Modelling theinteraction effect of entrepreneurial opportunity and artificial intelligence networking on entrepreneurialbehaviour: A multinomial logit approach

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Abstract
This study enriches the debate about entrepreneurial behaviours through a new perspective based on artificial intelligence networking (AIN). We tested the effect of the interaction between artificial intelligence networking and entrepreneurial opportunity (recognition and exploitation) on entrepreneurial behaviour. To reach this objective, we adopted a multinomial logit model.
The results show that network centrality, network scale, and relationship stability as dimensions of AINenhance the effect of opportunity exploitation and recognition on entrepreneurial behaviour. However, this effect seems to differ among dimensions of entrepreneurial behaviour. Our main result is the definition of a critical pathway for opportunity recognition and exploitation as the main determinant of successful entrepreneurial behaviour.
Our findings might assist entrepreneurs to understand how to recognize and exploit opportunity through the use of AINto maximize the chance ofsuccessful entrepreneurial behaviour. The information provided in this research stresses the important role of AIN in making the entrepreneurial decision-making processmore operational and relevant. The mind mapping of a dynamic approach can orient entrepreneurs and respond to two main questions: how to proceed and which way to develop entrepreneurial behaviour through AIN.
Keywords: entrepreneurial behaviour, opportunity recognition, opportunity exploitation, artificial intelligence networking, multinomial logit model**.**

1. Introduction

Nowadays, entrepreneurs must be able to invest in an uncertain environment, characterized by highly complex risk (Knoben, Ponds and Van Oort, 2011). As entrepreneurs, they must be able to identify, appreciate and exploit entrepreneurial opportunities (Shane, 2000) to trigger entrepreneurial behaviour.This concept seems to be important for economic and social development,as wellas personal development due to the relative importance of such decision and its result (Coan, 2011).
Souza (2015)associate entrepreneurial behaviour to an entrepreneurial activity through some specific characteristics such as ability to recognize and perceivean opportunity, planning to

start a project related to this opportunity, and power to be self-independent, persuasive and good at networking. In this sense, we will admit that entrepreneurial opportunity can stimulate and determine an entrepreneurial behaviour to generate an entrepreneurial activity.

Ardichvili et al. (2003) suggest that identification and selection ofsuitable opportunities are the main abilities needed for entrepreneurial success, it can't be found but constructed. Venkataraman (1997) argue that this opportunity is discovered.

Ge et al. (2016), present another conception according to which entrepreneurial opportunity, is identified based on a marketing analysis to collect information in the first stepcalled - opportunity recognition (OR) - then he will be able to exploit and use this opportunity based on its financial and professional advantages compared toothers -opportunity exploitation (OE).

OR involves the possibility of introducing something new to the market (Gaglio, 2004). It includes three distinct processes: sensing and perceiving need; discovering the relationship between a need's nature and availability to be met, and creating a new equilibrium between needs and distinctive resources (De Koning andMuzyka, 1999).

Then, if an entrepreneur decides to realize a perceived opportunity, this is considered OE (Shane and Venkataraman, 2000). To effectively exploit opportunity, entrepreneurs have to be able to shift their conception of resources, which define an opportunity'soperational viability (Choi et al., 2008).

Both OR and OE seem to be determinants for the success of an entrepreneurial process (Shamudeen et al., 2017). Implementation and determination of opportunities mainly depend on entrepreneurs' knowledge considered effective for OR (Marvel & Lumpkin, 2007),and for OE (Foss et al., 2013). The importance of knowledge is widely debated and admitted in this field, but the nature of knowledge needed for this process is still unclear. For some researchers,the required knowledge is personal, such as experience (Ardichvili and Cardozo, 2000). For others, knowledge of the market and technology is the most determinant, in combination with personal cognitive characteristics(Hajizadeh and Zali, 2016). Additionally, some researchers are not interested in the type of knowledge; for them, what matters is how it is shared (Corbett, 2007).

Shi et al. (2020) confirm that knowledge transfer can be ensured by different network entities between two levels of knowledge: from high to potential. Jang (2013) argues that network activities,like personal and social activities, are determinants for entrepreneurialsuccess. We suppose that artificial intelligence networking can assist knowledge transfer and generation, to define entrepreneurial opportunity. It can guide entrepreneurs to identify opportunities through shared knowledge, and push opportunity exploitation by facilitating both information transfer, and connection with different partnerships able to assist entrepreneurs and attract financial support.

As mentioned above, we aim to understand entrepreneurial opportunity (recognition and exploitation) as a determinant of entrepreneurial behaviour through the use of artificial intelligence networking as a tool. This study will enrich literature in this field,since OR as a field of research is still fragmented and empirically underdeveloped (George et al., 2016). Added to this, Siegel and Renko (2012) admit that knowledge use and its different mechanisms contribute to OR, but the way it can be integrated is still unclear.The integration

and adoption of artificial intelligence networkingcould provide a response tothis question,and fillthe huge literature gap identified around contingent factors as a regulator between OR and OE (Khin and Lim, 2018).Until recently, we could not find research which provides evidence about an exhaustive approach of entrepreneurial behaviour determinants based on OR, OE or the interaction between them (Calzaet al., 2020).

That said, the main question raised here is howartificial intelligence networking can boost the effect of opportunityrecognition and exploitation on entrepreneurial behaviour.It is about highlighting the role of opportunity recognition and exploitation, combined with the use of networking,on entrepreneurial behaviour.

