emotional tone of Twitter communication is associated with the investor type of VC or BA, we use logistic regression with a binary variable for investor types. Table 3 presents the results of the regression analysis. First, we built models for each type of control variable (*Model 1 – 2*) and then one for all control variables (*Model 3*). The full control model shows negative relationships with *gender* (-1.578; $p < 0.01$) and *tweets* on Twitter (-0.504; $p < 0.01$). Positive relationships with the investor type VC are to the variables *Founder* (0.708; $p < 0.01$), *IPO* (0.421; $p < 0.05$), *Hotspot* (1.516; $p < 0.01$) on the investor control level and to the investor network in the form of Twitter *followers* (0.799; $p < 0.01$) on the Twitter control level. The full model (*Model 4*) adds the measure of *emotional tone*. Here, in this full model, the results suggest that there are significant differences between investors on the concept of *emotional tone*. VCs communicate more with positive words assigned to positive emotions than BAs (0.021; $p < 0.01$). In summary, the results show that our hypothesis is supported, as VCs show higher scores on *emotional tone*.

Robustness check without investor superstars

In a previous study, Block et al. (2019) pointed out that Twitter samples can also include celebrities (“Twitter superstars”), such as actors, athletes, or well-known musicians. Such public persons often have many followers on social media due to their large fan base. In our sample, the most famous investor has over 19.3 million followers on his profile. Therefore, Block et al. (2019) argue that such superstars may behave differently in communication than professional investors due to their profession. Furthermore, a team in the back office may support such superstar accounts. For this reason, we control our results by excluding the superstars from our sample. For this purpose, we only use investors who have less than 100,000 followers on their Twitter profiles. This exclusion reduces our sample to 759 investors. Table 4 represents our findings for this analysis.

In line with our main analysis, we run four models (*Model 1 – Model 4*). Three of them are for our control variables, and one builds the full model with *emotional tone*. These results of the analysis support our findings from the main study, as here

Table 3 Main analysis: Logistic regression (dependent variable: Venture capitalist 1/0)

	Model 1	Model 2	Model 3	Model 4
	Investor control model	Twitter control model	Full control model	Full control model
<i>Independent variable: Investor emotions</i>				
Emotional tone				0.021*** (0.007)
<i>Control variables: Investor level</i>				
Gender	-1.015*** (0.233)		-1.578*** (0.271)	-1.685*** (0.276)
Founder	0.839*** (0.215)		0.708*** (0.236)	0.723*** (0.239)
log1p(IPO)	0.633*** (0.186)		0.421** (0.200)	0.443** (0.199)
Hotspot	1.847*** (0.236)		1.516*** (0.259)	1.611*** (0.265)
<i>Control variables: Twitter level</i>				
log1p(followers)		0.802*** (0.091)	0.799*** (0.102)	0.782*** (0.101)
log1p(friends)		-0.139 (0.097)	-0.050 (0.105)	-0.035 (0.104)
log1p(Tweets)		-0.405*** (0.091)	-0.504*** (0.106)	-0.512*** (0.104)
Constant	-0.487* (0.261)	-1.308*** (0.489)	-2.701*** (0.579)	-4.570*** (0.846)
Observations	822	822	822	822
Log Likelihood	-322.438	-321.584	-276.643	-272.112
Akaike Inf. Crit	654.877	651.168	569.285	562.225

* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

also the *emotional tone* (0.020; $p < 0.01$) shows significant differences between VCs and BAs. As in the main analysis, the robustness check also supports our hypothesis.

Robustness check with a wordcount minimum

Previous studies argue that the LIWC software requires a minimum number of words in the sample for each person to work (Fisch & Block, 2021; Kaiser & Kuckertz, 2023). Therefore, we follow Tata et al. (2017) and set our word count to a minimum of 1,500 per investor. In doing so, we exclude 124 investors who tweet less than 1,500 words in their Twitter profile. We then calculated our logistic regression for this sample of 698 investors. The results are summarized in Table 5. The findings of this robustness check are in line with our previous models and show a positive association with *emotional tone* (0.043; $p < 0.01$).

