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Sandro Castaldo - Marta Ugolini - Gianmario Verona

To Act or Not to Act: the impact of Artificial Intelligence on Perceived Uncertainty and Entrepreneurial Behavior

FEDERICO CARICASULO* CIRO TROISE*

Framing of the research. *The digital transformations that we have faced globally in the last years have introduced several new technologies, such as the blockchain, artificial intelligence (AI) and the cloud, which are deeply changing our private life as well as work (Chalmers et al., 2021; Makridakis, 2017). Several entrepreneurs have been involved in this change, embracing digital technologies as the core tools of their businesses, and have received many benefits for their enterprises, such as reduced costs of information and human labor brought by innovations such as cloud and AI (Fossen and Sorgner, 2021), which help their enterprises to remain competitive (Chen and Tian, 2022). Even though these benefits due to digital transformation have improved entrepreneurs' competitiveness, there is a critical issue underlying the widespread adoption of these new tools. There is little information about changes due to new technologies for costumers and industries, as well as on the market where they operate (Chen and Tian, 2022) which, blended with the lack of knowledge caused by these digital innovations' novelty, have become a new and additional source of environmental uncertainty for entrepreneurs (Chen and Tian, 2022; Nambisan, 2017). This point is emblematic of the changes due to AI: the general vantage it offers, the improvement of the data analysis process, should increase the amount of information disposed by entrepreneurs, and decrease consequently the uncertainty felt about the environment where they operate (Chalmers et al., 2021). On the other hand, AI should cause an increase of entrepreneurs' environmental uncertainty, especially about the impact on their market. Because of its nature of new technology, they have little information about the impact on their ventures which should cause an increase of the environmental uncertainty they felt (Chen and Tian, 2022; Milliken, 1987).*

In the frame of ambiguity exposed above, several entrepreneurs have positively valued the benefits offered by AI and have chosen to act, founding new ventures which offer services and solutions based on the exploitation of this new technology (AI-based NV). They have chosen, in front of the ambiguity due to AI, to bear the uncertainty and, subsequently, to engage an entrepreneurial behavior through the action of founding a new venture.

Entrepreneurship literature does not set a clear point of view about the impact of AI on the uncertainty felt and on entrepreneurial intents and actions (Townsend and Hunt, 2019) as founding a new venture, although there is close literature on the bond between entrepreneurial action and the impact of uncertainty (Townsend et al., 2018) and about the link among AI and uncertainty (Obschonka and Audretsch, 2020; Townsend and Hunt, 2019; Upadhyay et al., 2021). Concerning the first bond, despite the different meanings attributed to uncertainty's origin, all authors tend to agree on one thing: increased uncertainty negatively affects entrepreneurial activity (Townsend et al., 2018). On the link between AI and uncertainty, the academic dialogue has become complex. Some authors such as Milliken (1987), Sarasvathy (2001) and McMullen and Shepherd (2006) indicated new technologies as a source of uncertainty. Other authors such as Upadhyay et al. (2021), Obschonka and Audretsch (2020) and Townsend and Hunt (2019) suggested that AI may have a mitigating effect on uncertainty.

From this perspective, we could suppose that entrepreneurs' founding act has not been impacted by the uncertainty they felt and, subsequently, the entrepreneurial intention underlying their behavior was not affected either. Nonetheless, many potential entrepreneurs have negatively evaluated the action of founding an AI-based NV. Following the same logic expressed above, we could also suppose that those who do not act have been overwhelmed by uncertainty they felt about AI and that this should have impacted their entrepreneurial behavior and the underlying entrepreneurial intention. Building on this paradoxical statement, we pose our research questions: a. Does Artificial intelligence impact on a potential entrepreneur's PEU influence entrepreneurial intention and action of founding a new AI-based venture? b. Does an entrepreneur's AI-related PEU be an explanatory variable to distinguish potential entrepreneurs who will be engaged in entrepreneurial behavior from those who will not?

