Towards a qualitative understanding of human capital in entrepreneurship research

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Abstract

Purpose – The purpose of this paper is to revisit the conceptualization and measurement of human capital in entrepreneurship research.

Design/methodology/approach – By contrasting reflective and formative conceptions, it shows that human capital is more appropriately seen as defined and formed by its indicators (education, work experience, entrepreneurial experience, industry experience, and managerial experience). It, then, explores the configurations of these indicators in a qualitative comparative analysis framework based on Boolean algebra and fuzzy-set methodology. It derives an empirical typology of the human capital of nascent entrepreneurs, based on two primary combinations of indicators.

Findings – The paper shows that the relationship between human capital and venture emergence is best represented as multiple, conjectural causation, i.e. human capital matters through certain combinations of its indicators.

Originality/value – The discussion and results offer novel and valuable insights into entrepreneurship researchers for the conceptualization and use of human capital constructs.

Keywords Human capital, Nascent entrepreneurs, Formative and reflective measures, Fuzzy-set analysis

Paper type Research paper

Introduction

The construct of human capital is widely used in entrepreneurship research, as recent meta-analytical reviews show (Martin *et al.*, 2013; Unger *et al.*, 2011). It represents the knowledge and skills – whether general or specific to the task context – that individuals bring to a task they set out to perform and, as a basic tenet, is expected to improve task performance (Becker, 1975). Based on this premise, a human capital perspective has been used to predict a variety of entrepreneurial outcomes such as becoming a nascent entrepreneur or self-employed, new venture formation, and new venture performance and survival. As such, human capital represents an intuitive and appealing construct for predicting entrepreneurial outcomes. The challenge for empirical research, however, lies in translating the theoretical notion of human capital into valid operationalization in specific studies. The purpose of this paper is to critique the current practice of using disjointed proxies of education and experience, and discuss how human capital can be represented in a more holistic manner.

Bruderl *et al.* (1992) emphasize the need to adapt the construct of human capital to the particular context of study and, accordingly, distinguish traditional indicators of general human capital (education and work experience) and three indicators of human capital specific to the context of entrepreneurship: entrepreneurial experience, industry experience, and managerial experience. Each of these five indicators offers a glimpse into the entrepreneurs' human capital and, to the extent that it is used in a study, can be expected to have a positive relationship with the entrepreneurial outcomes of interest. But as the brief review below suggests, the evidence for such relationships is relatively mixed. This reflects significant heterogeneity in the studied relationships, based on different conceptualizations of human capital as well as contexts in which it is developed (Martin *et al.*, 2013; Unger *et al.*, 2011).

In regard to general human capital, there is evidence that both education and work experience increase the likelihood of engaging in start-up activities (Davidsson and Honig, 2003) and of

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venture survival (Bates, 1990; Bruderl *et al.*, 1992; Gimeno *et al.*, 1997). But equally, other studies have shown no relationship of these human capital indicators with business survival (Bosma *et al.*, 2004) or with the achievement of nascent business milestones (Davidsson and Honig, 2003).

In regard to entrepreneurial experience, evidence suggests positive relationships with becoming a nascent entrepreneur (Davidsson and Honig, 2003), successfully founding a business (Rotefoss and Kolvereid, 2005), and the likelihood of future self-employment (Carroll and Mosakowski, 1987; Evans and Leighton, 1989). In addition, prior entrepreneurial experience can positively affect venturing progress but has no effect on the likelihood of first sale (Davidsson and Honig, 2003); and vice versa, it is associated with higher initial venturing progress but has no effect on subsequent progress (Samuelsson and Davidsson, 2009). Similarly, studies show a positive relationship between entrepreneurial experience and firm size (Bruderl *et al.*, 1992; Colombo *et al.*, 2004), profitability (Bosma *et al.*, 2004), and external funding (Chatterji, 2009) and, at the same time, no effect on new venture survival (Bosma *et al.*, 2004; Bruderl *et al.*, 1992; Delmar and Shane, 2003, 2004), the timing of new product introduction (Schoonhoven *et al.*, 1990), and new venture performance (West and Noel, 2009).

In regard to industry experience, there is tenuous relationship with successful transition from nascent to infant entrepreneur (Wagner, 2005), but no relationship with venturing progress (Samuelsson and Davidsson, 2009). Similarly, some studies show a positive relationship between industry experience and funding (Chatterji, 2009), and growth and survival (Bruderl *et al.*, 1992; Cooper *et al.*, 1994; Gimeno *et al.*, 1997; Pennings *et al.*, 1998; Stuart and Abetti, 1990; Van de Ven *et al.*, 1984), while others have found no effect on survival (Delmar and Shane, 2004), on the timing of new product introduction (Schoonhoven *et al.*, 1990), and on performance (West and Noel, 2009).

Finally, in regard to managerial experience, some studies have shown it to have no effect on new venture survival but positive effects on various initial organizational characteristics (Bruderl *et al.*, 1992; Colombo *et al.*, 2004); others have shown the opposite, i.e. positive effect on organizational survival and no effect on business performance (Bosma *et al.*, 2004).