Table 4 Robustness check without Twitter Superstars

	Model 1	Model 2	Model 3	Model 4
	Investor control model	Twitter control model	Full control model	Full control model
<i>Independent variable: Investor emotions</i>				
Emotional tone				0.020*** (0.007)
<i>Control variables: Investor level</i>				
Gender	-1.014*** (0.238)		-1.697*** (0.288)	-1.793*** (0.292)
Founder	0.858*** (0.218)		0.727*** (0.246)	0.741*** (0.249)
log1p(IPO)	0.782*** (0.219)		0.670*** (0.236)	0.688*** (0.237)
Hotspot	1.865*** (0.243)		1.493*** (0.272)	1.576*** (0.278)
<i>Control variables: Twitter level</i>				
log1p(followers)		0.975*** (0.103)	1.015*** (0.117)	0.990*** (0.117)
log1p(friends)		-0.280*** (0.104)	-0.214* (0.114)	-0.194* (0.113)
log1p(Tweets)		-0.439*** (0.095)	-0.562*** (0.112)	-0.565*** (0.110)
Constant	-0.571** (0.267)	-1.460*** (0.510)	-2.910*** (0.609)	-4.689*** (0.894)
Observations	759	759	759	759
Log Likelihood	-304.314	-298.853	-251.166	-247.441
Akaike Inf. Crit	618.629	605.706	518.332	512.882

* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

Robustness check with further control variables

The third robustness check adds further control variables that could influence our main results. On a communication level, previous research shows that people could use words that express an authentic tone (Block et al., 2024). Therefore, we add the LIWC summary variable *authentic* to control for this (Pennebaker et al., 2015). Furthermore, individuals can express their social status through the language they use (LIWC, 2023). Therefore, we add the LIWC summary variable *clout* as a further control variable for this robustness check (Pennebaker et al., 2015). Both control variables are based on an internal algorithm of LIWC and *authentic* builds on Newman et al. (2003) and *clout* on the study from Kacewicz et al. (2014). Moreover, previous studies show a connection between investor personality and their behavior (Block et al., 2019). Therefore, we build on the personal values dictionary and add four control variables that measure the expressed *openness to change*, *self-transcendence*, *self-enhancement*, and *conservation* in a text (Ponizovskiy et al., 2020). Overall, we add

Table 5 Robustness check with a wordcount minimum

	Model 1	Model 2	Model 3	Model 4
	Investor control model	Twitter control model	Full control model	Full model
<i>Independent variable: Investor emotion</i>				
Emotional tone				0.043*** (0.010)
<i>Control variables: Investor level</i>				
Gender	-0.962*** (0.254)		-1.595*** (0.298)	-1.800*** (0.310)
Founder	0.534** (0.240)		0.402 (0.266)	0.386 (0.274)
logIp(IPO)	0.608*** (0.198)		0.395* (0.214)	0.393* (0.213)
Hotspot	1.713*** (0.259)		1.439*** (0.285)	1.582*** (0.298)
<i>Control variables: Twitter level</i>				
logIp(followers)		0.819*** (0.101)	0.858*** (0.113)	0.823*** (0.112)
logIp(friends)		-0.139 (0.112)	-0.061 (0.119)	-0.028 (0.119)
logIp(Tweets)		-0.432*** (0.146)	-0.619*** (0.165)	-0.448*** (0.171)
Constant	-0.145 (0.296)	-1.257 (0.895)	-2.010** (0.976)	-6.979*** (1.516)
Observations	698	698	698	698
Log Likelihood	-274.845	-263.417	-232.519	-221.910
Akaike Inf. Crit	559.691	534.835	481.038	461.819

* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

these six control variables to our main model in Table 6. The results show that our main result is robust, and only the significance level changes (0.019; $p < 0.05$).

Further analysis to explore emotions and investor characteristics

Besides our main analysis, we explore further differences between VCs and BAs expressed in their Twitter communication. Therefore, we use other independent variables from our sample of LIWC concepts and analyze how these are associated with the investor type.