To de-fragment the paradoxical statement expressed above and search for answers to our research question, it should be useful to start from the bond between entrepreneurial action and the uncertainty caused by new technologies. Milliken has proposed a framework for assessing the uncertainty felt by entrepreneurs -the Perceived Environmental

* PhD Student of *Business and Management* - University of Turin, Italy
e-mail: federico.caricasulo@unito.it

• Research fellow of *Business and Management* - University of Turin, Italy
e-mail: ciro.troise@unito.it

Uncertainty (PEU)- based on three dimensions: the state where the organization operates, the effect of phenomena on their organization on the response put in place by entrepreneurs to face the context (e.g., Milliken, 1987, Townsend et al., 2018, and McKelvie et al., 2011). Milliken's PEU framework has been reprised by McMullen and Shepherd in their Theory of Entrepreneurial Action under the condition of Uncertainty (TEAUU) (McMullen and Shepherd, 2006), where the authors postulate that entrepreneurs act when their PEU is supported by their willingness to bear the uncertainty felt. Starting from this assumption, the framework of McMullen and Shepherd proposes to explain how subjective uncertainty about a phenomenon's entrepreneurial opportunity, such as the introduction of new technologies, impacts on general entrepreneurial action (Grégoire et al., 2010; Shepherd et al., 2007).

In order to explain the entrepreneurial action as behavior, the work of McMullen and Shepherd reprises Ajzen's Theory of Planned Behavior (TPB) elements, seeing perceived desirability and feasibility as key constructs that transform a phenomenon's opportunity into action behavior (Ajzen, 1991; Grégoire et al., 2010). In this way, Ajzen's theory gets in touch with McMullen-Shepherd's theory and allows us to narrow our attention to the primal core of the new venture foundation process, the formation of the intent to perform the entrepreneurial action (Autio et al., 2001; Kautonen et al., 2015; Schlaegel and Koenig, 2014; Schwarz et al., 2009).

Purpose of the paper. *In order to answer our research questions, the purpose of this paper is dual: first, to verify if the perceived uncertainty about state, effect and response by new venture founders due to the adoption of AI as a core of their business could impact their entrepreneurial intention and, subsequently, the entrepreneurial action of founding this kind of venture. Second, to evaluate if a potential entrepreneur's perceived uncertainty could be a variable that distinguishes potential entrepreneurs who will be engaged in entrepreneurial behavior from those who will not.*

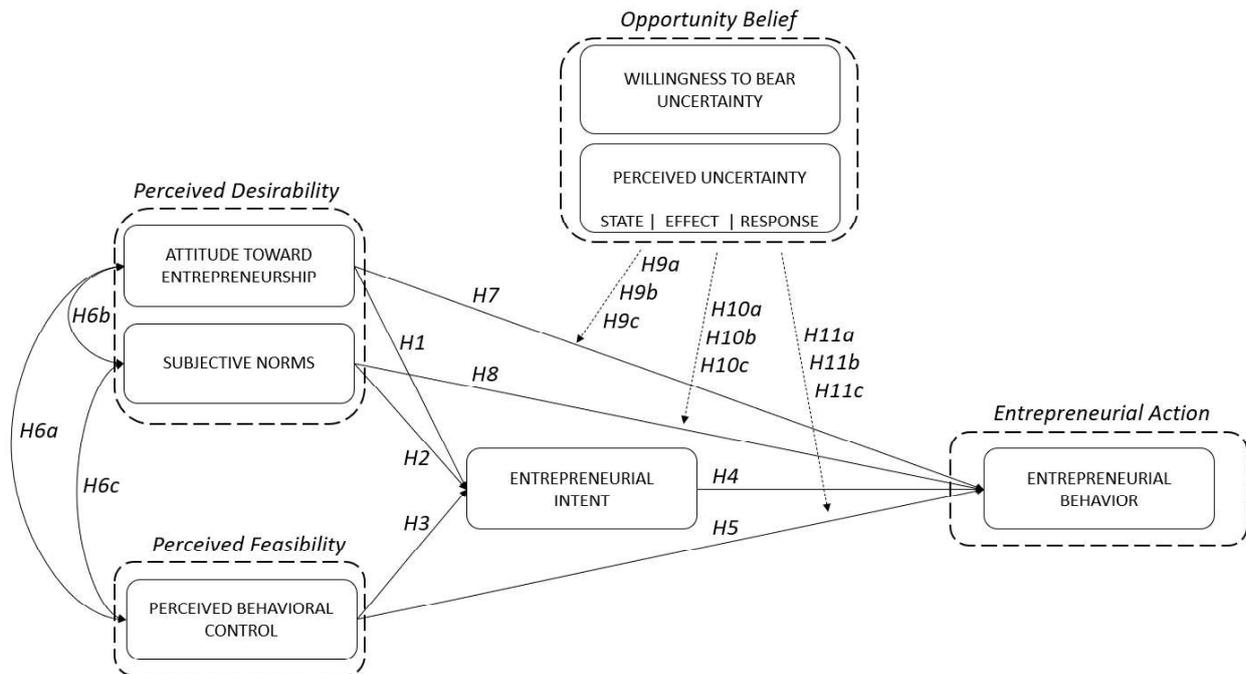
To start to de-fragment our research questions and understand the mechanism underlying the entrepreneurial intention and behavioral action to find a new venture, we propose to adopt Kautonen's adaptation of Ajzen's TPB (Kautonen et al., 2015). The original theory has been widely adopted by entrepreneurship scholars, who have proposed several adaptations to explain the entrepreneurial behavior and the underlying intention (e.g., Autio et al., 2001; Kautonen et al., 2015; Schlaegel and Koenig, 2014). In particular, Kautonen's proposal of Ajzen's TPB application for entrepreneurship reprises previous research (Kautonen et al., 2013) and states that: a. The entrepreneurial behavior is subject to a direct effect caused by entrepreneurial intention (Autio et al., 2001; Kautonen et al., 2015; Schlaegel and Koenig, 2014); b. The entrepreneurial intention is influenced by a direct effect due to three elements, the attitude toward entrepreneurship, the subjective norms and the perceived behavioral control (Autio et al., 2001; Kautonen et al., 2015; Schlaegel and Koenig, 2014); c. The perceived behavioral control exerts a direct effect on entrepreneurial action. Kautonen's TPB adaptation could explain the reason behind the entrepreneurial action of founding an AI-based NV and the underlying entrepreneurial intention. Consequently, we assume the following: H1. The attitude toward entrepreneurship has a direct effect on entrepreneurial intention; H2. The subjective norms have a direct effect on entrepreneurial intention; H3. The perceived behavioral control has a direct effect on entrepreneurial intention; H4. The entrepreneurial intention has a direct effect on entrepreneurial behavior. H5. The perceived behavioral control has a direct effect on entrepreneurial behavior.