The resulting model could be adopted by researchers and entrepreneurs to investigate the relationship and interactions between opportunity recognition, opportunity exploitation and artificial intelligence networking, to provide knowledge and information about entrepreneurial behaviour. This would enable researchers and entrepreneurs to easily identify the mechanisms and technologiesthat have the highest effect, and strengthen entrepreneurial behaviour, leading to increased entrepreneurship.

This study contributes to enrich the existing literature on entrepreneurial opportunity research in four main ways. First, it provides a clear definition of opportunity recognition and opportunity exploitation, as well as entrepreneurial behaviour,which can enrich and support theoretical discussion in this field. Second, a developed measurement scale of interrelations between our main constructs will allow future research to explore these effects differently and improve constructquality. Third, the analysis integrates an important variable - artificial intelligence - and contributes to understanding how this technology can be used to make the entrepreneurial process easier and more reliable. Finally, this research is the first to use multinomial logit regression on the entrepreneurial field,making entrepreneurial behaviour more predictable. Our aim is to make entrepreneurial behaviour as measurable and controllable as possible, even though human behaviour remains difficult to predict.

2. Literature review

2.1 Entrepreneurial behaviour

De Jong et al. (2011) consider entrepreneurial behaviour the act of identifying and exploiting opportunities. Thus, entrepreneurial behaviour is based on a cognitive approach to identify opportunities and make them operational.

Kuratko et al. (2005) define entrepreneurial behaviour as the undertaking of activities to discover, evaluate and exploit an entrepreneurial opportunity. These three steps also require knowledge management and development to be able to discover an opportunity at the right time, to appreciate it and finally exploit it. However, the appreciation and definition of this opportunity still depends on personal perception.

Mair (2005) suggests another aspect of entrepreneurial behaviour: it is considered a transition from independent activities to cooperative behaviour, to accomplish a task in an entrepreneurial way.

To understand entrepreneurial behaviour according to the need of this research, we refer to the concept of entrepreneurial behaviour characteristics defined by Krüger et al. (2017). Three categories of these characteristics were presented by MSI (1990): personal characteristics(expressed in terms of achievementsdirectly related to opportunityseeking and

initiative, based on risks and degree of commitment); planning (expressed as an information seeking process to set goals and plans); and finally, power (independence, the persuasive effect of networking and self-confidence).

As we can see, opportunity constitutes one of the most important components of entrepreneurial behaviour. Stevenson et al. (1989) argue that identifying and selectingan appropriate opportunity represents the most important determinant of a successful project.

As defined by the majority of existing researchers, we can conclude that entrepreneurial opportunity is still the first step for the definition of EB. Shane and Venkataraman (2000) present entrepreneurship as exploitation of entrepreneurial opportunity through three main elements: how to explore it, by whom, and finally with what result. They consider that this process is based on three main stages: discover, evaluate and exploit new goods and services.

To make this conception clearer and more operational, we have to define entrepreneurial opportunity and its specification, in order to explore how it can determine entrepreneurial behaviour. Which mechanisms and technologies can enhance this interrelation of interdependence, and how can its effect be maximised?

2.2 Entrepreneurial opportunity: recognition and exploitation

The development of an opportunity is considered cyclical; it is directly related to an ability developed through information and knowledge networks, which regroups entrepreneurs' alertness and personal traits (such as creativity) and the nature of an opportunity (Ardichvili et al., 2003).

This definition couldanswer our question related to mechanisms and technologies, and explain how entrepreneurial opportunity can lead to entrepreneurial behaviour and more operational and useful conditions.Here, information and knowledge collected, treated and transformed by networking can translate opportunity from a simple idea to an operational act.

Kuckertzet al. (2017) argue that an entrepreneurial opportunity is composed of two dimensions: recognition and exploitation,both crucialto the entrepreneurial process. Similarly, Shane and Venkataraman (2000) demonstrate that the discovery of an opportunity is necessary for entrepreneurship, but not itself enough, because the entrepreneur must still exploit this opportunity. Jarvis (2016) considers that these steps of recognition and exploitation are, often, consecutive. We must specify that the use of *often*, in this context, allows us to suppose that the process could also be simultaneous, and the time to make the decision to exploit varies among entrepreneurs and among contexts. Shane and Nicolaou (2015)claim that the first step to start a business can depend either on capturing an opportunity (OR), or exploit it directly (OE).

Our literature review therefore suggests there is a specific process for entrepreneurial behaviour,through entrepreneurial opportunity, with entrepreneurs using information and knowledge on two levels (internal and external) according totheir personal references or factors. To recognize opportunity, therefore, there are three factors:first,the entrepreneursthemselves;second,interactions to share information and opinions (on two levels: internal between entrepreneurs and external);and last, the nature and kind of opportunity.

We present in the following section the composition or factors which determine opportunity recognition and exploitation. Then, we will make a comparative approach between them to

decide if these concepts are related and sequential or synchronous. Table 1 presents the definition of each opportunity according to specific criteria.

The identification of specific factors related to opportunity recognition, in the literature, confirms our initial hypothesis that entrepreneurial behaviour is assimilated to a reflexive individual process,and reinforced by an integrative (or associative) process.

There are two main OR factors identified: entrepreneurial alertness,and asymmetry between knowledge and information. Entrepreneurial alertness is assimilated to a high level of awareness through intensive interaction between the entrepreneur and the market (Ardichviliet al., 2003). This means that a high level of information must be reached (Ray and Cardozo, 1996) and entrepreneurs'existing knowledge will trigger their entrepreneurial alertness to information received or collected (Shane, 1999). In other words, entrepreneurs' primary knowledge shapeshow they receive incoming information, and they will be able to detect an opportunity if it can be related to their existing knowledge (the asymmetry(correspondence) between knowledge and information).The greater the fit between information and knowledge, the higher the alertness and recognition.