Since investment decisions are also connected with complex cognitive work (Huang, 2018), such as analyses of the market, financial potential, or the start-up team (Granz et al., 2020), the question arises of how the investor types of VC and BA differ in their analytical work. Therefore, we add the independent variable *cogproc*,

Table 6 Robustness check with new control variables on the communication and personality level

	Model 1	Model 2	Model 3	Model 4
	Investor control model	Twitter control model	Full control model	Full model
<i>Independent variable: Investor emotions</i>				
Emotional tone				0.019** (0.008)
<i>Control variables: Investor level</i>				
Gender	-1.015*** (0.233)		3.599** (1.433)	-1.810*** (0.299)
Founder	0.839*** (0.215)		-0.030 (1.232)	0.792*** (0.251)
log1p(IPO)	0.633*** (0.186)		-1.818*** (0.668)	0.395* (0.202)
Hotspot	1.847*** (0.236)		-1.425 (1.495)	1.585*** (0.279)
<i>Control variables: Twitter level</i>				
log1p(followers)		0.802*** (0.091)	-0.168 (0.328)	0.766*** (0.105)
log1p(friends)		-0.139 (0.097)	0.420 (0.438)	-0.041 (0.110)
log1p(Tweets)		-0.405*** (0.091)	0.745* (0.436)	-0.481*** (0.108)
<i>Control variables: Communication level</i>				
Authentic			-0.025*** (0.008)	-0.029*** (0.009)
Clout			-0.033*** (0.012)	-0.032** (0.015)
<i>Control variables: Personality level</i>				
Conservation			-1.264*** (0.209)	-1.284*** (0.266)
Self Transcendence			0.155 (0.183)	0.298 (0.214)
Openness to change			-0.115 (0.136)	-0.146 (0.155)
Self Enhancement			0.062 (0.139)	0.116 (0.158)
Constant	-0.487* (0.261)	-1.308*** (0.489)	5.980*** (1.073)	-0.060 (1.441)
Observations	822	822	822	822
Log Likelihood	-322.438	-321.584	-359.710	-256.510
Akaike Inf. Crit	654.877	651.168	733.420	543.020

* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

which measures how the cognitive processes are expressed and calculate a value based on a dictionary with 797 words. This dictionary has different subcategories, such as *insight*, *causation*, *discrepancy*, *tentative*, *certainty*, and *differentiation* (Pennebaker et al., 2015). Model 1 in Table 7 visualizes our findings and shows a positive connection between VCs and their expressed cognitive processes (0.092; $p < 0.1$).

Table 7 Post-hoc analysis with other independent variables

	Model 1 Investor type	Model 2 Investor type
<i>Independent variable: Cognitive processes and drives</i>		
Cogproc	0.092* (0.049)	
Drives		0.121** (0.052)
<i>Control variables: Investor level</i>		
Gender	-1.547*** (0.272)	-1.613*** (0.273)
Founder	0.704*** (0.237)	0.698*** (0.238)
log1p(IPO)	0.419** (0.200)	0.433** (0.199)
Hotspot	1.533*** (0.260)	1.549*** (0.263)
<i>Control variables: Twitter level</i>		
log1p(followers)	0.789*** (0.102)	0.773*** (0.101)
log1p(friends)	-0.051 (0.106)	-0.070 (0.106)
log1p(Tweets)	-0.543*** (0.108)	-0.441*** (0.106)
Constant	-3.181*** (0.640)	-3.990*** (0.809)
Observations	822	822
Log Likelihood	-274.840	-273.841
Akaike Inf. Crit	567.681	565.682

* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

Furthermore, as previous research argues that VCs and BAs differ in their motives for acting and going into start-up relationships (De Clercq et al., 2006), we explore how VCs and BAs are different in their communicated drivers. To measure this, we use the LIWC overarching concept of *drives* as a dictionary with 1,103 words included. *Drives* covers different subcategories such as *affiliation*, *achievement*, *power*, *reward*, and *risk* (Pennebaker et al., 2015; Tata & Niedworok, 2020). We run a further logistic regression with *drives* as the new independent variable, and our results in *Model 2* in Table 7 show a positive association with the investor type of VCs (0.121; $p < 0.05$).

Discussion and implications

Our findings have implications for research on the personal characteristics of investors, as well as for the practice of entrepreneurs and investors. A summary overview of these implications can be found in Table 8 before they are subsequently discussed.