Rather than aim to provide a comprehensive overview of human capital in entrepreneurship research, this brief review serves to highlight the complexity of this domain, as evident in the mixed evidence for the relationship between human capital inputs and entrepreneurial outcomes. There are two ways to reflect upon and reconcile this mixed evidence. First, one can argue that different entrepreneurial outcomes are sufficiently complex and, thus, important contingencies or intervening factors may not be properly captured in the various studies (e.g. Dimov, 2010). Indeed, Unger *et al.*'s (2011) assessment clearly shows that an overall low relationship between human capital and entrepreneurial success subsumes a variety of moderating factors such as the nature or task relatedness of human capital, the business context, and the particular success measure chosen.

Second, one can argue that the extant modelling of the relationships between the human capital indicators and entrepreneurial outcomes does not properly capture the nature of the human capital construct. Indeed, not all five indicators are normally used in statistical models, perhaps reflecting an implicit assumption that they may be interchangeable as reflections of human capital. In addition, statistical estimations typically model only their direct effects, thereby ignoring any configurational patterns that may exist among these indicators.

In this paper, I focus on the second approach by revisiting the nature of the human capital construct and suggesting new approaches to its understanding and representation. In the next section, I contrast the conceptions of human capital as a reflective and formative construct and present evidence for the latter, based on data on nascent entrepreneurs featured in the Panel Study of Entrepreneurial Dynamics (PSED) II (Reynolds and Curtin, 2008). Rather than being interchangeable reflections of an underlying construct, the five

human capital indicators are independent building blocks of human capital. In the third section, I elaborate on this formative relationship by exploring the distinct configurations, based on fuzzy-set analysis, among the five indicators in the context of solo nascent entrepreneurs featured in the PSED II. In the fourth section, I re-examine these configurations based on their relationships with the emergence of the nascent venture.

Reflective and formative conceptions of human capital

The relationship between theoretical constructs and their measure represents an important yet overlooked aspect of theoretical reasoning (Edwards and Bagozzi, 2000). Edwards and Bagozzi distinguish two types of relationship between a construct and its measures, reflective and formative. In the first, a construct is viewed as a cause of its measures. Such measures are termed reflective as they represent manifestations of the same underlying construct. This conception underlies considerations related to reliability and factor analysis. It presupposes high correlation among the measures (indicators) and models these measures as a function of the underlying construct and (measurement) error (Kline, 2005). As such, reflective constructs require a minimal but not necessarily exhaustive set of consistent indicators.

In contrast, in the second conception, measures are viewed as causes of the respective construct. In this sense, the construct is formed by its measures. The classic example of a formative construct is socioeconomic status (SES), which is inferred from observable characteristics such as education, income, and occupational prestige (Heise, 1972). These characteristics represent distinct, independent dimensions of SES and increases in each of them increases SES regardless of the levels of the other characteristics. More broadly, a formative construct is defined and caused by certain antecedent indicators (Edwards and Bagozzi, 2000) and does not presuppose high correlations among its indicators (MacKenzie *et al.*, 2005). The proper development and measurement of formative constructs depends on identifying and using an exhaustive list of relevant indicators (Diamantopolous *et al.*, 2008).

Conceptually, in relation to the five indicators discussed in the introduction, human capital can be more readily portrayed as a formative construct. Indeed, it is defined by one's education and work, entrepreneurial, industry, and managerial experience. Changes in one's education or specific experience can increase one's human capital regardless of one's other experience. Therefore, properly capturing one's human capital requires inclusion of all relevant indicators of one's education and experience.

In order to compare formally the reflective and formative conceptions of human capital, I used data on nascent entrepreneurs from the PSED II. This data set was chosen because it represents the largest and most representative study of nascent entrepreneurial activity (Reynolds and Curtin, 2008), and has been used in over 120 peer-reviewed publications[1]. Although the data chosen here come from the USA, the PSED methodology has been applied across a number of countries. Thus, there is an opportunity to replicate the results presented here across a number of different national contexts.

Data on nascent entrepreneurs' human capital

The PSED II containing a cohort of 1,214 nascent entrepreneurs, i.e. people currently involved in starting a business, is selected and followed over five years, recording the characteristics of the individuals involved, business milestones achieved, and the ultimate fate of these entrepreneurial efforts. The selection of the nascent entrepreneurs is based on a screening of a random sample of 31,845 adults between October 2005 and January 2006. Eligible nascent entrepreneurs were identified based on two criteria. The first involved a positive answer to at least one of the following three questions: "Are you, alone or with others, currently trying to start a new business, including any form of self-employment or selling any goods or services to others?"; "Are you, alone or with others, now trying to start a new business or a new venture for your employer, an effort that is part of your normal work?"; "Are you, alone or

with others, currently the owner of a business you help manage, including self-employment or selling any goods or services to others?" The second criterion comprised of affirmations that the person had been active in the nascent entrepreneurial activity over the past 12 months, he or she would own part of the business, and the business was not yet fully operational. A business was considered operational if it had received revenues for more than six months, if its revenue exceeded its expenses, and if the monthly expenses included salaries or wages for the actively involved owners for 6 of the previous 12 months.