As well as Kautonen et al., McMullen-Shepherd's TEAUU also reprises Ajzen's TPB (Grégoire et al., 2010). Grégoire et al. underline how these two authors built their theory from previous studies on entrepreneurship which group Ajzen's causes of intention into two elements, the perceived desirability, containing the attitude and the subjective norms, and the perceived feasibility, embedding the perceived behavioral control (Grégoire et al., 2010). McMullen-Shepherd postulate that an entrepreneurial action -like founding a new venture- is a behavior influenced by these two interrelated elements, the perceived desirability and the perceived feasibility (McMullen and Shepherd, 2006; Grégoire et al., 2010). Consequently, TEAUU states that all Ajzen's attitudes, grouped in perceived desirability and feasibility, are interrelated and directly impact entrepreneurial action. From this postulate, we can attempt to explain the action of founding AI-based NV by proposing the following: H6. Attitude toward entrepreneurship (a), Subjective norms (b) and Perceived behavioral control (c) are related; H7. The attitude toward entrepreneurship has a direct effect on entrepreneurial action behavior; H8. The subjective norms have a direct effect on entrepreneurial action behavior.

The TEAUU has been applied by McMullen and Shepherd in different contexts, such as the introduction of new technologies (McMullen and Shepherd, 2006). This phenomenon influences the personal recognition of opportunity - so-called opportunity-belief - and impacts on perceived feasibility and desirability. The opportunity-belief is composed of two elements, the perceived environmental uncertainty and the willingness to bear it (McMullen and Shepherd, 2006; Shepherd et al., 2007). The authors state that elevated levels of uncertainty, such as that caused by new technologies, could be obstacles to the choice to bear it and hide the recognition of personal opportunities. Consequently, they suppose that opportunity-belief components should affect entrepreneurial action touching the perceived feasibility and desirability (Grégoire et al., 2010; McMullen and Shepherd, 2006; Shepherd et al., 2007). In line with this proposition, we could assume that AI-based NV's founder has chosen to bear a certain level of perceived uncertainty that affects Ajzen's attitudes through each dimension. Subsequently, we could postulate the following: H9. Perceived State (a.), Effect (b.) and Response (c.) uncertainties act as moderators between the attitude toward entrepreneurship and entrepreneurial action; H10. Perceived State (a.), Effect (b.) and Response (c.) uncertainties act as moderators between the subjective norms and entrepreneurial action; H11. Perceived State (a.), Effect (b.) and Response (c.) uncertainties act as moderators between perceived behavioral control and Entrepreneurial Behavior.

