Artificial intelligence as an enabler for entrepreneurial finance: a practical guide to AI-driven video pitch evaluation for entrepreneurs and investors

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Abstract

Purpose – While different attempts have been made to use artificial intelligence (AI) to codify communicative behaviors and analyze startups' video presentations in relation to crowdfunding projects, less is known about other forms of access to entrepreneurial finance, such as video pitches for candidacies into startup accelerators and incubators. This research seeks to demonstrate how AI can enable the startup selection process for both entrepreneurs and investors in terms of video pitch evaluation.

Design/methodology/approach – An AI startup (Speechannel) was used to predict the outcomes of startup video presentations by analyzing text, audio, and video data from 294 video pitches sent to a leading European startup accelerator (LUISS EnLabs). 7 investors were also interviewed in Silicon Valley to establish the differences between humans and machines.

Findings – This research proves that AI has profound implications with regards to the decision-making process related to fundraising and, in particular, the video pitches of startup accelerators and incubators. Successful entrepreneurs are confident (but not overconfident), engaging in terms of speaking quickly (but also clearly), and emotional (but not overemotional).

Practical implications – This study not only fills the existing research gap but also provides a practical guide on AI-driven video pitch evaluation for entrepreneurs and investors, reshaping the landscape of entrepreneurial finance thanks to AI. On the one hand, entrepreneurs could use this knowledge to modify their behaviors, enabling them to increase their likelihood of being financially backed. On the other hand, investors could use these insights to better rationalize their funding decisions, enabling them to select the most promising startups.

Originality/value – This paper makes a significant contribution by bridging the gap between theoretical research and the practical application of AI in entrepreneurial finance, marking a notable advancement in this field. At a theoretical level, it contributes to research on managerial decision-making processes – particularly those related to the analysis of video presentations in a fundraising context. At a practical level, it offers a model that we called the "AI-enabled video pitch evaluation", which is used to extract features from the video pitches of startup accelerators and incubators and predict an entrepreneurial project's success.

Keywords Decision making, Entrepreneurship, Artificial intelligence, Machine learning, Entrepreneurial finance, Communication

Paper type Original article

Introduction

The verbal and non-verbal skills of individuals in real-life communication situations can have a crucial impact on audience members' behavior. Through a dramaturgical and interactive approach, we can imagine situations in which an actor (leader) and audience (followers) play. Charismatic leaders' cognitions and situational assessments guide their efforts to manage followers' impressions of them, their vision, and their organization (Gardner and Avolio, 1998).

These aims align with the communication of the entrepreneur, as an entrepreneurial leader is a person who communicates and inspires the level of competence necessary to influence individuals to become willing participants in fulfilling innovative goals. This effective communication is contagious and must be expressed through verbal and non-verbal messages (Darling and Beebe, 2007).

Entrepreneurs who effectively communicate their potential and that of their projects are more likely to succeed in engaging investors (Clark, 2008). Entrepreneurs' communication skills have a crucial impact on startup pitch presentations. These pitches are communicative interactions, in which entrepreneurs make formal, oral, and persuasive appeals to potential investors in an attempt to raise funds (Kawasaki, 2015).

These presentations have become popular when selecting startups for both startup accelerators and incubators that are able to scout the most promising entrepreneurial projects in a short amount of time. The selective nature of accelerators, with figures of just 3% for startup admissions, shows not only the crucial weight conferred to the initial decision-making process and associated criteria, but also highlights a potential preference for the best applications, which could yield higher returns later in the business lifecycle (Yin and Luo, 2018).

Artificial intelligence (AI), defined as the examination of how digital computers and algorithms perform complex processes that normally require or exceed human intelligence (Andersen, 2002), can enhance management decision-making processes, increasing the quality of the decisions made in terms of effectiveness and efficiency (Kraus *et al.*, 2020). AI improves entrepreneurs' decision-making processes (e.g. entrepreneurial decisions), as well as decisions made by others that directly affect entrepreneurs (e.g. investment decisions) (Liebregts *et al.*, 2020).

Several attempts have been made to use AI to codify entrepreneurs' communicative behaviors and analyze the video presentations of startups, especially in relation to decision-making processes in crowdfunding (Duan *et al.*, 2020; Kaminski and Hopp, 2020; Raab *et al.*, 2020; Korzynski *et al.*, 2021). Building on this foundation, we intend to demonstrate how AI can be an enabler for entrepreneurial finance also in the startup selection process for accelerators and incubators in terms of video pitch evaluation.

There are two reasons why this inquiry is appropriate and timely. First, while previous researchers have focused the potential of AI on the crowdfunding platform, less is known about other forms of access to entrepreneurial finance, such as video pitches used for candidacies into the programs of startup accelerators and incubators. This could be a promising avenue of research with regards to decision-making (Giuggioli and Pellegrini, 2023). To the best of our knowledge, this study is the first of its kind. Second, the context of accelerators and incubators is distinctly different from that of crowdfunding platforms. A broad audience evaluates video presentations pertaining to crowdfunding, while only expert investors evaluate them in accelerators and incubators, which adopt a more business-oriented and less impressionable approach (Ormiston and Thompson, 2021). Thus, it is crucial to establish whether or not the same assumptions hold up in a different scenario.

This research is particularly original and valuable as it extends the application of AI in entrepreneurial finance beyond crowdfunding, exploring its impact in the arena of startup accelerators and incubators. Specifically, this paper's contribution is twofold. At a theoretical level, it contributes to research on decision-making processes related to fundraising and, in particular, to startup accelerators and incubators powered by AI. At a practical level, this

study uses AI to extract features from video pitches for startup accelerators and incubators, developing a new model called "AI-enabled video pitch evaluation" to predict an entrepreneurial project's success. This represents a breakthrough, considering its potential to revolutionize how entrepreneurs and investors make decisions. On the one hand, entrepreneurs could use this knowledge to modify their behaviors, enabling them to increase their likelihood of being financially backed. On the other hand, investors could use these insights to better rationalize their funding decisions, enabling them to select the most promising startups. To sum up, this study not only fills the existing research gap but also provides a practical guide for entrepreneurs and investors about AI-driven video pitch evaluation, reshaping the landscape of entrepreneurial finance thanks to AI.