Table 8 Implications for practice and research

Findings on (emotional) differences between business angels and venture capitalists	Implications for entrepreneurs, investors, and policymakers	Implications for future research
<ul style="list-style-type: none"> • BAs and VCs differ in their expressed emotional tone in their Twitter communication • VCs express a more positive tone; BAs are more emotional in their expressed negative emotions • Besides emotions, VCs communicate more cognitive processes and more on their drives (e.g., affiliations) 	<ul style="list-style-type: none"> • Entrepreneur: Prepare investor communication (e.g., pitch presentation, business plan, reporting) analogous to investors' emotional tone; Communicate target-group oriented (e.g., BAs more on an emotional level, VCs more on an analytical level) • Investor: Reflect on their online communication (e.g., emotional tone); Search for support to share thoughts and get emotional support (e.g., angel networks) • Policymaker: Develop support programs for investors and their psychological states (e.g., emotional support) 	<ul style="list-style-type: none"> • Investigate the perception of investor emotions from the entrepreneurs' point of view and their influence on the choice of a financier • Examine the differences in trustworthy communication between different types of investors • Investigate the impact of a portfolio company's failure on investors' emotions

General discussion and interpretation of the main findings

Although entrepreneurship research, in general, has already explored the emotions and emotional differences of entrepreneurs from other groups (Tata et al., 2017), this has been sparse in the context of investors. Furthermore, in previous research on entrepreneurial finance that compares VCs and BAs, their characteristics, such as emotions, were rarely examined. However, despite this, prior research suggests that VCs and BAs differ with respect to their expressed emotions. Therefore, in this study, we aimed to answer the question of how the expressed emotions of VCs and BAs differ. Smith and Bergman (2020) argue that for a comprehensive picture of entrepreneurial resource exchange relationships, all parties need to be considered. Therefore, our results with investor emotions extend this picture by investigating investor emotions, especially of VCs and BAs, and comparing them.

Based on previous research in entrepreneurial finance and psychology, we hypothesized that VCs have a better understanding of their professional role as an employee of a VC organization and thus communicate their emotions more professionally than BAs. In particular, we attribute this to the different backgrounds of investors, with VCs taking on a different role than BAs due to their involvement with a VC organiza-

tion. Based on our analysis, this hypothesis can be supported, as VCs show significant differences in the concept of *emotional tone*. This result also remains in the further analysis of the robustness check: In the analysis of *emotional tone*, the model shows that VCs are more prone to positive emotions in their expressed emotions via Twitter.

With this study, we contribute to the entrepreneurship literature in different ways. First, we analyze the investor emotions of two essential actors from entrepreneurial finance and extend previous knowledge on emotion research in entrepreneurship research, which focuses primarily on entrepreneurs (1). We show that VCs and BAs also differ in personal characteristics and extend the research stream on the differences between these two types with an emotion perspective (2). We use investors' tweets to operationalize the expressed emotions as a novel method and show how such an approach is helpful in researching complex psychological concepts and target groups (3). Overall, we offer an additional starting point (Block et al., 2019) for researching psychological concepts in the entrepreneurial finance landscape and their investors.

Since our results show that BAs express more negative emotional tone than VCs, connections can also be made to other entrepreneurship studies that have captured differences between managers and entrepreneurs (Obschonka et al., 2017). For example, entrepreneurs show stronger expressions of the personality trait neuroticism, i.e., they show their negative emotions more obviously than managers do (Obschonka et al., 2017). Thus, our results also suggest this in a different context as we see VCs in their manager role because some VCs in our sample fulfill this function as partners in the organization. Furthermore, we know from the literature that the setting influences communication, and in-work from nonwork communication also affects content (Sanchez-Burks et al., 2003). Consequently, VCs are always connected to their VC organization, even in social media, as communicated content can also influence the employer (positive and negative reputation). Obschonka et al. (2017) explain this in their case with possible departments (e.g., marketing) within the organizations that professionally manage the respective Twitter accounts of the managers. In our robustness test, we, therefore, also removed accounts with more than 100 K followers, but the results remain stable. However, this does not preclude VCs from receiving professional support in general (e.g., through departments within the VC organization) regarding their online self-presentation. Furthermore, we have already pointed out in the hypothesis development that taking on roles means that persons are not necessarily themselves (Goffman, 1959). Using the robustness check and adding the control variable authentic, we checked the extent to which investors speak authentically in their tweets. This shows a negative association with the investor type of the VC. This is an interesting result that indicates that the VCs in our sample consciously use Twitter in their assumed role.