The 1,214 so identified nascent entrepreneur then participated in a detailed initial phone interview and, at the time of this analysis, in two follow-up interviews, in 12-month intervals. In the initial phone interview, extensive data were collected on the nascent entrepreneur's characteristics, the characteristics of the other owners in the business, and the status of the business activities. I selected five characteristics that represent the five discussed indicators of the nascent entrepreneur's human capital. Education was measured on a five-point scale, based on the question "What is the highest level of education you have completed?" The answers to this question were grouped in five categories: below high school, high school, some college or vocational degree, bachelor's degree, and graduate studies. Work experience was measured by the years of paid, full-time work experience. Entrepreneurial experience was measured by the number of other businesses the respondent had helped start as owner or part-owner. Industry experience was measured by the years of work experience in the industry in which the new business would compete. Finally, managerial experience was measured by the number of years in which the respondent had had managerial, supervisory, or administrative responsibilities. All experience variables were logged.

In addition to the above five indicators of human capital, I included two perceptual measures of human capital, based on the respondents' degree of agreement with the following statements: "Overall, my skills and abilities will help me start this new business" and "My past experience will be very valuable in starting this new business". These statements reflect the definition of human capital as the knowledge and skills relevant to a task at hand and were measured on a five-point scale, ranging from strongly agree (5) to strongly disagree (1).

Full set of data were available for 1,185 nascent entrepreneurs. Table I provides the descriptive statistics and correlations for the seven indicators of human capital. Notably, although these indicators exhibit positive inter-correlations, these correlations are relatively low.

Analysis

The reflective and formative conceptions of human capital were compared in a structural equation modelling framework. Since formative models are underidentified and thus cannot be estimated on their own (Bollen and Lennox, 1991), one recommended approach for their estimation involves the addition of two reflective indicators (Diamantopolous *et al.*, 2008; MacKenzie *et al.*, 2005). In this setting, I used the measures of education and experience as formative indicators and the two perceptual measures of human capital as reflective

	Mean	SD	1	2	3	4	5	6
1. Education	3.24	1.08	1.00					
2. Work experience	2.85	0.82	0.19	1.00				
3. Entrepreneurial experience	0.48	0.60	0.18	0.28	1.00			
4. Industry experience	1.71	1.21	0.06	0.27	0.11	1.00		
5. Managerial experience	2.03	1.06	0.27	0.60	0.37	0.25	1.00	
6. My skills and abilities will help me	4.49	0.63	0.07	0.04	0.06	0.20	0.08	1.00
7. My past experience will be very valuable	4.39	0.82	0.08	0.16	0.13	0.36	0.21	0.51

Table I.
Descriptive statistics and correlations of the human capital indicators

indicators. In the first step, I compared the fit of this formative model with the fit of a model in which all seven measures were used as reflective indicators. The formative model exhibited good fit ($\chi^2(4) = 6.0$, $p > 0.1$; GFI = 0.999, CFI = 0.999, RMSEA = 0.021). In contrast, the reflective model exhibited poor fit ($\chi^2(14) = 478.6$, $p < 0.001$; GFI = 0.898, CFI = 0.681, RMSEA = 0.167). When only the education and experience variables were used as reflective indicators, the fit of the reflective model was better ($\chi^2(5) = 14.7$, $p < 0.05$; GFI = 0.995, CFI = 0.989, RMSEA = 0.041), but still worse than the fit of the formative model. I provide a summary of the estimated models in Figure 1.

In the second step of the analysis, I conducted a vanishing tetrad test to formally evaluate whether the reflective specification of human capital represented a proper model structure (Hipp and Bollen, 2003). A tetrad is formed from four random variables and represents the difference of the products of the covariances of two different pairs among the four variables. A tetrad is vanishing when the said difference is zero. In determining whether a model is properly specified, the vanishing tetrad test is based on the notion that, given the model structure, some of its tetrads should be vanishing. In a reflective model, given that the measurement errors for the different indicators are assumed to be uncorrelated among themselves as well as with the underlying construct, all tetrads implied by the model should be vanishing (Hipp and Bollen, 2003). A global test of this has been automated in a SAS macro, which compares the observed covariance structure among the five variables with the covariance structure implied by the reflective model

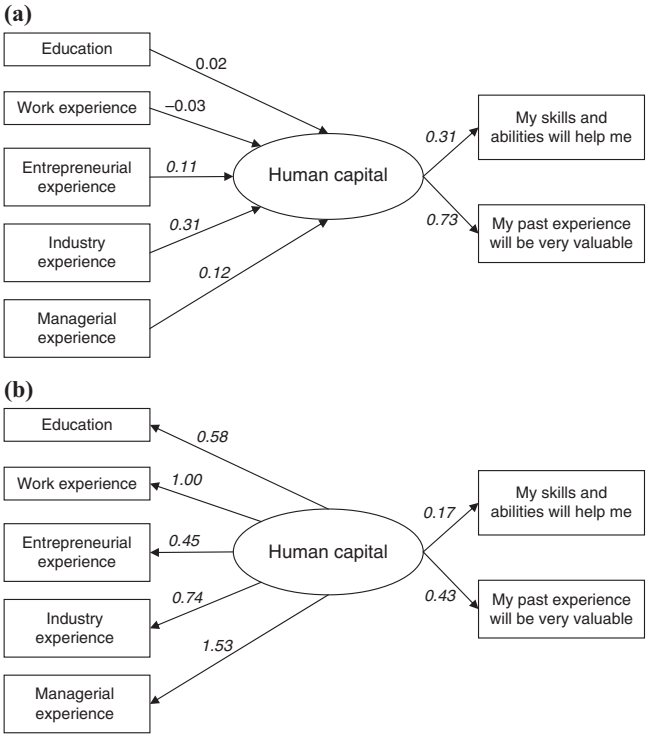

Figure 1.
Formative and reflective models of human capital

Notes: (a) $\chi^2(4) = 6.0$, $p > 0.1$; GFI = 0.999, CFI = 0.999, RMSEA = 0.021; (b) $\chi^2(14) = 478.6$, $p > 0.001$; GFI = 0.898, CFI = 0.681, RMSEA = 0.167. Coefficient values shown in italic are significant at $p < 0.05$

(Hipp *et al.*, 2005). The test indicates that the null hypothesis of all vanishing tetrads can be rejected ($\chi^2(5) = 15.19$, $p < 0.01$).