In the next section, the theoretical background is shown. Then, the methodology adopted to implement our analysis is outlined. Subsequently, results and discussions are put forward. Finally, the conclusions of the study are given.

Theoretical background
Communication strategies in entrepreneurial settings
The verbal and non-verbal skills of an individual in real-life communication situations can have a crucial impact on those they interact with. These skills have been shown to influence different outputs, such as the sales obtained by persons selling goods on street markets and in TV commercials (Clark and Pinch, 1995), the success of tasks and targets delivered by managers when briefing staff teams (Clark, 1999), the level of applause political speakers receive at party conferences (Heritage and Greatbatch, 1986), the monetary contributions offered by the public to street entertainers (Mulkay and Howe, 1994), and the occurrence of bids at auctions (Heath and Luff, 2007). The effectiveness of these presentations depends on six effective delivery behaviors: vocal volume, rate of speech, voice quality (characterized as verbal behaviors), posture, gesture, and body movement (characterized as non-verbal behaviors) (Gunderson and Hopper, 1976).

Communication is used in organizational contexts – especially by CEOs – to communicate ideas to stakeholders and influence strategies (D'Aveni and MacMillan, 1990). We can distinguish between verbal (i.e., what the CEOs say) and non-verbal (i.e., how the CEOs say it) communication. Non-verbal behavior, such as facial expressions and gestures, can convey a lot of information, including a person's opinions, values, emotions, and cognitive and physical states (Helfat and Peteraf, 2015). Audiences develop expectations regarding appropriate communication styles (Burgoon et al., 1975, 2002). For example, positive violation (i.e., exceeding expectations) increases the persuasiveness of the message, while negative violation (i.e., the failure to meet these expectations) has the opposite effect (Averbeck and Miller, 2014).

This is in line with the communication of the entrepreneur. An entrepreneurial leader communicates and inspires competence to influence individuals to become willing participants in the fulfillment of innovative goals. This persuasive communication can become contagious through verbal and non-verbal messages (Darling and Beebe, 2007). Within entrepreneurial literature, some research focuses on entrepreneurial communication in terms of the narratives that construct the identity of the entrepreneur, helping new entrepreneurs take on the appropriate persona, establish appropriate ties, build their ventures (Downing, 2005; Phillips et al., 2013), deal with risks related to establishing an entrepreneurial venture, and process the failures and setbacks that come with the territory (Byrne and Shepherd, 2015; Singh et al., 2014). Other research focuses on how culture and community interact with entrepreneurship in terms of the social ties that are evident through other entrepreneurs who can serve as mentors and support systems (Rigg and O'Dwyer, 2012; Phillips et al., 2013), through family (Jaskiewicz et al., 2015; Yanagisako, 2002), or through ethnic groups or communities (Iyer and Shapiro, 1999; Mckeever et al., 2014).

Accelerator and incubator contexts

Entrepreneurs' communication skills have a crucial impact on startup pitch presentations. These pitches provide investors with detailed data about the applicant's technology and business strategy, while giving them a chance to personally see the entrepreneur in action (Galbraith *et al.*, 2013; Kawasaki, 2015).

Video pitches have become very popular for accelerators and incubators looking to quickly scout the most promising entrepreneurial projects. Generally, incubators take care of startups in their initial stages, host them in their premises, offer workspaces, and help them raise seed capital through venture capitalists (Yin and Luo, 2018). Accelerators, in addition to these activities, focus on providing education, mentorship, and financing to the entrepreneurs (Cohen and Hochberg, 2014) to allow them to cross the stage known as "the valley of death" – the transition that occurs when moving from initial funding from friends and relatives to capital from other investors (Aartsen *et al.*, 2018).

Unlike incubators, which are usually managed by local governments and universities, accelerators are often managed by private and institutional investors (Dahl, 2011). Usually, accelerators have standard features: fixed-term (about three months); cohort-based (help cohorts of startups with the new venture process); mentorship-driven (by successful entrepreneurs, investors, or corporate executives); or those that culminate in a graduation or demo-day (an event where startups pitch to an audience of investors) (Cohen and Hochberg, 2014).

Pertinent literature suggests that accelerators positively impact accelerated startups by acquiring knowledge (Battistella *et al.*, 2017) and through startup valuation (Kim and Wangman, 2014), entrepreneurial orientation (Hayter *et al.*, 2018), startup performance (Gonzalez-Uribe and Leatherbee, 2017), and the ability to receive subsequent funding (Radojevich-Kelley and Hoffman, 2012).

These accelerator programs are selective, with only a 3% startup admission. This highlights the relevant weight of the initial decision-making process and associated criteria. However, this also highlights an accurate preference for the best applications, with the goal of obtaining high returns on investment (Yin and Luo, 2018). Most cited elements related to these assessment criteria are linked to technical variables, such as the maturity of startups in terms of product/service, market, and team (Butz and Mrozewski, 2021). This aligns with incubators' assessment criteria (Nicholls-Nixon and Valliere, 2021), which are connect to competitive advantage and uniqueness of the solution (Hackett and Dilts, 2004; Bruneel *et al.*, 2012; Kakabadse *et al.*, 2020), market size and potential (Lumpkin and Ireland, 1988; Colombo and Delmastro, 2002; Torun *et al.*, 2018) and team expertise and experience (Lee and Osteryoung, 2004; Cheng and Schaeffer, 2011; Bruneel *et al.*, 2012). However, another area of scholarly literature has proven that these assessment criteria are also connected with non-technical variables, such as communication and leadership skills (Muzyka *et al.*, 1996; Marino-Garrido *et al.*, 2020).