The last point related to this reflexive process supposes that recognition can be voluntary or accidental, and we think that here AI can make a difference. This point will be discussed and detailed in the next section.

Table 1. Opportunity recognition vs opportunity exploitation

	Opportunity recognition	**References**	**Opportunity exploitation**	**References**
Aspects	**Perceptions**	**Gibbs, 2009**	**Behaviours**	**Gibbs, 2009**
Process	**Cognitive**	**Correia Santos et al., 2015**	**Nascent entrepreneurial**	**Gibbs, 2009**
Activities	**Beingalert** **Searching** **Gathering information** **CommunicatingProblem-solving** **Evaluating**	**Gregoire et al., 2010;Correia Santos et al., 2015**	**Developing a product or service, acquiringhumanresources, planning the business, understandingcustomers and the market, gatheringresources and setting up the organization**	**Gibbs, 2009**
Capabilities	**Creative and strategicthinking** **Open mind** **Acquiringknowledge and information perception**	**Shane and Nicolaou, 2015** **Tang et al., 2012** **Ozgen and Baron, 2007** **Ardichvili et al., 2003**	**Reacting to feedback** **Hiringemployees** **Written business plan** **Evaluation of the acceptance of products or services** **Building up a network** **Approachinginvestors or the government** **Setting up formal**	**Gartner et al., 2010** **McGee et al., 2009** **Shane and Delmar, 2004** **Foss et al., 2013** **Haynie et**

			structures	**al., 2009; Lassalle and McElwee, 2016 Gartner et al., 2010**
Similarities	**Depends on an individuallevel (behaviour, activity and decisionmaking)(Kuckertzet al., 2016). Creativityisconsidered as a commonantecedent factor (Shane and Nicolaou, 2015).**			

Through our analysis, we have demonstrated that entrepreneurial opportunity is a determinant for entrepreneurial behaviour, and without opportunities, entrepreneurial behaviour cannot be defined or established. Additionally, we noted that entrepreneurial opportunity is a multidimensional concept, which requires not only recognition and exploitation, but also an interaction between these two processes. Another seemingly important aspect is the nature of each kind of opportunity. Opportunity recognition can be associated with a cognitive process to select an appropriate opportunity, which dependson the entrepreneur's reflection. In contrast, opportunity exploitation relates to a behavioural approach.

We have to determine how opportunities are created, discovered and exploited to be able to identify the role of artificial intelligence networking.

2.3Entrepreneurial opportunity, artificial intelligence networking and knowledge management

To determine the role of AIN in the entrepreneurial opportunity process (recognition and exploitation), we hypothesise that AIN can improve the knowledge management (KM) essential for recognisingan opportunity at the right time, and exploiting it effectively, as discussed in 2.2.

The KM process has three main options. The first supposes that knowledge is given (Davenport andPrusak, 2000; McElroy, 2003). The second considers KM to be created through the integration of what is needed and generated by a life cycle phase (McElroy, 2003). The third optionargues that KM is related to organizational culture, and generates innovation (Davenport andPrusak, 2000), by creating, sharing and acquiring knowledge in an organization (Darroch, 2003). In this last perception, the innovative aspect can be associated with the creation of new opportunities ready to be recognized.

In any case, if knowledge is given, and opportunity exists and is recognized, if an opportunity is created according to a specific need, this can be identified byan entrepreneur seeking opportunity, including new, emergent opportunity which requires additional effort to localize.

Short et al. (2010) demonstrate that many researchers associating entrepreneurial opportunity with knowledge managementadopt different theoretical perspectives. Some studies admit that opportunity is rooted in the epistemological approach with historical roots (Alvarez, Barney, 2010). Others suppose that opportunity is directly determined by entrepreneurs via the nature and characteristics of the knowledge they use in the process of defining it (Alvarez et al., 2014).

Along the same lines, Gaglio (2004) states that KM is the key factor in controlling the learning process relating to opportunity. This process is closely attached to an entrepreneur's cognition and mode of learning (Bingham et al., 2007). McKelvey andLassen (2013) define two types of knowledge which can be associated with the learning process to define opportunity: technical and market knowledge. These are managed differently due to learning asymmetries, according to which each entrepreneur learns differently based on personal experience.

Kuckertz et al. (2017) demonstrate that the opportunity recognition process requires six activities: to be alert, to search, to gather information, to communicate, to solve the problem and to evaluate.Dubini and Aldrich (1991) state that networking can be used as a tool to expand action and save time for entrepreneurs. They identify a new kind of networking behaviour, which seems to be higher-performing than usual business behaviours,through the construction of strong links.

Turati (1988) stressesthat entrepreneurs need networks to pursue appropriate opportunitiesfor networking, and to collect and use necessary resources.Ilićet al. (2019) demonstrate that new technologies can enhance the entrepreneurial process through the diffusion of knowledge and the ability to reliably collect data in realtime, improving creativity and self-efficacy.

Our objective here was to understand the general idea and mechanisms which support our idea, but the main objective is still to determine a prototype of entrepreneurial behaviour in terms of entrepreneurial opportunity and AIN.

In this case, we suppose that the level of entrepreneurial behaviour (EB) will be appreciated and provideas high, low or uncertain. *High* signifies that a person becomes an entrepreneur (takes action), *low* that entrepreneurial behaviour is not adopted (no action), and *uncertain* that the final decision has not been taken yet. No effect supposes that the respondent is indifferent. Where there is no effect (equilibrium), we will be able to hypothesise the existence of other determinants.