This analysis suggests that a reflective model is not a proper representation of the relationship between the construct of human capital and its measures. While there is a common factor to the five indicators, this factor explains only a very small proportion of the variance of those indicators. Indeed, an exploratory factor analysis of the five indicators reveals that no other factors are evident in the data – the eigenvalue of the second factor is only 0.064. Therefore, one can conclude that the five indicators of human capital operate in an independent manner and so are more appropriately considered as formative measures of human capital, whereby each contributes a distinct aspect of one's human capital. The proper measurement of human capital as a formative construct depends on identifying all its relevant indicators and on specifying their functional relationships with the construct (Diamantopolous *et al.*, 2008). In this regard, while the set of five indicators can be deemed sufficiently exhaustive – based on their extensive use and theoretical consideration in the literature – the question of the nature of their relationship with the construct has remained unexplored. I examine this question in the next section.

Configurations of human capital indicators

How can the human capital of two individuals with different experiences, both in terms of extent and nature, be compared? Can a higher educational degree be compared with a few extra years of entrepreneurial, industry, or managerial experience? These are clearly difficult questions that go to the heart of our understanding of human capital as formed by its indicators. They suggest that, in terms of their human capital, individuals can be more meaningfully compared in a holistic rather than piecemeal manner.

Ragin (1987) distinguishes variable- and case-oriented approaches in making comparisons and studying relationships, each involving a trade-off between complexity and generality. The former approach reduces individual cases to a set of variables with the goal of discovering general relational patterns between these variables and an outcome of interest. In this approach, there is an implicit assumption that the sought effects exist independent of the context. The latter approach treats individual cases as holistic configurations and seeks to appreciate the complexity of how their elements combine to produce certain outcomes. It is, thus, suitable for studying conjectural causation, i.e. when several conditions jointly determine an outcome of interest.

I summarize this approach below based on Ragin's seminal work, which provides the logical underpinnings of configurational thinking. The particular method that arises from it, qualitative comparison analysis (QCA), has gathered significant momentum in the organizational and management literature as a way of capturing the more complex nature of causality (e.g. Fiss, 2007; Greckhamer *et al.*, 2008). It has also been successfully applied in the entrepreneurship literature as a means of understanding the effects of more holistic configurations of factors (Krause *et al.*, 2014; Mandl *et al.*, 2016; Muñoz and Dimov, 2015). The broad contribution of this work is to highlight the conjunctural and equifinal nature of the relationships that comprise the entrepreneurial process, whereby factors normally considered on a piecemeal basis are rarely sufficient on their own as they interplay with other conditions (Muñoz and Dimov, 2015).

Methodological considerations

The classic functional representation of a formative construct is as a linear combination of its indicators, i.e. $HC = \sum \beta_i x_i + \varepsilon$, where β_i and x_i represent, respectively, the weight and value of indicator i. In this variable-oriented formulation, the individual components are added to produce a total human capital score. There are two challenges to this formulation. First, the total score is sensitive to the scale on which the individual indicators are measured.

Even if the values of the individual indicators are standardized, there is an underlying problem that these indicators may have qualitatively different population distributions. Second, this formulation implicitly assumes that the different indicators are interchangeable and mutually compensating. The ratio β_i/β_j represents how many units of indicator j can be used to replace one unit of indicator i to produce the same total score. Therefore, a simple comparison of two total scores cannot offer meaningful insights into the combination of indicators that produce those scores. To the extent that this combination reflects some underlying career patterns, which give rise to qualitatively different human capital constellations, it is necessary to appreciate the complexity of one's human capital and to seek more qualitative human capital comparisons across people.

As a synthesis of the rigour of variable-oriented approaches and the appreciation of complexity inherent to case-oriented approaches, Ragin (1987) developed a qualitative comparative methodology on the basis of Boolean algebra. The gist of this approach lies in identifying a set of relevant causal factors for an outcome of interest and constructing a "truth table" which shows the different combinations of those factors and the respective outcome for each combination. This approach is holistic by design and moves from maximum complexity towards some simplification of that complexity. In this method, the unit of analysis is the configuration of factors rather than the individual for whom these factors are measured. In the simplest, "crisp-set" version of this method, the factors of interest and the outcome are dichotomous in nature, i.e. they can take on a value of zero or one that indicate whether the factor is absent or present. Once a truth table is constructed, certain minimization algorithms can be applied to produce "prime implicants", i.e. configurations that cannot be reduced further and that can be combined to produce all the configurations in the original truth table. This is a process of bottom-up simplification in which two conditions that produce the same outcome but vary on one factor can be combined into a condition in which this factor is deemed redundant.