AI and decision-making in management and entrepreneurial finance

Decision-making is a crucial managerial task (Sundaramurthy and Lewis, 2003). Effective decision-making is one of the building blocks of organizational success (Blenko *et al.*, 2010), and human decision-makers face conscious and unconscious biases that can lead to negative consequences for the firm overall (Le Meunier-FitzHugh *et al.*, 2011).

In the 4th industrial revolution, big data is available in unprecedented volumes from a variety of data sources (Bagnoli *et al.*, 2019). This information could be a source of competitive advantage if organizations successfully leveraged its benefits (Tabesh *et al.*, 2019).

Nowadays, the merging of big data with algorithmic advancement and enhanced computational capacity and storage has given rise to AI (Chui *et al.*, 2018). In this scenario, AI methodologies are growing across a wide array of fields in addressing and solving real-world problems, such as protein folding (Jumper *et al.*, 2021; Srivastava *et al.*, 2022), pandemic analysis (Chopra *et al.*, 2022), and behavioral analysis (Yen *et al.*, 2021). Through AI-enabled solutions, organizations can leverage these benefits, but they also have to consider the consequences of using this technology for managerial roles (Leyer and Schneider, 2021).

AI can contribute to human decision-making by enhancing the speed and accuracy of data collection and processing (Jarrahi, 2018). It can also aid management decision-making processes (Oppioli *et al.*, 2023) in contexts such as marketing (Stone *et al.*, 2020), sales (Ramesh *et al.*, 2018), human resources (Tambe *et al.*, 2019), accounting and auditing (Han *et al.*, 2023), and finance (Singh *et al.*, 2022).

Generative AI has been receiving growing consensus with regards to the positive impact it can have on organizational decision-making (Floridi and Chiriatti, 2020; Kar *et al.*, 2023). For example, it can aid marketing strategies by improving search engine optimization and reducing the production costs associated with content creation (Reisenbichler *et al.*, 2022). From a sales perspective, through generative AI, these models can produce better recommendations and develop powerful reporting systems to improve customer interactions (Sinha *et al.*, 2023). For human resource professionals, it can automate and streamline repetitive tasks, such as those undertaken in employee recruiting and onboarding processes, by answering frequent questions and directing new hires to relevant resources (Aguinis *et al.*, 2024). In accounting and auditing, generative AI can be applied to automate repetitive tasks, generate reports, and analyze reporting data to free up time for accountants and auditors, all while facilitating better decision-making (Zhao and Wang, 2024). Last but not least, in finance, it can predict firms' risk-management capabilities and stock return performance (Chen *et al.*, 2023).

In an entrepreneurial finance context, AI can increase human skills related to entrepreneurs' and investors' decision-making (Giuggioli and Pellegrini, 2023) by detecting and analyzing signals sent during human-to-human interactions, advancing our understanding of entrepreneurial decisions as well as investment decisions (Liebregts *et al.*, 2020). These algorithms predict crowdfunding project fundraising outcomes in advance. If companies know beforehand which factors might improve their financing success rates, entrepreneurs can focus on these aspects to improve their performance, and investors can reduce risks and use their funds for projects with higher success rates, increasing the likelihood of them being rewarded for their investment (Wang *et al.*, 2020).

In this scenario, only a few studies have used AI in the context of selection practices for startup accelerators and incubators. For example, thanks to a machine learning approach, on a study on accelerators across developed and emerging countries (United States, Brazil and India), it was found that capabilities and competencies of accelerators differentiated outcomes within the same ecosystem, while external environment dampened accelerator outcomes in emerging economies (Shetty *et al.*, 2020). Moreover, still thanks to a machine learning methodology, it was found that the most important predictors of business ideas' acceptance into incubators in Italy are the characteristics of the entrepreneurial team and their available financial resources (Capatina *et al.*, 2023). These results are connected with those of another study who proved that Italian incubators are willing to foster entrepreneurial teams by providing both specialized support services and access to financial resources (Sansone *et al.*, 2020).

Hypotheses development

Emotions and presentation skills influence personal, social, and economic decisions (Schwarz and Clore, 1988). Several researchers have used AI to analyze decisions made related to crowdfunding video presentations, applying psychological theories, such as impression management and emotional theories.

When outlining the impression management theory, Goffman (1959) used the term "performance" to refer to activities that serve to influence observers, suggesting that individuals can manage impressions of others through two different activities: the expression they give, which can be rooted in the language they use; and the expression they give off, which relates to non-linguistic or visual aspects of this process. Impression management skills are crucial to an entrepreneur's success (Baron and Markman, 2000) and to their ability to raise finance from investors (Mason and Harrison, 2003).

Through visual cues and verbal expressions, entrepreneurs seek to engage stakeholders by managing their surroundings and their visual environment (Clarke, 2011). Presentation elements may evoke certain frames that connect with or bridge stakeholders' understanding of their venture, influencing their perceptions and increasing the likelihood of them perceiving a new venture as cognitively legitimate (Nagy *et al.*, 2012).

Impression management techniques can be classified into five categories: self-promotion, i.e., boasting or showing skills in an attempt to be seen as competent; ingratiation, i.e., favors or compliments given in an attempt to be seen as likable; exemplification, i.e., appearing hard-working and busy in an attempt to be seen as dedicated; intimidation, i.e., using threats in an attempt to be seen as menacing; and supplication, i.e., showing a lack of resources in an attempt to be seen as needy (Jones and Pittman, 1982).

This categorization has been used to teach an AI algorithm how to analyze crowdfunding videos. This proved that self-presentation and exemplification techniques are positively associated with crowdfunding success, while intimidation is negatively related to crowdfunding success (Korzynski *et al.*, 2021).

These findings are in line with other studies, where having sufficient skills, knowledge, and the ability to start a business indicates and leads to entrepreneurial propensity (e.g. Koellinger *et al.*, 2007). In this view, confidence has been shown to influence entrepreneurial intentions (Ferreira *et al.*, 2012). The selection process for an accelerator or incubator should be no different, hence:

> *H1.* Confidence in the enunciated content of the video pitch positively affects the likelihood of being admitted into the accelerator or incubator.