The theoretical framework exposed can be synthesized in the figure below (fig.1).

Fig. 1



Methodology. In order to test our hypotheses about the impact of perceived uncertainty due to AI on each element of the theoretical framework and determine its effect on our two dependent variables -the entrepreneurial intent and the entrepreneurial behavior-, we assume to adopt an empirical, quantitative approach.

To measure the variables of our theoretical framework, we followed methodological procedures already tested by several authors on PEU, TPB and TEAUU, adopting a variation of Ashill and Jobber (2010) and Milliken's (1987) Likert scale to assess perceived State, Effect and Response uncertainties and Kautonen et al. (2015)'s Likert scale to measure Ajzen's TPB variables.

This research is a work in progress. We are currently creating a dedicated questionnaire that will be sent to the target sample. The population sample was identified among people who participated in business plan competitions, hackathons and other initiatives dedicated to the realization of AI-based NV. There are two motivations behind the choice of our sample. First, all the participants of these initiatives have a certain measure of entrepreneurial intent. Second, we will distinguish those entrepreneurs who chosen to bear uncertainty and acted from those who have not. The questionnaire, following the progress of this research, will adopt multi-item scales and will contain questions concerning the perception of environmental uncertainty according to the three dimensions of environmental uncertainty identified by Milliken, "state", "effect" and "response" (Ashill and Jobber, 2010; Milliken, 1987) and questions about the variables of Kautonen's TPB adaptation (Kautonen et al., 2015).

The questionnaire's answers will then be split into two macro-groups, those who chose to bear uncertainty and act and those who have not. According to results obtained by our sample in terms of distribution and number of responses, we will determine the best strategy to assess the effect of our independent variables -entrepreneur's perceived state, effect and response uncertainty- on entrepreneurial intent and action behavior.

Results. The expected findings of the research should confirm the impact of AI-related PEU on founders' entrepreneurial intent and entrepreneurial action behavior of founding new ventures that offer services and solutions based on the exploitation of AI.

To begin with entrepreneurial intent, we expect it will be positively affected by attitude toward behavior, subjective norms and perceived behavioral control (H1, H2, H3), in line with previous research on entrepreneurship and TPB focused on entrepreneurial intention in high school and university contexts (e.g., Autio et al., 2001; Schlaegel and Koenig, 2014). The entrepreneurial action behavior, following the results of Kautonen et al.'s study on Austrian and Finland adult population (Kautonen et al., 2015) should be affected by entrepreneurial intent (H4) as well as by perceived behavioral control (H5). The theoretical correlation between perceived desirability and feasibility has also been successfully tested in Schlaegel and Koenig's work on determinants of entrepreneurial intent (Schlaegel and Koenig, 2014) and, subsequently, we expect a confirmation of hypotheses H6a, H6b, H6c.

Looking at the individual components of PEU, the perceived state, effect and response uncertainty, each of these should be influenced by AI into the formation of perceived uncertainty. Following the current literature, we can attempt an attribution of which kind of impact AI should have. First, on the state uncertainty dimension. This one increases as the unpredictability of the components of the organizational environment grows. AI should contribute to make a leaner decision-making environment and, consequently, should have a lenitive effect on this dimension (Nambisan, 2017;

Townsend and Hunt, 2019; Upadhyay et al., 2021). Second, there should be a visible impact on effect uncertainty. It should grow up similarly to the unpredictability of the environmental effects on one's business. Consequently, the variable should have a negative impact on this dimension due to the unpredictability of technological changes' rapidity and consistency caused by AI (McMullen and Shepherd, 2006; Milliken, 1987; Sarasvathy, 2001). Third, there should be an impact on response uncertainty, increasing this as the unpredictability of possible choices and consequences on one's organization increases. AI's improvement of the data analysis process should support decision-making systems in uncertainty and, consequently, have a lenitive impact on this dimension (Chalmers et al., 2021; Obschonka and Audretsch, 2020; Upadhyay et al., 2021).