An extension of this QCA involves moving from "crisp" sets, in which all factors are dichotomous, towards "fuzzy" sets (Ragin, 2000). In a fuzzy-set framework, a factor can take on gradated values between 0 and 1. This allows the researcher to specify the conditions that allow specifications of conditions when the factor can be deemed absent, present, or in between. Based on a multi-dimensional assessment of how close a particular combination of factors is to a crisp-set counterpart, a set of configurations is derived that represents a truth table. The fsQCA software (Ragin *et al.*, 2006) facilitates the production of the truth table – subject to the qualitative input provided by the researcher – and automates the minimization algorithms.

This qualitative comparative analysis has a wide range of applications, originally in sociology (e.g. Ragin *et al.*, 1984), and more recently in management and entrepreneurship, when the focus of explanation is on the conjunction of several relevant factors (e.g. Fiss, 2007; Muñoz and Dimov, 2015). I illustrate its implication for deriving an empirical typology of the combinations of human capital indicators by using the PSED II data introduced in the previous section. I start with the five human capital variables identified in the data – education, work experience, entrepreneurial experience, industry experience, and managerial experience.

Empirical illustration

For the human capital data on entrepreneurs from the PSED II data set, a crisp-set application may not be appropriate. Indeed, to classify individuals as having vs not having experience or having vs not having education requires sensitive judgements about the point of dichotomization. This judgement is alleviated in a fuzzy-set analysis. An important first step in this analysis is the calibration of the variables, i.e. scaling them over the range from zero to one, with one indicating full inclusion in the respective set, zero indicating full

exclusion from the set (Ragin, 2000). The calibration procedure involves the specification of at least three values representing, respectively, when a variable can be considered a clear member of the set, when it can be considered "in between", and when it can be considered a clear non-member (Ragin, 2006).

For the education variable, the calibration values I used were 4, 3, and 2 (i.e. bachelor degree, some college or vocational degree, and high-school degree). Thus, individuals with at least a bachelor degree are considered as belonging to the education set, those with a high-school degree or less are considered as not belonging to that set, and the rest are considered in between the two sets. For entrepreneurial experience, I used 2, 1, and 0 as calibration values. That is, individuals who have helped start at least two other businesses are considered members of the entrepreneurship experience set and those who have not started other businesses are considered non-member. Those who have helped start one other business are considered in between. For the industry, and managerial experience variables I used 10, 5, and 1 as calibration values. Thus, those with at least ten years of experience are considered "experienced", those with one year of experience or less are considered "not experience", and the rest are considered in between. Finally, for work experience the calibration values were 15, 10, and 5. I note that slight modifications of the calibration values produce results consistent with those reported below. The distributions of the five variables across the different calibration categories are presented in Table II.

The truth table for this analysis is presented in Table III. This table contains 32 conditions, i.e. all possible combinations among the five human capital indicators, and the number of cases for each condition is also given. Each human capital indicator is represented by a single letter: D (education), W (work experience), E (entrepreneurial experience), I (industry experience), and M (managerial experience). In each condition (row), each indicator is featured with a 0/1 value, based on whether the indicator is present or absent in that condition. Thus, each condition represents a corner of the vector space as defined by the combination of indicators. A case is estimated to belong to a condition if it has greater than 0.5 membership in the respective corner of the vector space (Ragin, 2006). Notably, only 478 cases (out of 1,195) are shown to belong to 1 of the 32 conditions. In deriving an empirical typology, the outcome variable represents whether a condition is more or less prevalent. In this case, with 478 cases and 32 conditions, each condition is expected to have 15 cases if the cases are randomly distributed across conditions. Therefore, I coded all conditions in which the number of cases exceeded 15 as 1 and the remaining cases as 0.

After performing the minimization algorithms, the following solution is derived:

$$HC = dWe + DWM + WIM + weim \quad (1)$$

In this notation, whether the letter is uppercase or lowercase represents whether the particular indicator is present or absent in a particular condition. The multiplication operation in the above notation represents the Boolean "AND" and shows joint presence of several indicators. The addition operation represents the Boolean "OR" and is used to join terms that each constitute dominant representations of human capital. Thus, there are four

	Education		Work experience		Entrepreneurial experience		Industry experience		Managerial experience	
	Value	% cases	Value	% cases	Value	% cases	Value	% cases	Value	% cases
Non-member	2	23.8	5	12.8	0	54.5	1	31.2	1	16.2
In between	3	39.0	10	20.2	1	21.1	5	30.1	5	37.0
Member	4	37.2	15	67.0	2	24.4	10	38.7	10	46.8