Another crucial element is the candidate's method of communication. Effective founders use a dedicated tone of voice and express excitement and commitment through words (Korzynski *et al.*, 2021). Similarly, the outcome of crowdfunding startup pitches can be inferred using text, speech, and video object-related metadata (Kaminski and Hopp, 2020).

Written text often fulfills a ceremonial role, where entrepreneurs show that they can conform to expectations. The most important signals convey information that is not easily inferable from written text and is often specific to a given product or business opportunity. These signals capture the attention of potential backers. Potential campaign videos are more likely to be receptive if the product is shown in action, rather than through sketches. Linguistic expressions that are abstract and more emotionally salient increase campaign success. Tone and voice also affect how potential backers react to crowdfunding campaigns (Kaminski and Hopp, 2020).

Those who speak quickly are perceived as credible, knowledgeable, and trustworthy (Miller *et al.*, 1976). Analyzing 500 popular TED talks, research has also shown that the most successful presenters speak at an average rate of about 190 words per minute, depending on their language (Gallo, 2014). Considering the speed of a speech as an element linked to

audience engagement, fast talking can be viewed as more engaging. In the accelerator or incubator selection program, we hypothesize that:

H2. Engagement in the video pitch positively affects the likelihood of being admitted into the accelerator or incubator.

Another aspect affecting financial investors' decisions is the phenomenon of emotional contagion, which is "the tendency to automatically mimic and synchronize movements, expressions, postures, and vocalizations with those of another person and, consequently, to converge emotionally" (Hatfield *et al.*, 1992, pp. 153-154).

Facial expressions can be contagious. Emotional expressions flow from the sender to the recipient, who picks up on the expressed emotions and develops similar feelings (Hatfield *et al.*, 1994). Three factors that influence the outcome of the emotional contagion process are: the nature of the relationship between the observer and the expresser, the nature of the event eliciting the emotions, and the expressed emotion itself (vanKleef *et al.*, 2015). Individuals are more likely to catch the emotions of others if they like them, identify with them, or share their goals (Kimura *et al.*, 2008).

This theory has guided several studies on the success of crowdfunding campaigns using AI algorithms. Results have shown that facial expressions of happiness (a positive emotion) and sadness (a negative emotion) positively affect funding decisions (Raab *et al.*, 2020). However, entrepreneurs who look more trustworthy are more likely to succeed when crowdfunding (Duan *et al.*, 2020). Entrepreneurs' facial expressions influence the decision-making process of potential stakeholders and funders. Accordingly, we infer similar conclusions for an accelerator or incubator:

H3. The emotional expressions of the entrepreneur in the video pitch positively affect the likelihood of being admitted into the accelerator or incubator.

Methodology
Sample selection
To test our hypotheses, we used data collected from *LUISS EnLabs* (*LVenture Group*, now merged into *Zest Group*) – one of the leading startup accelerators in Italy and Europe (Chicco, 2024). To apply to this accelerator, startups needed to send both a written pitch deck and a video pitch. The accelerator's investors initially judge startup admissions based on these two documents, before scheduling an in-person interview and presentation.

We collected all video pitches submitted between 2017 and 2021–1,290 in total. We cleaned the database of startups whose video pitch links were no longer available (612 videos), and those for which the video pitches were not fully analyzable, e.g. entrepreneurs who do not appear in the video pitch and thus do not show facial expressions (384 videos). The final database contained 294 pitches. Only 10 startups were admitted to the accelerator and received funding. These were considered successful. If the algorithms recognized more than one speaker, we analyzed the speaker who appeared more frequently.

Analyses
To analyze the 294 video pitches, we employed different AI techniques for text, audio, and video data. Specifically, we used *Speechannel*, an AI startup specializing in video analysis for HR and communication purposes (Romano, 2021).

We decided to adopt this solution for three main reasons. Firstly, another study within the entrepreneurial field has already successfully used an AI-driven startup to analyze videos (Korzynski *et al.*, 2021). Secondly, this startup has been recognized as a prominent tool for AI-driven video presentation analysis by the Italian press (Millucci, 2021; Sbandi, 2021).

Thirdly, this tool offers a robust and comprehensive suite of video presentation analytics that cover various communication aspects, such as speech patterns, tones, and facial expressions. Therefore, *Speechannel* enables a credible and efficient analysis of video pitches, which is essential for assessing the multifaceted nature of entrepreneurial video presentations.

Specifically, three analyses were performed through *Speechannel*. In the sentiment analysis, using natural language processing, the spoken content was transcribed and analyzed. This involved understanding the affective sentiment in the text, assessing confidence. In the audio analysis, using speech recognition, the audio was transcribed to analyze speech pace and delivery, focusing on word rate. In the video analysis, using computer vision, non-verbal cues such as facial expressions were assessed to interpret emotional status.

All of these analyses permitted the use of AI in evaluating human communication and assessing the effectiveness of startup video pitches in terms of admission into the accelerator.

Variables

To measure the impact of communication on the accelerator's decision, we used the startup's admission in the accelerator as the dependent variable. For the independent variables, we considered 3 categories: confidence (sentiment analysis), engagement (audio analysis), and emotions (video analysis). For each category, we considered a different set of informative factors for a total of 12 variables: 3 confidence (sentiment analysis); 3 engagement (audio analysis); and 6 emotions (video analysis).

All these independent variables were chosen because they represent the suite of video presentation analytics provided by *Speechannel*. By adopting this broad analytical perspective, we aimed to capture the full spectrum of communicative elements that influence the decision-making outcomes in startup accelerator and incubator environments, in terms of video pitch evaluation.