Based on this analysis,sevenhypotheses are adopted:

H1. AIN, OR and OE generate a high EB level (EB1).

H2. AIN, OR and OE generate a low EB level (EB2).

H3. AIN, OR and OE generate anuncertain EB level (EB3).

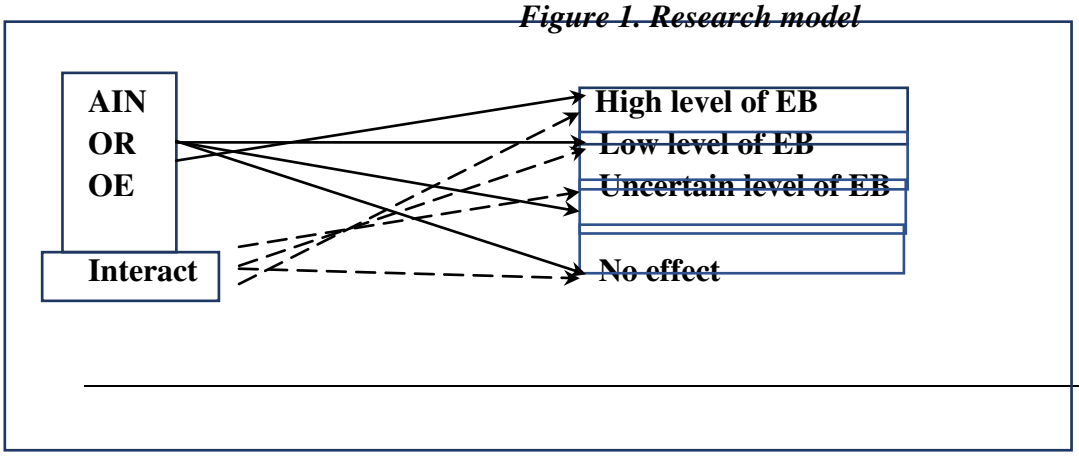
H4. AIN, OR and OE do not affect EB level (EB4).

H5. The interaction between AIN, OR and OE generates anuncertain EB level.

H6. The interaction between AIN, OR and OE generates a high EB level.

H7. The interaction between AIN, OR and OE generates low EB level.

Figure 1. Research model



3. Methodology

A hypothesis test was performed usinga multinomial logit model. Data collected from a survey of 501entrepreneurs were treated and manipulated by STATA 16, with 22 items covering five network dimensions (Shi et al., 2020).Entrepreneurial opportunity wasmeasuredusing the scale developed by Farmer et al. (2011): 5 items for opportunity discovery or recognition and 4 items for opportunity exploitation**.**

3.1 Principal Component analysis

To facilitate the treatment of the data, we associated different items in a single index to facilitate theiruse and interpretation. For each variable, we exploreditsimplicit composition or multidimensionality to make it more operational. Inall, three variables were presented: OR, OE and AIN.

Table 2 shows the components selected and the correlation of each variable. The main objective was to calculate the index for each dimension.

Table 2. Dimensions index

Dimensions	**Items**	**Component**		**Index**
		1	**2**	
Network centrality (NC)	**NC1** **NC2** **NC3**	**-,652** **,326** **,736**	**,460** **,889** **,014**	$NC = w_1 NC1 + w_2 * NC2 + w_3 * NC3$ **w_1, w_2, w_3, w_4,and w_5 are the applied weights for each category**
Network scale (NS)	**NS1** **NS2** **NS3** **NS4** **NS5**	**,393** **,595** **,707** **,599** **,500**	**,681** **,469** **-,173** **-,362** **-,415**	$NS = w_1 NS1 + w_2 * NS2 + w_3 * NS3 + w_4 NS4 + w_5 * NS5$ **w_1, w_2, w_3, w_4, and $w_5$are the applied weights for each category**
Relationship strength (RS)	**RS1** **RS2** **RS3** **RS4** **RS5**	**,540** **,570** **,744** **,673** **,331**	**-,468** **-,509** **,174** **,302** **,637**	$RS = w_1 RS1 + w_2 * RS2 + w_3 * RS3 + w_4 RS4 + w_5 * RS5$ **w_1, w_2, w_3, w_4, and $w_5$are the applied weights for each category**
Relationship stability (RST)	**RST1** **RST2** **RST3** **RST4**	**,591** **,573** **,637** **,666**	**,544** **,604** **-,275**	$RST = w_1 RST1 + w_2 * RST2 + w_3 * RST3 + w_4 RST4 + w_5 * RST5$ **w_1, w_2, w_3, w_4, and $w_5$are the applied weights for each category**

	RST5	**,647**	**-,341 -,410**	
Reciprocity (R)	**R1 R2 R3 R4**	**,644 ,714 ,649 ,546**		$R = w_1R1 + w_2 * R2 + w_3 * R3 + w_4R4$ **w_1, w_2, w_3, and $w_4$are the applied weights for each category**
Opportunity recognition (OR)	**OR1 OR2 OR3 OR4 OR5**	**,667 ,651 ,650 ,564 ,633**	**-,414 -,474 -,092 ,621 ,465**	$R = w_1R1 + w_2 * R2 + w_3 * R3 + w_4R4$ **w_1, w_2, w_3, and $w_4$are the applied weights for each category**
Opportunity exploitation (OE)	**OE1 OE2 OE3 OE4**	**,645 ,686 ,705 ,600**		$NS = w_1OE1 + w_2 * OE2 + w_3 * OE3 + w_4OE4 + w_5 * OE5$ **w_1, w_2, w_3, w_4, and w_5 are the applied weights for each category**

According to the recommendation of Perez etal. (2015), the final weight (w_i) is as follows:

$$w_i = \sum_{k=1}^{n} (a_{k,i} * \frac{\sqrt{\lambda_k}}{\sum_{j=1}^{n}\sqrt{\lambda_j}})$$

With

K is the number of components, $a_{k,i}$ are self-vectors ranged between 1 to k, λ_k is theself-valueof principal component k and $\sum_{j=1}^{n}\sqrt{\lambda_j}$ the sum of the adopted self-value based on selected criteria.