Table II. Descriptive statistics for the calibrated human capital variables

Human capital indicators							
D	W	E	I	M	Number of cases	Cum %	Outcome
1	1	0	1	1	67	14.0	1
1	1	1	1	1	64	27.4	1
0	0	0	0	0	52	38.3	1
1	1	0	0	1	38	46.2	1
1	1	1	0	1	35	53.6	1
0	1	0	1	1	30	59.8	1
0	1	1	1	1	27	65.5	1
1	0	0	0	0	24	70.5	1
0	1	0	0	0	22	75.1	1
0	1	0	1	0	19	79.1	1
0	1	0	0	1	17	82.6	1
0	1	1	0	1	13	85.4	0
0	0	0	1	0	12	87.9	0
1	1	0	0	0	10	90.0	0
1	0	0	1	0	9	91.8	0
1	1	1	0	0	7	93.3	0
1	1	0	1	0	6	94.6	0
1	0	0	1	1	4	95.4	0
1	0	1	1	1	4	96.2	0
0	0	1	0	0	3	96.9	0
1	0	1	0	1	3	97.5	0
0	0	0	0	1	2	97.9	0
0	0	0	1	1	2	98.3	0
0	1	1	1	0	2	98.7	0
1	1	1	1	0	2	99.2	0
0	0	1	1	0	1	99.4	0
0	1	1	0	0	1	99.6	0
1	0	1	0	0	1	99.8	0
1	0	1	1	0	1	100.0	0
0	0	1	0	1	0	100.0	0
0	0	1	1	1	0	100.0	0
1	0	0	0	1	0	100.0	0

Table III.
Truth table for the empirical typology of human capital based on fuzzy-set analysis

Notes: D, education; W, work experience; E, entrepreneurial experience; I, industry experience; M, managerial experience

such representations: no education, work experience, no entrepreneurial experience (dWe); education, work experience, managerial experience (DWM); work experience, industry experience, managerial experience (WIM); and no work experience, no entrepreneurial experience, no industry experience, no managerial experience (weim).

Given that only 478 cases are captured by this analysis, I also examined the full range of cases using a crisp-set analysis, in which the human capital indicators were dichotomized along their median values (>3 for education, >10 for work experience, >0 for entrepreneurial experience, >5 for industry experience, and >7 for managerial experience). In addition, I also performed these analyses on the subset of "solo" nascent entrepreneurs, i.e. those operating alone on an independent business, in order to exclude the possibility that when entrepreneurs act in teams they may do so on the basis of complementary human capital. There were 532 solo entrepreneurs in the data and full data were available for 511 of them. The results from the three additional analyses are as follows.

All cases, crisp-set:

$$\mathrm{HC} = \mathrm{dWM} + \mathrm{WEM} + \mathrm{WIM} + \mathrm{weim} + \mathrm{dwim} + \mathrm{dwem} \quad (2)$$

solo cases, fuzzy-set:

$$HC = WM + deim \quad (3)$$

solo cases, crisp-set:

$$HC = WIM + deim + dwim + dwem + dWEM \quad (4)$$

There are two patterns that are observed in these solutions. First, the fuzzy-set combinations seem to be a subset of the crisp-set combinations, due to their use of stricter criteria for inclusion in the different conditions. Second, the human capital combinations of solo entrepreneurs are generally a subset of the human capital combinations of all nascent entrepreneurs. This is to be expected, since among the entire group of entrepreneurs there may be those who only act because of the involvement of their partners who may bring some important missing skills.

Equation (3) derived from a fuzzy-set analysis of solo entrepreneurs suggests that there are two dominant human capital constellations in the data, which can be used to represent the majority of nascent entrepreneurs. The first involves a combination of work experience and managerial experience (WM). This combination is present in all of the other solutions as well. The second involves a combination of no education, no entrepreneurial experience, no industry experience, and no managerial experience (deim). Portions of that combination are also present in all of the other solutions. These two combinations are difficult to represent using a variable-oriented approach since they would require the construction of two-, three-, and four-way interactions that would not only pose statistical power challenges but also make interpretation very difficult.

Human capital and venture emergence

As a final illustration of the utility of the QCA, I examine the relationship between human capital and venture emergence in the context of the solo nascent entrepreneurs in the PSED II. The reason for the choice of solo entrepreneurs was that for cases where more than one person was involved in starting a particular business, it would have been more difficult and complex to make attributions about the success or failure of the emerging venture to the human capital characteristics of the particular respondent.

In the first-three follow-up interviews, in 12-month intervals, the nascent entrepreneurs in the study were questioned on the status of their business creation efforts. If the business had revenues, these revenues exceeded expenses for over six months, and if the expenses included salaries for the actively involved owners, the business was considered operational. If the business had not yet reached those milestones, but the nascent entrepreneurs had time commitment to the business (more than 160 hours over the past 12 months and more than 80 hours in the next 6 months), considered the venture to represent a major career focus over the next 12 months, or still considered themselves actively involved, they were considered still actively trying to establish the business. Finally, when the nascent entrepreneurs acknowledge to be disengaged from the business, the venturing efforts were considered abandoned. Over the three follow-up interviews, I could infer the status of 453 of the 511 solo entrepreneurs. Examination of the missing cases revealed that they were not different in terms of industry experience, but tended to have lower education, work experience, entrepreneurial experience, and managerial experience. Of the 453 venturing efforts with known status after three years, 203 (44.8 per cent) were discontinued, 162 (35.8 per cent) were still active, and 88 (19.4 per cent) reached operating status.

As a first analysis, I did a traditional statistical estimation of the venturing status as a function of the nascent entrepreneur's human capital characteristics. For ease of comparison across analyses, I used only the human capital variables in the model. I note that introducing

additional controls, such as whether the business had revenue or whether the nascent entrepreneur had devoted full time to the business at the time of the initial interview, did improve the explanatory power of the model, but did not change the effects of the human capital variables. Given the categorical nature of the venturing status variable, I estimated two models: a multinomial logit model with the middle category (still active) as the baseline, and a logit model in which the middle category was excluded and direct comparison was made between the abandoned and operating status cases.