Specifically, confidence was measured in terms of the overall sentiment inferred from the contents of the speech: POSITIVE, NEGATIVE, or NEUTRAL sentiments. Engagement was measured as per the number of WORDS, MINUTES, and WORDS PER MINUTE. Emotions were measured by asking AI to detect SAD, ANGRY, FEAR, SURPRISED, HAPPY, and DISGUST from facial expressions. These variables are summarized in Table 1.

Data processing

We considered each variable separately, statistically testing the empirical distributions between "funding" (positive) versus "no funding" (negative) (*t*-test). Given the small amount of data from the positive class, the results are not so clear. However, there is a clear difference in distribution for most of the considered variables. We use a *p*-value $< 5-10\%$ as a quantitative signal (Pearson, 1900).

Given the nature of such data, we considered 3 statistical tests to enable the mean to achieve statistical redundancy. We used a standard *t*-test for iid samples (Student, 1908), the Mann-Whitney *U* test (Mann and Whitney, 1947), and the Kolmogorov-Smirnov test (Smirnov, 1944).

In a second step, we used all the variables together and we trained a simple binary classifier to predict acceptance and rejection (logistic regression).

The startups that received funding (positive) are in green, and startups that did not receive funding (negative) are in red (Figure 1–3).

Qualitative insights

We also interviewed 7 investors in Silicon Valley to assess the differences between humans and machines. We asked 3 questions related to confidence, engagement, and emotional factors. The first question was on entrepreneur's confidence. The second concerned the ideal time in minutes for pitches and speech speed. The third concerned entrepreneurs' emotions.

Analyses	Variables	Description
Sentiment analysis (Confidence)	POSITIVE	The text expresses an overall positive sentiment in the speech
	NEUTRAL	The text does not express either positive or negative sentiments in the speech
	NEGATIVE	The text expresses an overall negative sentiment in the speech
Audio analysis (Engagement)	WORDS	The speech's total number of words
	MINUTES	The speech's total number of minutes
	WORDS PER MINUTE	The speech's number of words per minute
Video analysis (Emotions)	SAD	The physical appearance of a person's face expresses sadness in the video
	ANGRY	The physical appearance of a person's face expresses anger in the video
	FEAR	The physical appearance of a person's face expresses fear in the video
	SURPRISED	The physical appearance of a person's face expresses surprise in the video
	HAPPY	The physical appearance of a person's face expresses happiness in the video
	DISGUSTED	The physical appearance of a person's face expresses disgust in the video

Source(s): Table by authors

Table 1.
Variables explanations

Results

Confidence (sentiment analysis)

We normalized each variable in [0, 1] for better comparison. Tests are statistically significant for NEGATIVE and NEUTRAL, and non-conclusive for POSITIVE. Stronger confidence up to a certain point helps in the acceptance process. However, excessive confidence can be perceived as negative, and pitches with a relatively high level of negativity (>0.4) are rejected. Most pitches with very high levels (>0.8) of positivity are accepted. These results partially validate Hypothesis 1 (Figure 1).
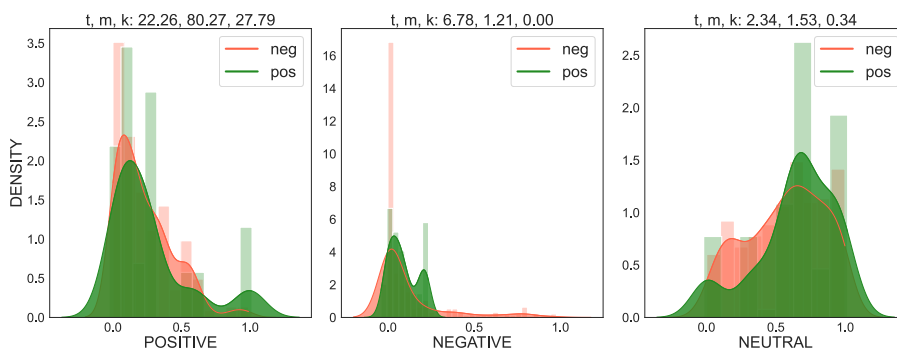
Source(s): Figure by authors

Figure 1.
Empirical distribution for confidence variables (POSITIVE, NEGATIVE, and NEUTRAL) considering funded startups (green) and non-funded startups (red)

Engagement (audio analysis)

All 3 statistical tests are significant. Most successful pitches are between 3 and 4.5 min, with a word rate of 130–200. Unsuccessful pitches can be any length. Too short (<2) or too long

(>6) pitches tend to be rejected independently of other factors (they are probably difficult to understand or boring), suggesting that Hypothesis 2 is well explained (Figure 2).
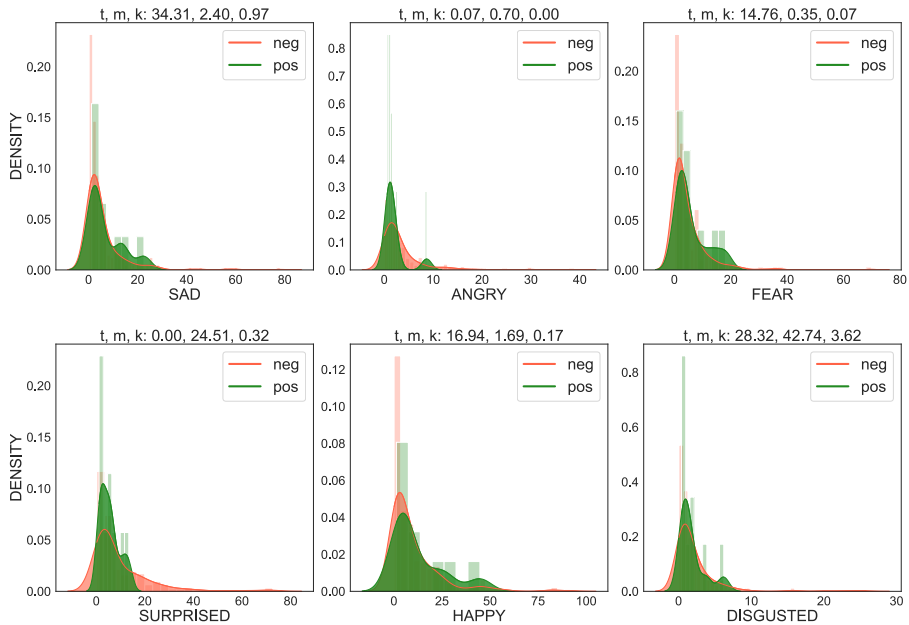
Source(s): Figure by authors