The calculated Dimensions index enabled testing of the multinomial logit regression model, with the introduction of the indexes tothe main model.

3.2 Multinomial logit regression

Zerai and Banks (1999) argue that logistic regression represents the probability of an event, classifiedas a categorical and "dependent" variable; in this case, entrepreneurial behaviour (EB). Considered discrete,EB is converted to continuous in terms of the probability of adopting entrepreneurial behaviour. Four cases are defined: high, low, uncertain and indifferent. The linear model cannot be used in this study because there are more than 2 alternatives, so we chose to proceed withmultinomial logistic regression, which ismore appropriate, as it is used when categories are unordered.

Thus, we suppose that EB has N classes (here N=4). One value (typically the first, the last, or the value with the most frequent outcome)is chosen as the reference category. The probability of affiliation in other classes is compared to the probability of affiliation in the reference class.

Hence, if the first class is the reference, then, for N = 2, …, 5

$$\ln \frac{P(Y_i = N)}{P(Y_i = 1)} = \alpha_n + \sum_{k=1}^{n} (\beta_{nk} * X_{tk}) = Z_{nt}$$

With

Y_i defines different categories of EB (from 1 to 4). X is the different componentsanalysed, extracted from the first section of AIN dimensions,opportunity recognition (OR) and opportunity exploitation (OE).

The probabilities for N= 2, …, 4are computed as follows

$$P(Y_i = N) = \frac{EXP(Z_{nt})}{1 + \sum_{h=2}^{N} EXP(Z_{ht})}$$

For the reference classes, the probabilities take the following expression:

$$P(Y_i = N) = \frac{1}{1 + \sum_{h=2}^{N} EXP(Z_{ht})}$$

We added an equation related to the interaction variables between the OR and OE variables with the various network items. The goal was to see if AIN is considered a factor that could enhancethe effect of the OR and OE variables on entrepreneurial behaviour.

4. Results and discussion

The hypothesis test was evaluatedin three main steps. For each step, we had three main variables: OR, OE, AIN with four dimensions, and EB with four levels (high, low, uncertain and indifferent). To enrich the results, we associated with each hypothesis, four classes according to the relative importance of this effect for respondents (strongly agree, agree, neutral and disagree).

The first step related to the effect of each dimension on EB (high (1), low (2), uncertain (3) and indifferent (4)). The objective was to determine the most determinant factor on each figure,and appreciate the relative importance of this effect for respondents.

The second step measured the interaction effect on EB. We tested the combined effect of the variables, to understandthe role of AIN. We aimed to test the robustness of the effect measured on the first step with the presence of AIN.

The third and last step wasdetermined by classes to localize the degree of agreement or disagreement with previous results in our sample.

Table 3 shows the effects of OE, OR and the various network items on the four entrepreneurial behaviour items (EB1 to EB4). Maximum likelihood methods were used for estimation.

Table 3. Effects of OE, OR and AIN on the main three entrepreneurial behaviours

	EB1 (high)				EB2 (low)				EB3 (uncertain)			
	(2)	(3)	(4)	(5)	(2)	(3)	(4)	(5)	(2)	(3)	(4)	(5)
Dim	**2**	**3**	**4**	**5**	**2**	**3**	**4**	**5**	**2**	**3**	**4**	**5**
NC	**0.193**	**0.00750**	**0.0860**	**-0.00275**	**0.168**	**-0.0766**	**0.0331**	**-0.0880**	**-0.178**	**-0.0475**	**0.0253**	**-0.0690**
	(0.221)	**(0.200)**	**(0.191)**	**(0.235)**	**(0.155)**	**(0.146)**	**(0.126)**	**(0.160)**	**(0.189)**	**(0.142)**	**(0.142)**	**(0.162)**
RS	**0.413****	**0.497*****	**0.243**	**0.529*****	**0.470*****	**0.372*****	**0.177***	**0.435*****	**0.278***	**0.390*****	**0.434*****	**0.257***
	(0.185)	**(0.164)**	**(0.154)**	**(0.204)**	**(0.138)**	**(0.129)**	**(0.105)**	**(0.141)**	**(0.152)**	**(0.119)**	**(0.120)**	**(0.135)**
RST	**0.181**	**0.397*****	**0.312****	**0.394***	**0.0213**	**0.250***	**0.0844**	**0.244***	**0.0958**	**0.168**	**0.193**	**0.229**
	(0.168)	**(0.151)**	**(0.142)**	**(0.202)**	**(0.132)**	**(0.132)**	**(0.106)**	**(0.143)**	**(0.151)**	**(0.120)**	**(0.121)**	**(0.141)**
R	**-0.227**	**0.0564**	**0.131**	**0.590****	**0.221**	**0.0186**	**0.0662**	**0.189**	**-0.247**	**0.0993**	**-0.185**	**-0.0955**
	(0.195)	**(0.176)**	**(0.169)**	**(0.239)**	**(0.153)**	**(0.143)**	**(0.120)**	**(0.157)**	**(0.172)**	**(0.140)**	**(0.139)**	**(0.159)**
NS	**-0.257**	**-0.296***	**-0.425*****	**-0.415****	**-0.194**	**-0.227***	**0.140**	**-0.00988**	**0.228**	**0.0135**	**0.0309**	**-0.0112**
	(0.192)	**(0.166)**	**(0.160)**	**(0.194)**	**(0.132)**	**(0.118)**	**(0.103)**	**(0.128)**	**(0.152)**	**(0.115)**	**(0.116)**	**(0.130)**
OR	**0.328***	**0.463*****	**0.667*****	**0.726*****	**-0.167**	**0.584*****	**0.350*****	**0.197**	**0.220**	**0.436*****	**0.671*****	**0.613*****
	(0.198)	**(0.175)**	**(0.169)**	**(0.224)**	**(0.145)**	**(0.149)**	**(0.119)**	**(0.151)**	**(0.168)**	**(0.132)**	**(0.137)**	**(0.156)**
OE	**-0.167**	**0.190**	**0.396****	**0.675*****	**-0.0756**	**-0.146**	**-0.0151**	**-0.0431**	**-0.0804**	**0.224***	**-0.142**	**-0.101**
	(0.179)	**(0.168)**	**(0.162)**	**(0.234)**	**(0.141)**	**(0.141)**	**(0.116)**	**(0.152)**	**(0.165)**	**(0.130)**	**(0.133)**	**(0.153)**
Const	**0.297**	**1.741*****	**2.387*****	**0.287**	**-0.658*****	**-0.263**	**0.426*****	**-0.524*****	**-0.555*****	**0.665*****	**0.696*****	**0.0650**