The results of the two estimations are shown in Table IV. In the multinomial logit model, none of the human capital variables help explain the reaching of operating status. In regard to abandonment, industry experience had a negative and significant effect ($p < 0.01$), suggesting that nascent entrepreneurs with greater industry experience were less likely to abandon their venturing efforts. In the logit model, both industry and managerial experience had positive and significant effects ($p < 0.05$). This suggests that when comparing the abandoned and operating status cases, the latter involved nascent entrepreneurs with greater industry and managerial experience.

As a second analysis, I did a qualitative comparison among the nascent entrepreneurs based on fuzzy-set analysis. I calibrated the venturing status variable so that operating status and abandonment were considered, respectively, members and non-members of the venture emergence set and the still active category was considered in between. The truth table is shown in Table V. On the basis of established recommendations, I selected only the conditions with at least seven cases, thus, capturing 82 per cent of all cases (Ragin, 2006). I then coded the outcome variable as 0 or 1 based on the degree each condition was estimated to belong to the set of operating businesses. The truth table in fuzzy-set analysis offers two measures of the degree to which a particular corner of the vector space – as defined by the combination of indicators – belongs to the outcome set: consistency and proportional reduction in error (pre). The former represents the degree to which membership in the particular condition is a consistent subset of the outcome set. The second represents the degree to which the error in predicting the outcome is reduced if one knows the condition to which a case belongs. The product of the two measures can be used to identify gaps in the range of consistency measures and, thus, draw the line between the two categories of the outcome variable. In this case, the outcome was coded as 1 for three conditions and as 0 for the remaining nine conditions.

The application of the minimization algorithm produced the following solution:

$$\mathrm{VE} = \mathrm{dWIM} + \mathrm{DWEm}$$

It suggests that two combinations of human capital indicator are associated with reaching operating status: no education, work experience, industry experience, and managerial

Table IV.
Multinomial logit and logit estimation of venture emergence

	Multinomial logit estimation Likelihood of reaching		Logit estimation
	Discontinuation	Operating business	Operating business vs discontinuation
Education	−0.12 (0.10)	−0.04 (0.13)	0.12 (0.13)
Work experience	0.28 (0.16)	0.28 (0.23)	0.00 (0.22)
Entrepreneurial experience	−0.20 (0.20)	−0.19 (0.23)	0.03 (0.24)
Industry experience	−0.26 (0.10)**	−0.03 (0.12)	0.24 (0.12)*
Managerial experience	−0.15 (0.12)	0.21 (0.17)	0.35 (0.16)*
Constant	0.68 (0.49)	−1.61 (0.69)*	−2.42 (0.71)***
Log-likelihood	−460.72		−169.75
χ^2	26.00**		17.21**
n	453		291

Notes: Standard errors shown in parentheses. *$p < 0.05$; **$p < 0.01$; ***$p < 0.001$

Human capital indicators								Outcome criteria		
D	W	E	I	M	Number of cases	Cum %	Outcome	Consist	Pre	Product
1	1	1	1	1	41	17.8	0	0.63	0.31	0.20
1	1	0	1	1	30	30.9	0	0.62	0.34	0.21
1	1	1	0	1	19	39.1	0	0.61	0.30	0.18
0	0	0	0	0	18	47.0	0	0.50	0.12	0.06
0	1	1	1	1	14	53.0	1	0.69	0.41	0.28
1	1	0	0	1	13	58.7	0	0.61	0.29	0.18
0	1	0	0	0	11	63.5	0	0.49	0.07	0.03
0	1	0	0	1	9	67.4	0	0.60	0.26	0.15
0	1	0	1	1	9	71.3	1	0.68	0.37	0.25
0	1	1	0	1	9	75.2	0	0.65	0.23	0.15
1	1	1	0	0	8	78.7	1	0.67	0.34	0.23
0	1	0	1	0	7	81.7	0	0.66	0.28	0.18
1	0	0	0	0	6	84.3		0.57	0.20	0.12
1	1	1	1	0	6	87.0		0.75	0.29	0.21
1	0	0	1	0	5	89.1		0.67	0.16	0.11
1	0	1	0	1	4	90.9		0.73	0.22	0.16
0	1	1	1	0	3	92.2		0.75	0.25	0.19
1	0	1	0	0	3	93.5		0.67	0.11	0.08
1	1	0	1	0	3	94.8		0.68	0.29	0.20
0	0	0	1	0	2	95.7		0.70	0.24	0.17
0	0	1	0	0	2	96.5		0.77	0.28	0.22
1	0	1	1	0	2	97.4		0.84	0.10	0.09
0	0	0	0	1	1	97.8		0.71	0.06	0.04
0	0	1	1	0	1	98.3		0.92	0.04	0.04
0	0	1	1	1	1	98.7		0.91	0.20	0.19
0	1	1	0	0	1	99.1		0.74	0.32	0.24
1	0	0	1	1	1	99.6		0.73	0.16	0.12
1	1	0	0	0	1	100.0		0.60	0.17	0.10
0	0	0	1	1	0	100.0		0.76	0.18	0.14
0	0	1	0	1	0	100.0		0.87	0.10	0.09
1	0	0	0	1	0	100.0		0.68	0.09	0.06
1	0	1	1	1	0	100.0		0.93	0.52	0.48