As we know, there are different characteristics between VCs and BAs (Cohen & Wirtz, 2022; De Clercq et al., 2006; Hellmann et al., 2019; Mason & Stark, 2004; van Osnabrugge, 2000), in a previous study on the differences between VCs and BAs, Fairchild (2011) argues that these two investor types also differ in smoother factors such as their behavior. We support this argument with our empirical results and show in the context of expressed emotions that VCs and BAs differ – especially that VCs express a more positive tone. Through the previous research findings, various

economic distinctions have already been discussed; with our study, a psychological dimension is now also part of this discussion. Therefore, our study introduces a new dimension to this entrepreneurial finance research stream – emotions.

Previous research shows that online communication shapes individuals' identities so that a digital identity can also be created via social media (Block et al., 2023; Fisch & Block, 2021; Obschonka et al., 2017). Compared to offline identity, there are also parallels with individuals' digital identity (Gosling et al., 2011). In this vein, our results could indicate that VCs use their online communication for their individual impression management and create their digital identity on Twitter. And in this case, the higher emotional tone suggests that they could be aware of their role as speaking for a VC.

A further explanation for the differences could result from the different investment phases of VCs and BAs and the corresponding risks that investors take with their involvement. As we know, BAs are usually invested in earlier stages than VCs, which follow later (Drover et al., 2017). A frequently used parameter in the entrepreneurship and management literature to explain the situation of start-ups is the uncertainty that is connected to these young companies (Scarbrough et al., 2013; Shane & Cable, 2002). Accordingly, investors also take these risks in relationships with entrepreneurs and start-ups. Hence, our results could indicate that BAs share the emotional journey with founders earlier, which is evident in their tweets.

With Twitter and a dataset of 994,969 tweets overall, we offer a new way of researching personal investor characteristics, showing insights into their psychology. As Block et al. (2019) show in their earlier study, the richness of such data for investor personality research, we show how to use it for emotion research in an entrepreneurial finance context.

Besides our main analysis, we add two post-hoc analyses with other independent variables to explore further explanations for differences between VCs and BAs. In doing so, we show that VCs express their cognitive processes in their communication on a higher level as well as their drivers. As a result of this post-hoc analysis, we suggest two propositions. First, from previous entrepreneurship research, we know that the investment process is connected with analytical work (e.g., Granz et al., 2020; Huang, 2018). Furthermore, they are embedded in an organizational context with limited partners as their stakeholders (e.g., Kollmann et al., 2014), with whom they have to communicate and explain their investments. In addition, they often have a team of analysts in the background to support them in their cognitive work. Based on this, in combination with our findings, we suggest the following proposition.

Proposition 1. Venture capitalists and angel investors differ in their analytical processes. This distinction is evident in their language, with venture capitalists using more analytical and reasoning-driven terms in their communication.

Second, research discusses different investment motives between VCs and BAs (De Clercq et al., 2006). While BAs primarily have personal motives, the financial objectives towards their stakeholders also play a central role for VCs. In addition, VCs are exposed to competition from other VC organizations, while BAs are often more

anonymous. Therefore, and in combination with our post-hoc findings, we suggest the following proposition.

Proposition 2. Venture capitalists and angel investors differ in their motivations. Venture capitalists tend to articulate their motives more explicitly and use language that emphasizes their motivations.