	(0.316)	**(0.264)**	**(0.256)**	**(0.337)**	**(0.182)**	**(0.164)**	**(0.134)**	**(0.173)**	**(0.213)**	**(0.160)**	**(0.160)**	**(0.180)**
Observ	**501**	**501**	**501**	**501**	**501**	**501**	**501**	**501**	**501**	**501**	**501**	**501**

***Indicates significance at the 1% level. **Indicates significance at the 5% level. *Indicates significance at the 10% level. Standard deviation inparentheses.

The results clearly show that the network dimension (RS) displays the most important effect on different items except EB1 (Class 4). Its effect isgreatestonEB3.

NC shows non-significant effects except on EB4 (negative effects on Class 3);see alsoTable 4 below. RST has positive and statistically significant effects on EB1, EB2 and EB4. This variable recorded the largest impact on Class 5. Its effect isnon-significant on EB3.

Reciprocity (R)exhibits ambiguous effects on the different items of EB. Its effect is negative and statistically significant onEB4. On the other hand, its effect ispositive on EB1.

The same finding is valid for the network scale (NS), whichhas apositive effect only on EB4. In contrast, it had a negative effect on EB1,and non-significant on EB3.

The non-significance of the majority of items used here on EB3 allows us to confirm that these variables, if combined, seem to be enough for the entrepreneurial decision.

Opportunity recognition (OR) shows positive effects on the different EB items (except EB4). This signifies that OR is important for entrepreneurial behaviour,independentlyof the intensity or probability to adopt it (high,low, uncertain or indifferent). The entrepreneurial mindset maintains its importance. Proportionally, opportunityexploitation (OE) has positive effects only on EB1 and EB3. This means that OE favours a high or uncertain level of EB. This recalls the concept of risk aversion, which varies accordingtoan entrepreneur'spersonality.

Table 4. The effect of OE, OR and AIN dimensions on EB4 (indifferent)

VARIABLES	**2**	**3**	**4**	**5**
NC	**-0.0586**	**-0.324****	**-0.254****	**-0.224**
	(0.170)	**(0.139)**	**(0.124)**	**(0.165)**
RS	**0.0892**	**0.0833**	**0.172**	**0.228**
	(0.147)	**(0.116)**	**(0.106)**	**(0.145)**
RST	**0.210**	**0.257****	**-0.00344**	**0.273***
	(0.150)	**(0.123)**	**(0.106)**	**(0.150)**
R	**-0.271***	**0.110**	**-0.0476**	**0.103**

	(0.164)	**(0.136)**	**(0.122)**	**(0.163)**
NS	**0.0557**	**0.236****	**0.246****	**0.236****
	(0.141)	**(0.111)**	**(0.102)**	**(0.133)**
OR	**0.407****	**0.516*****	**0.630*****	**0.445*****
	(0.163)	**(0.132)**	**(0.123)**	**(0.158)**
OE	**-0.147**	**-0.199**	**-0.0134**	**-0.172**
	(0.154)	**(0.131)**	**(0.121)**	**(0.155)**
Constant	**-0.956*****	**-0.0417**	**0.366*****	**-0.705*****
	(0.196)	**(0.149)**	**(0.136)**	**(0.180)**
Observations	**501**	**501**	**501**	**501**

*****Indicates significance at the 1% level. **Indicates significance at the 5% level. *Indicates significance at the 10% level. Standard deviation inparentheses.**

Table 5 shows the effects of the different interaction variables on the different EB items.

Table 5: Interaction effect on EB

	EB1	**EB2**	**EB3**	**EB4**
OR_RS	**+**	**NS**	**NS**	**NS**
OE_RS	**NS**	**NS**	**NS**	**+**
OE_NC	**+**	**+**	**NS**	**NS**
OR_NC	**+**	**NS**	**NS**	**NS**
OR_RST	**NS**	**+**	**NS**	**+**
OE_RST	**+**	**NS**	**NS**	**NS**
OE_R	**NS**	**NS**	**+**	**+**
OR_R	**+**	**NS**	**NS**	**+**
OR_NS	**+**	**+**	**+**	**+**

+ indicates positive and statically significant at least at 10% level of significance.
NS indicates that the effect is statistically insignificant.