Emotions (video analysis)

We normalized each variable in [0, 1] for better comparison. With the exception of DISGUSTED, 2 out of 3 statistical tests are significant (SAD, ANGRY, FEAR, SURPRISED, HAPPY). The test for DISGUSTED is inconclusive. Higher (up to a certain point) levels of emotion for HAPPY generally signify acceptance. However, above certain thresholds (>0.4/ 0.5), the pitch becomes over-emotional, and the startup is rejected. Low levels (0.25) of ANGRY, FEAR, and SURPRISE are enough to reject the startup. HAPPY is much higher at around 0.5. These results partially validate Hypothesis 3 (Figure 3).

Source(s): Figure by authors

In Table 2, we provide the results for the 3 statistical tests. We considered the difference between variables for funded vs non-funded startups to be statistically significant when the values reported were smaller than 5%. In green, we show the tests that were significant in our analysis. For many variables, differences correlate with whether a startup is funded or not, validating our hypotheses.

Summary of results and correlation with fundraising

The analysis of 294 video pitches reveals key insights related to successful fundraising in startup accelerators and incubators.

Regarding confidence, the sentiment analysis showed a strong link between positive sentiment and successful pitches. Confidence in language significantly influences investor perception, while overconfidence is detrimental. Regarding engagement, the audio analysis identified an optimal speed between 130 and 200 words per minute as the most effective, balancing enthusiasm and clarity. Deviations from this speed negatively affected pitch effectiveness. Regarding emotions, the video analysis indicated that emotionality, particularly positive emotions, strongly impacts investor decision-making in a positive way, while being over-emotional is detrimental.

VARIABLES	t-test (%)	Mann-Whitney test (%)	Kolmogorov-Smirnov test (%)
POSITIVE (Sentiment Analysis)	30.10	94.17	17.66
NEGATIVE (Sentiment Analysis)	9.12	0.55	0.01
NEUTRAL (Sentiment Analysis)	2.66	1.76	0.10
WORDS (Audio Analysis)	0.01	0.32	0.79
MINUTES (Audio Analysis)	0.09	1.20	2.62
WORDS RATE (Audio Analysis)	0.46	1.66	2.63
SAD (Video Analysis)	34.27	2.49	1.57
ANGRY (Video Analysis)	0.07	0.86	0.01
FEAR (Video Analysis)	14.78	0.36	0.07
SURPRISED (Video Analysis)	0.00	27.88	0.32
HAPPY (Video Analysis)	17.00	1.76	0.20
DISGUSTED (Video Analysis)	28.23	40.61	8.09

Source(s): Table by authors

All of these results demonstrate the crucial correlation between communicative patterns and successful fundraising outcomes. It reveals that the success of startup pitches is based not only on the content but also on how that content is delivered: a combination of confidence, engagement, and emotions is the key.

Predictive model: the AI-enabled video pitch evaluation
We then tried to assess the predictive power of these variables. Building a machine learning model with a small sample is challenging, and we therefore used simple models. Given the unbalance between positive and negative classes, we subsampled the majority class (rejected startups) to achieve a ratio of pos/neg 1/3 (10 positives, 30 negatives) for each iteration. We repeated this subsampling process 100 times (with replacements) and averaged the results. The model of choice was a balanced logistic regression – a classifier that accounts for unbalanced classes and re-weights the learner accordingly (James *et al.*, 2013). This model performs well compared to a series of considered models, and it is easy to implement and interpret. Table 3 shows our comparison of simple machine learning models. Logistic Regression performs well, with a balanced accuracy of 78% and F1-score of 83% – much higher than a Random Classifier. For the Random Classifier, we assigned class information proportionally to the positive/negative ratio in the train set. We reported a Random Classifier with a balanced 50% accuracy and F1-score of 64%.

These results show that information in the selected variables can be learned, and that an increase in performance can be compared to a Random Classifier. Our model works better than randomizing, showing that the variables contain information that can identify promising startups.

Figure 4 shows the importance of each parameter in the Logistic Regression Classifier. We considered 100 experiments, normalized the coefficients for each trial, and averaged the trials. The classifier relies heavily on emotional variables.

Discussion
Communication and signaling theories have often been used to help scholars and practitioners understand fundraising decisions (Ahlers *et al.*, 2015; Connelly *et al.*, 2011). Studies have applied AI to codify communication and analyze crowdfunding presentations (Korzynski *et al.*, 2021; Kaminski and Hopp, 2020; Raab *et al.*, 2020; Duan *et al.*, 2020). However, less is known about other forms of access to entrepreneurial finance, such as video

Models	Accuracy	Balanced accuracy	ROC AUC	F1 score
Linear SVC	0.92	0.94	0.94	0.92
Linear discriminant analysis	0.83	0.78	0.78	0.83
Perceptron	0.83	0.78	0.78	0.83
Logistic regression	0.83	0.78	0.78	0.83
Ridge classifier	0.75	0.72	0.72	0.76
Decision tree classifier	0.75	0.72	0.72	0.76
Passive aggressive classifier	0.75	0.72	0.72	0.76
XGB classifier	0.67	0.67	0.67	0.69
SGD classifier	0.75	0.61	0.61	0.73
Extra tree classifier	0.75	0.61	0.61	0.73
Nearest centroid	0.75	0.61	0.61	0.73
Random classifier	0.75	0.50	0.50	0.64