According to the discussion above, we should always have a certain level of minimal perceived uncertainty and, from the values obtained, a range of possible values where entrepreneurs have decided to bear the PEU and it does not affect their willingness to bear it and act. This is in line with previous studies on entrepreneurship and uncertainty, where the latter is seen as a constant, undeletable element that entrepreneurs should face in their activities (McMullen and Shepherd, 2006; Sarasvathy, 2001; Townsend et al., 2018). Following the TEAUU, new venture founders should choose to bear the PEU and, subsequently, this should impact the founder's perceived feasibility and desirability. These elements, reprising the works of Grégoire et al. (2010) and Kautonen et al. (2015), would have a positive impact on the formation of entrepreneurial action behavior.

Consequently and according to the assumptions above, we expect the following answers to our research questions. First, AI's impact on potential entrepreneur's PEU influences entrepreneurial intention and action of founding a new AI-based NV. The perceived state and response uncertainty related to AI should increase the uncertainty of potential founders, which should act as a negative moderator in the formation of entrepreneurial action behavior (H9a, H9c, H10a, H10c, H11a, H11c). The perceived effect of uncertainty related to AI should decrease the uncertainty of potential founders and has an impact as a positive moderator on the formation of entrepreneurial action behavior (H9b, H10b, H11b).

Second, the impact of PEU dimensions will be different between the two groups analyzed and, subsequently, this variable would be a potential indicator to distinguish potential entrepreneurs who will be engaged in entrepreneurial behavior from those who will not.

Research limitations. The proposed research has some limitations. The first one lies in the choice of the population analyzed. Selecting those who previously participated in entrepreneurship promotion initiatives such as business plan competitions and hackathons will allow us to verify the presence of effective entrepreneurial action and, subsequently, to simplify the willingness to bear the PEU of entrepreneurs in a dichotomic variable. Because of this choice, however, it will not be possible to analyze the role of personal strategies in the development of willingness to bear their uncertainty.

The second limitation of this research is to focus its attention on the generality of multi-item scales adopted in order to measure the TPB variables. They will allow us to investigate the largest variety of population selected for this research but, due to their generalization, they may not be accurate in the measurement of variables in a specific context, for example, those studied by Autio et al. (2001) and Schwarz et al. (2009) on the formation of entrepreneurial intent and action in the educational context.

The third limit of our work is to have narrowed our investigation on entrepreneurs who acted through entrepreneurial promotion initiatives. Future research should enlarge this study to firms and new ventures' founders who have not been involved in events such as business plan competitions and hackathons, where they could have received material support in the engagement of entrepreneurial intent and action.

Managerial implications. Our work should have several managerial implications. The first one is to give decision-makers a practical framework that analyses the impact of a new and little-known technology such as AI on the international market. The original proposition of Milliken's PEU (Milliken, 1987), reprised by several authors such as Ashill-Jobber (2010) and McMullen-Shepherd (2006), takes into account how the international market is felt by entrepreneurs. Different individual perceptions of uncertainty about the market due to AI could identify new potential partners and/or competitors in the international market who are valuating similar entrepreneurial opportunities and, subsequently, new sources of competitive advantage (Porter, 2008).

The second one is to underline the importance of investments in an entrepreneur's personal education in theme of new digital technologies such as AI. The proposed framework highlights, consistent with entrepreneurship literature, the moderate effect of uncertainty on entrepreneurial behavior underlying the action (Knight, 1921; Milliken, 1987; Townsend et al., 2018). Prior knowledge, acquired through personal education as well as from individual life paths, could reduce uncertainty about new opportunities offered by phenomena like AI and, subsequently, stimulate the engagement of new entrepreneurial actions (McMullen and Shepherd, 2006; Shepherd et al., 2007). This point, in line with previous studies on the internationalization of new ventures, global digitalization phenomena and entrepreneurial action, should explain how entrepreneurs and managers could assess the international market and decide to engage in their entrepreneurial behavior (Hashai and Zahra, 2022; Nordman and Melén, 2008)

Originality of the paper. The proposed research is expected to provide new insights into the literature on entrepreneurial action, uncertainty and AI. First, we would propose a new theoretical framework that mixes uncertainty and entrepreneurial behavior into a merged operationalizable model useful for identifying the personal characteristics underlying entrepreneurial intention and action. Second, the proposed framework could be adopted in several studies to assess the impact of uncertainty due to new technologies and, in general, phenomena of entrepreneurial intention and

action. Third, we should offer a new perspective on entrepreneurship and AI, suggesting a new motivation behind the choice of adopting this new technology as a core business resource.

Keywords: *Entrepreneurial action; Perceived uncertainty; Theory of Planned Behavior; Entrepreneurial intent, Artificial Intelligence; Quantitative approach*

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