Implications for entrepreneurs, investors, and policymakers

Based on our findings of this study, we suggest several implications for the practice of entrepreneurial finance, especially for entrepreneurs, investors, and policymakers. First, we show that investors' online communication is based on emotions and that VCs and BAs differ in their expressed tone on Twitter. Therefore, entrepreneurs can use our findings to prepare their investor communication and focus on these differences (e.g., pitch presentations and business plans). For example, previous research shows that BAs should be picked up emotionally (Mason & Stark, 2004). Our results also show that BAs react more emotionally, so entrepreneurs could address this in their communication with BAs and focus more on the emotional tone. Furthermore, our results show an association between the cognitive processes and the drives of VCs, which entrepreneurs could also use in VC communication (e.g., more analytical, focus on drives). Moreover, as drives include affiliations (Pennebaker et al., 2015), previous studies of VC research show that common affiliations help to create a fit for entrepreneurs and VCs (Panda & Dash, 2016). Next to this, entrepreneurs could create awareness about the different roles between VCs and BAs (employed manager vs. individual investor) and that different roles expect different (emotional) communication. Second, our findings could also be helpful for investors in their investment practice. Investors can use our findings to reflect their digital communication style and their emotional tone (e.g., How do I impress others? What impression does my online self-presentation create?). Particularly in view of the circumstance that BAs also compete with other investors (e.g., other BAs, VCs), the impact of their self-presentation on others can play a role here. Furthermore, we also argue that the emotional differences are related to the situation of investors that BAs often invest alone. Here, BAs could look for support (e.g., angel networks) and generate more positive emotions. Third, our findings could also be used by policymakers and their development of programs for entrepreneurial actors. Considering that investors are also essential players in innovation and start-up ecosystems, our findings could be used to launch support programs for investors that provide psychological support. As our results show, individual investors seem to need more emotional support than those who belong to an organization and invest institutionally. Finally, our study is in a row with earlier papers that also used social media as a research method to investigate psychological constructs (Block et al., 2023; Tata et al., 2017). Therefore, investors and entrepreneurs should understand that their online communication is transparent for the community and, as a result, for future relationship partners. In this vein, practice can use our findings to reflect on their digital communication behavior and think about their self-presentation and what picture they create of themselves.

Limitations and implications for future research

We see this study as an initial point to understand the emotions of VCs and BAs better and give inspiration for future research on investor emotions in the entrepreneurial finance context. Therefore, some limitations of this study go along with promising research areas for future studies. First, we rely on the emotional concepts of the LIWC software. Since other dictionaries have been developed recently that can also analyze emotional words in a text, such dictionaries could further complement our findings. For example, since LIWC is a closed dictionary, open dictionaries can also be added. Second, we compare VCs and BAs as two critical actors in the entrepreneurial finance literature. Nonetheless, there are other actors that may show different emotional reactions. For example, crowdfunding investors are used to the entire investment process being digital and, therefore, to communicating digitally. Third, our data foundation is digital investor communications, so words from other data sets, such as podcasts or videos, might provide further insights. Second, our results show that VCs and BAs also signal their emotional state via their tweets, which is why, based on this, the question arises to what extent positive or negative emotions actually influence investments. Therefore, further research could investigate how investor emotions are perceived and evaluated by entrepreneurs, thereby answering the question of how investor emotions influence entrepreneurs in their choice of partners. Third, Mohammad and Turney (2013) consider trust related to emotions. It is known from previous research that trust is also a relevant concept for the entrepreneur-investor relationship (Middelhoff et al., 2014; Shepherd & Zacharakis, 2001). Therefore, further research could extend previous trust research by measuring trust not through interviews or questionnaires but through textual communications, thereby answering the question of how trustworthy communication differs between investor types. Fourth and finally, emotions can be influenced by different situations, which is why emotional tone tends to be more positive or more negative depending on the situation. While our study presents an overall view of investors' emotional tone, further research could create a panel dataset that looks at emotions in different time windows. Since such panel data sets are also implementable with Twitter (Fisch & Block, 2021), further research could examine how investors' emotions change when, for instance, a portfolio company fails, thereby answering the research question of how investor emotions change when their portfolio firms fail.

Conclusion

This study provides insights into the emotions that investors leave behind via their Twitter digital footprints and express to their audience. We show differences in the emotions expressed between the investor types VCs and BAs. As we advance, we could use this to stimulate a discussion on how emotions influence decision-making behavior in the investment process of start-up financing.

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Declarations

Competing interests The authors report that there are no competing interests to declare.

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