The results show that the OE_NC, OR_NC, OR_NS and OR_RST and OE_RST variables displayed significant effects on the different EB items. In general, artificial

intelligence networking, measured by the NC, NS and RST variables, boosts the effects of opportunity recognition and exploitation on entrepreneurial behaviour.

Table 6: Interaction effect on EB based on different classes

	EB 1 (high)				EB2 (low)				EB 3 (uncertain		
	(2)	(3)	(4)	(5)	(2)	(3)	(4)	(5)	(2)	(3)	(4)
S	2	3	4	5	2	3	4	5	2	3	4
	0.505*	0.168	0.288	-0.341	0.163	-0.197	0.0673	-0.0851	-0.136	-0.00131	0.0615
	(0.306)	(0.259)	(0.247)	(0.334)	(0.167)	(0.176)	(0.130)	(0.169)	(0.207)	(0.152)	(0.153)
	0.0960	0.393*	0.0923	0.383	0.419***	0.323**	0.0817	0.357**	0.132	0.360***	0.385**
	(0.249)	(0.211)	(0.199)	(0.249)	(0.157)	(0.144)	(0.113)	(0.148)	(0.170)	(0.129)	(0.130)
	0.329	0.486**	0.367*	0.542**	0.0121	0.395**	0.145	0.310**	0.0687	0.177	0.182
	(0.235)	(0.201)	(0.189)	(0.265)	(0.155)	(0.154)	(0.116)	(0.153)	(0.176)	(0.132)	(0.133)
	-0.0128	0.220	0.331	0.770***	0.342*	0.0500	0.115	0.255	-0.274	0.0363	-0.184
	(0.265)	(0.224)	(0.213)	(0.287)	(0.176)	(0.159)	(0.131)	(0.168)	(0.203)	(0.157)	(0.157)
	0.402	0.630***	0.783***	0.821***	-0.151	0.791***	0.393***	0.220	0.224	0.370***	0.666**
	(0.260)	(0.222)	(0.214)	(0.291)	(0.161)	(0.177)	(0.132)	(0.167)	(0.183)	(0.141)	(0.148)
	-0.179	0.274	0.503**	1.042***	-0.197	-0.276*	-0.00785	-0.0389	0.0498	-0.195	-0.109
	(0.260)	(0.218)	(0.210)	(0.326)	(0.168)	(0.161)	(0.136)	(0.172)	(0.201)	(0.147)	(0.150)
	0.490***	0.259*	0.0322	0.0711	-0.114	-0.166	-0.105	-0.146	-0.160	-0.00881	-0.0161
	(0.157)	(0.139)	(0.133)	(0.177)	(0.0962)	(0.124)	(0.0817)	(0.108)	(0.104)	(0.0872)	(0.0901
	0.00252	-0.0435	-0.0278	-0.0290	0.0523	-0.0687	-0.127	-0.101	-0.0493	0.0679	-0.0589
	(0.154)	(0.138)	(0.134)	(0.174)	(0.115)	(0.111)	(0.0938)	(0.119)	(0.126)	(0.1000)	(0.0982
	-0.257	0.401**	0.357**	0.167	0.309**	0.278*	-0.0373	0.114	0.230	-0.0357	-0.0127
	(0.207)	(0.182)	(0.174)	(0.240)	(0.141)	(0.142)	(0.119)	(0.156)	(0.160)	(0.132)	(0.129)
	0.268	0.337*	0.206	0.517**	-0.212	-0.00864	-0.163	-0.113	-0.00829	0.0220	0.0609
	(0.187)	(0.173)	(0.160)	(0.224)	(0.132)	(0.156)	(0.105)	(0.142)	(0.169)	(0.123)	(0.126)
	0.135	-0.0879	-0.132	-0.0983	-0.0216	0.240*	0.0756	0.0493	-0.114	-0.0268	0.0603
	(0.139)	(0.135)	(0.130)	(0.182)	(0.112)	(0.135)	(0.0906)	(0.122)	(0.128)	(0.0958)	(0.100)
	0.0162	0.185*	0.0729	-0.192	-0.0529	0.152	-0.0427	-0.0482	0.0278	0.00298	-0.0189
	(0.117)	(0.108)	(0.107)	(0.222)	(0.101)	(0.110)	(0.0817)	(0.118)	(0.112)	(0.0885)	(0.0877
	-0.147	-0.0545	-0.0255	-0.0438	-0.00768	-0.0347	-0.160	-0.0776	0.319**	-0.123	0.125
	(0.170)	(0.150)	(0.148)	(0.231)	(0.127)	(0.127)	(0.104)	(0.135)	(0.146)	(0.119)	(0.120)
	0.290**	0.323**	0.140	0.301	0.133	0.0444	0.139	0.185	-0.112	0.0411	-0.0970
	(0.143)	(0.132)	(0.131)	(0.195)	(0.102)	(0.131)	(0.0914)	(0.116)	(0.124)	(0.0967)	(0.104)
	0.468***	0.345**	0.263*	0.0726	0.0303	0.219*	0.173*	-0.164	-0.102	-0.0524	0.0279
	(0.175)	(0.146)	(0.138)	(0.172)	(0.117)	(0.115)	(0.0963)	(0.120)	(0.130)	(0.101)	(0.103)
	0.215	1.729***	2.415***	0.0117	-0.628***	-0.205	0.486***	-0.489**	-0.577**	0.688***	0.651**
	(0.352)	(0.286)	(0.276)	(0.394)	(0.200)	(0.192)	(0.150)	(0.196)	(0.227)	(0.171)	(0.173)
s	501	501	501	501	501	501	501	501	501	501	501