Source(s): Table by authors

Table 3.
Comparison of machine learning models

Source(s): Figure by authors
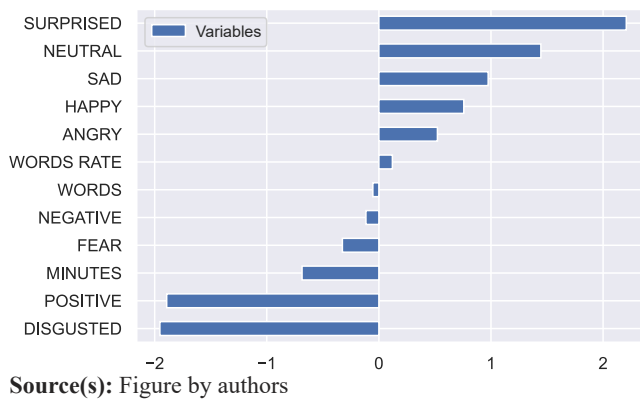
pitches for candidacies into startup accelerators and incubators. This research pioneers AI's application into entrepreneurial finance beyond crowdfunding, exploring its impact in this unique arena. Specifically, it proves that successful entrepreneurs have similar communicative patterns in terms of confidence, engagement, and emotions.

First, our model proves that enunciated confidence positively affects the likelihood of candidates being admitted into accelerators. Scholarly literature also posits that syntactic and linguistic structures are crucial in effectively communicating messages. The macro-level of discourse structure and the micro-level of lexico-grammatical patterns impact the audience's impression (Daly and Davy, 2016). Individuals who make careful choices with regards to words increase the perceived credibility of their speech, which enhances their persuasiveness (Burgoon *et al.*, 2002). Confident public speakers are less worried and are thus less likely to experience anxiety in comparison to those with less confidence. Higher anxiety levels may cause people to avoid presentations, inhibiting them from mastering experiences to boost their confidence (McNatt, 2019). Self-confidence positively influences entrepreneurial intention (Margahana and Negara, 2019). The majority of investors highlighted that: "confidence is very important", "confidence is key", "confidence helps to show the future", "confidence is quite essential in the pitch, lack of confidence will quickly kill the interest of the investor". However, some also state that: "it is important not to become arrogant" and "overconfidence may denote an inability to read reality, so there needs to be a balance". There are many opportunities to convince and stimulate audiences if entrepreneurs have confidence in themselves and their topic. This confidence affects what is said and how it is said. These findings confirm our first hypothesis and lead to our first proposition: *entrepreneurs should show confidence, but they should not be overconfident in video pitches*. This has significant implications for enabling the decision-making process in startup fundraising. It highlights the importance of confidence in influencing investor perceptions and decisions. This understanding can guide startups as well as investors in refining their approach. On the one hand, for entrepreneurs, this insight emphasizes the necessity of striking a balance between confidence and humility in their pitches. It suggests that entrepreneurs should focus on developing their self-confidence while being mindful of the fine line between confidence and arrogance. On the other hand, investors can use this knowledge to assess the potential success of startups more accurately, looking at the importance of confidence but also beyond the surface of it to gauge the true potential and realism of the entrepreneurs' proposals. Understanding this dynamic can allow them for a more precise evaluation of pitches, leading to more informed investment decisions.

Second, our model proves that engagement positively affects the likelihood of candidates being admitted into accelerators. This is in line with literature that posits that entrepreneurs who speak quickly convey enthusiasm, credibility, confidence, and intelligence (Maxwell and Levesque, 2014), while entrepreneurs who speak slowly and in monotone convey a lack of conviction, interest, and passion (Borg, 2013). Language intensity affects communicators' credibility and the quality and persuasiveness of their message (Burgoon *et al.*, 1975). Signals of underlying project quality also include a positive narrative tone (Allison *et al.*, 2017), in line with the thoughts of investors who believe the ideal pitch length should be 3–5 min and that entrepreneurs should speak quickly. The majority of investors said: "speaking fast is better", "if I had to choose between slow and fast, I prefer fast". However, some also stated: "the important is that the message is clear and understandable" and "it is important is to not lose the meaning". We interpret our results by considering that the voice and the language must be consistent with the pitch to establish a connection with the listeners and gain their trust. Just as actors use voice and language to make audiences feel emotions, a great pitch is no different. These findings confirm our second hypothesis and suggest our second proposition: *entrepreneurs should engage by speaking quickly, but they must be clear in their messages*. This has a huge impact for enabling fundraising decision-making. It underscores the effectiveness of enthusiasm and clarity in communication, suggesting that investors are influenced not just by the content but also by the delivery of the pitch. On the one hand, entrepreneurs should consider honing their presentation skills, focusing on an engaging delivery, without compromising clarity and coherence. Fast speech can be an asset, but it must be balanced with clear and understandable messaging. On the other hand, for investors, this finding could be a cue to pay attention to both the substance and style of presentations, as both elements play a crucial role in the overall impact of a pitch. This dual focus can provide a more comprehensive understanding of the startup's potential, increasing the likelihood of success of their decisions.

Third, our model proves that positive and negative emotions in video pitches positively affect the likelihood admittance into accelerators. This is in line with literature that posits that emotions influence the observer's attitude and their decision-making behavior as emotions influence observers' attitudes and decision-making behaviors (van Kleef *et al.*, 2015). Emotions influence decision-makers' expectations of the probability or desirability of their consequences, changing the ways they process these consequences (Loewenstein and Lerner, 2003). Positive emotions are associated with optimistic judgments and heuristic processing (Schwarz and Clore, 1988). A happy state can lead to a positive appraisal of a situation, motivating the decision-maker to maintain positive emotional feelings, for instance, by interacting generously (Frijda, 1994). These feelings can lead to a positive appraisal of a presented object of choice (Peace *et al.*, 2006), as well as more optimistic decision-making (Loewenstein and Lerner, 2003). Negative emotions signify that the sender is in need of support, motivating recipients to sympathize and help change his/her circumstances (Small and Verrochi, 2009). This leads to supportive behavior from potential backers (Raab *et al.*, 2020). These results correlate with investors' comments, arguing that the entrepreneur's emotions are crucial in a video pitch. The majority of investors highlighted that: "emotions can be a reinforcer", "everything is about emotions", "it is important to emotionally involve the counterpart", and "positive emotions are important, but it also depends on the problems solved". However, some stated: "speakers' emotions should be used sparingly" and "emotions can be a detractor if the ability to execute does not come through". Great communicators reach the mind and touch the heart if they do not forget the emotional aspect. The speaker's ability to express emotions shows that they are worthy of admiration and trust. These findings confirm our third hypothesis and indicate our third proposition: *entrepreneurs should show emotions, but they should not abuse their feelings*. This has significant implications for enabling the fundraising decisions. It reveals that emotional

expression in pitches can significantly impact investor attitudes and decisions, emphasizing the human element in business interactions. On the one hand, entrepreneurs should be aware of the power of emotions in their pitches. They need to skillfully express emotions to connect with their audience, ensuring that these emotions reinforce the message rather than detract from it. On the other hand, investors should consider the emotional aspects of pitches as a reflection of the entrepreneur's passion and commitment, while also being cautious of overly emotional presentations that might mask weaknesses in the business plan or execution capability. This double assessment can help investors to identify entrepreneurs who not only have compelling ideas but also the emotional maturity to lead a venture.

To sum up, the advent of AI in entrepreneurial finance has seen significant advancements in recent years. Building on the foundational work of previous studies, our research offers new insights into video pitch evaluation, specifically related to the startup selection process of accelerators and incubators powered by AI. This focuses specifically on the critical communicative elements of entrepreneurs – confidence, engagement, and emotional expressions – in terms of how they affect the likelihood of a startup's admission into these programs. This comparative analysis underscores the originality and value of our research, providing both theoretical concepts and practical applications that enable the fundraising decision-making process for both entrepreneurs and investors.

With this in mind, future research should focus on how the role of confidence, engagement, and emotions varies across different demographic groups (e.g. age, gender, or ethnicity), stages of the entrepreneurial cycle (e.g. early-stage or maturity stage), or industries (e.g. tech or social startups). Moreover, another promising avenue could be related to analyzing the entrepreneurial mindset in a non-entrepreneurial communication scenario, such as that of video CVs or video resumes. In this scenario, further research could investigate if specific communicative patterns (i.e., confidence, engagement, and emotions) are connected with the establishment of a business.

While AI offers remarkable opportunities for enabling the decision-making process in startup fundraising as previously discussed, it simultaneously brings to light significant ethical concerns and potential biases that must be addressed (Zhang *et al.*, 2021). Firstly, the use of AI in evaluating startup pitches, particularly in assessing aspects like confidence, engagement, and emotional expressions, could lead to ethical dilemmas related to fairness and transparency. AI algorithms, depending on their programming and the data they are trained on, might inadvertently perpetuate existing biases. For example, an AI approach might favor certain speech patterns, tones, or facial expressions that are more prevalent in specific demographic groups, leading to an unfair advantage or disadvantage for certain entrepreneurs. Secondly, another ethical concern is the privacy and data security of the entrepreneurs. AI systems require extensive data to function effectively, which might include sensitive information from startup pitches. Ensuring the confidentiality and security of this information is crucial, as any breach could have severe implications for the privacy rights of the entrepreneurial individuals involved. Therefore, it is crucial to approach the integration of AI in startup accelerators and incubators with caution, ensuring that ethical considerations and potential biases are thoroughly addressed. With this in mind, forthcoming research should also aim to develop AI systems that are transparent, fair, and unbiased in order to foster an ethical and effective startup ecosystem.

Conclusion

To the best of our knowledge, this is the first study demonstrating that AI can be an enabler for entrepreneurial finance during the startup selection process for accelerators and incubators in terms of video pitch evaluation. An AI approach was used to predict the outcome of startup video presentations by analyzing text, audio, and video data from 294

video pitches of a leading European startup accelerator. 7 investors were also interviewed in Silicon Valley to establish the differences between humans and machines.

AI has profound implications on the decision-making processes of accelerators and incubators. Successful entrepreneurs are confident (but not overconfident), engaging in terms of speaking quickly (but also clearly), and emotional (but not overemotional). The study offers a novel model through which we can analyze and interpret the video pitches of startup accelerators and incubators. Entrepreneurs who use this knowledge to sell themselves and their investment opportunities effectively are more likely to succeed in fundraising, and investors who use AI in their decision-making processes are more likely to select the most promising startups. To sum up, this paper makes a significant contribution by bridging the gap between theoretical research and practical application of AI in entrepreneurial finance. It offers a new lens and a practical guide through which both entrepreneurs and investors can approach the fundraising process, marking a notable advancement in this field.

There are three limitations of this study. The first relates to the methods of exclusion of video pitches and the use of only communicative parameters. Another is linked to the small sample of successful startups and the involvement of only one accelerator. The last one regards the potential biases related to speech patterns, tones, or facial expressions that might lead to an unfair advantage or disadvantage for certain entrepreneurs. However, this study sets a benchmark for further research in this field. Scholars are invited to build on this research and the proposed model, analyzing new studies and methodologies as well as new startup accelerators and incubators in other countries.

To conclude, we believe that AI can increase the human skillset of entrepreneurs and investors, enabling them to make better decisions. Startup accelerators and incubators should embrace AI to unlock the full potential of their programs and contribute to the entrepreneurial ecosystem. In this scenario, while understanding and mastering the art of communication is essential in fundraising, its true effectiveness emerges when combined with other key factors, such as the team and the metrics of a startup. Although AI can help humans overcome complexity through superior analytical approaches, the crucial role of humans and their intuition in dealing with the uncertainty of the decision-making process remains fundamental. In this way, AI can be an enabler for entrepreneurs and investors.

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