*****Indicates significance at the 1% level. **Indicates significance at the 5% level. *Indicates significance at the 10% level. Standard deviation inparentheses.**

This research aimed to test the effect of artificial intelligence networking on entrepreneurial behaviour, by measuring if the integration of artificial intelligence would enhance the effect of entrepreneurial opportunity recognition and exploitation. By doing so, this study belongs to entrepreneurial behaviour research based on a dynamic and preventive approach. The circumstances in which entrepreneurial behaviour can be formulated to maximise its chance of generation, through the combination of these variables,have never beforebeen explored. The results presented above show that this effect exists and is positive, and some critical synergetic effects can be defined. Also, the use of AIN, especially network scale, can stimulate and increase the effect of OR and OE on EB.

The findings confirm that:

- Opportunity recognition strongly determines a high level of entrepreneurial behaviour, but is insufficient for a low level. This variable is necessary but insufficient.
- Opportunity exploitation is non-significantatthe uncertain and low level. Although the literature suggests OE shouldbe slightly significantata high level, based on our sample, OE is less important than OR.
- The most important AIN factors ata high level are network scale (NS) and relationship strength (RS).
- Reciprocity (R) and network centrality (NC) donot affect different levels of entrepreneurial behaviour (EB1 to EB3). In contrast, NC is important for the indifferent state ofentrepreneurial behaviour.
- Relationship strength is the most important and determinant feature of artificial intelligence networking.
- Network scale is important for all levels of EB,whencombined with OR.
- After the introduction of AIN with entrepreneurial opportunity, the effect of opportunityexploitation, which seemed to be non-significant and not important, became positive and significantwhenassociated with network centrality (NC) and reciprocity (R). This last observation permits us to confirm that AIN is crucial for EB and can be used to stimulate indirectly the development of entrepreneurial activity.

These results converge with previous studies which insist on the effect of artificial intelligence on entrepreneurship (Ilićet al., 2019). The findings are in line with general agreement on the importance of entrepreneurial opportunity, especially opportunity recognition (Ardichvili et al., 2003). Our resultsencourage the emergent field of artificial intelligence and its role on the redefinition of entrepreneurship theories and model (Nambisan, 2017; von Brielet al., 2018).

5. Conclusion

Growing research about entrepreneurship activity and its development is due to its importance and positive effects on economic and social development. Asthe use of artificial intelligence becomes inevitable, entrepreneurs have to rethink their entrepreneurship models and theories, in order to update their knowhow in this field. Accordingly, the use of artificial intelligence networkingto promote and push entrepreneurial behaviour has become a

distinctive aspect for practitioners and academics.As a contribution to the field, this study aimed to identify the role of artificial intelligence networking on the definition of opportunity recognition and exploitation as necessary conditions for the adoption of entrepreneurial behaviour by addressing two questions: how artificial intelligence networking can contribute to the stimulation of opportunity recognition and exploitation, and how to predict the level of entrepreneurial behaviour for 501 entrepreneurs through the use of specific artificial intelligence network tools.

The results offer the following conclusions:

(i) Relationship strength positively affects opportunity recognition, whatever the level of generated entrepreneurial behaviour;

(ii) the interaction between artificial intelligence networking, especially with centrality (NC) and reciprocity (R),and opportunity recognition, generates a high level of entrepreneurial behaviour;

(iii) opportunity recognition is essential for different levels of entrepreneurial behaviour, but opportunity exploitation did not have the same importance in our sample;

(iv) Opportunity recognition, entrepreneursis the first and direct stimulus for entrepreneurs to adopt an entrepreneurial behaviour independently of the context;

(v) the interaction ensured by artificial intelligence networking is important, as the probability ofgenerating a high level of entrepreneurial behaviour is guaranteed;

(vi) artificial intelligence networking permits and stimulates entrepreneurial behaviour because it permits interaction, and facilitates cooperation and exchange, but the most important factor is still the frequency of communication.

Some important implications arise from our findings. First, to define entrepreneurial behaviour, some specific networks must be created between entrepreneurs, institutions and government, and data and information exchange seems to be very important. An entrepreneurial network, or mutual access to a mixed and shared entrepreneurial database would bevery determinant. This 'auto-alimented' information process wouldfacilitate auto-generation of entrepreneurialopportunity. A transparent and fluid network is also needed for entrepreneurial exploitation, to facilitate the adoption of an entrepreneurial process. As discussed, this kind of opportunity represents the first contact of entrepreneurs with the reality ofestablishing entrepreneurial projects. Moreover, having the right information atthe right time can make a difference to the continuity of the entrepreneurial process.

Second, based on our findings, the use of artificial intelligence networking must be expanded, as the effect of network scale on all levels of entrepreneurial behaviour highlights the importance of extension. This is not a one-offevent or an occasional process. Artificial intelligence exploitation must be embedded in the entrepreneurial process amonggovernments, entrepreneurs and market or society.

Our research hadtwo main limitations. First, we stressed the importance of artificial intelligence networking,without takinginto consideration its use and conception. The technical aspect must be revisited in order to specify the appropriate technology. Second, our scope waslimited to external determinants of entrepreneurial behaviour. The personal side is also important, because it determines risk aversionand the ability to accept the new

technology. We think that a combined personal, environment and technical approach couldbe useful to enrich our findings and orient future research.

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