Notes: D, education; W, work experience; E, entrepreneurial experience; I, industry experience; M, managerial experience; Consist, Consistency; Pre, proportional reduction in error

Table V.
Truth table for fuzzy-set analysis of venture emergence

experience (dWIM); and education, work experience, entrepreneurial experience, and no managerial experience (DWEm). In both cases the nascent entrepreneur has extensive work experience; in one case that experience is complemented by extensive industry and managerial experience (and less education), while in the other case it is complemented by more education and extensive entrepreneurial experience (and low managerial experience). Most importantly, none of the human capital indicators are singly associated with the nascent entrepreneur's reaching operating status. Overall, this solution illustrates multiple conjectural causation at work: different combinations of human capital indicators can produce different venturing outcomes.

A comparison of the two analyses leads to some interesting insights into the way in which the qualitative comparative analysis complements and extends the variable-oriented analysis. First, work experience is not highlighted in the logit analyses. This can be due to the fact that work experience matters not so much through its single variation across cases but through the way it is combined with other human capital indicators. Such complex relationships are very difficult to uncover in variable-oriented analysis since the inclusion of many higher-order interaction terms can significantly impede the interpretation of the results. Second, industry and managerial experience, while individually important in the

logit analyses, are combined in the qualitative comparison. This highlights the limitations to statistical control in the variable-oriented approach. The interpretation of the individual coefficients in the logit models is based on the condition "other things being equal". But to the extent that the human capital indicators form meaningful combinations and that certain such combinations are more likely than others, the "other things" cannot really be "equal". Finally, the qualitative comparative analysis shows that education and entrepreneurial experience, while not notable in the logit analyses, can contribute to venture emergence in certain combinations with the other human capital indicators.

Discussion

This paper revisits the conceptualization and measurement of human capital in entrepreneurship research. Human capital has been widely and consistently used to predict outcomes such as engaging in venturing efforts, venturing progress, and venture emergence, performance, and survival. Despite some clear inconsistencies in extant empirical findings, there has been no discussion of the logic or appropriateness of current approaches to measuring human capital. Explicit consideration of the relationship between the construct and its measures represents a central part to such discussion.

As encapsulation of the knowledge and skills that a person brings to the performance of the particular task (Becker, 1975), human capital has been measured in entrepreneurship research by five indicators: education, work experience, entrepreneurial experience, industry experience, and managerial experience (Bruderl *et al.*, 1992; Unger *et al.*, 2011). The first-two indicators represent the more general aspects of human capital in relation to the task at hand, while the other three represent its more specific aspects. Notably, these five indicators have rarely been used together and in many cases human capital predictions are limited to only few of them. Implicit in this approach is the notion that these indicators represent interchangeable proxies for one's human capital, albeit with varying degrees of proximity.

In this paper, I presented a formal assessment of this assumption in the context of the distinction between reflective and formative construct measures (Edwards and Bagozzi, 2000). In the first case, measures are affected by the underlying construct, while in the latter case they define and form the construct. Using human capital data on nascent entrepreneurs from the PSED II, I compared the two construct conceptions and showed that the latter is more appropriate, i.e. as a construct, human capital is defined and formed by its individual indicators. Changes in one indicator (e.g. education or industry experience) can change the person's human capital regardless of the movement or values of the other indicators. This suggests that a major focus in the measurement of human capital should be on using all five indicators and on understanding how they should be combined.

In the second part of the paper, I explored the issue of combining the human capital indicators by highlighting the limitations of the most basic representation of human capital, i.e. as a linear combination of its indicators. In terms of their human capital, individuals can be seen as holistic configurations of human capital indicators. This suggests that comparisons across individuals are difficult to perform meaningfully in a piecemeal manner. This challenge becomes clear in the context of the distinction between variable- and case-oriented approaches to social comparison (Ragin, 1987). The former focusses on one variable at a time, in abstraction from its context or embedding configurations, while the latter seeks to appreciate the complexity contained within a case as a whole. The latter approach is particularly suitable for situations when outcomes are derived from multiple, conjectural causation, i.e. the joint presence of several factors. Even though such qualitative understanding has long been limited in terms of the number of cases that can be considered, advances in qualitative comparative analysis based on Boolean algebra and fuzzy-set theory (Ragin, 2000; Ragin *et al.*, 2006) allow analysis of configurations of factors on a larger scale.

On the basis of such analysis, I showed that the human capital of nascent entrepreneurs can be represented in terms of two primary combinations of indicators: work experience and managerial experience; and lack of education, lack of entrepreneurial experience, lack of industry experience, and lack of managerial experience. These effectively represent two qualitatively different sets of entrepreneurs. In addition, in terms of its relationship with venture emergence, I showed that human capital matters through certain combinations of indicators that are not easily accessible by variable-oriented analyses. Both the empirical typology of nascent entrepreneurs' human capital and the multiple conjectural causation inherent in the relationship between human capital and venture emergence offer novel and valuable insights into entrepreneurship researchers and suggest promising avenues for aligning the human capital theory with the reality of (nascent) entrepreneurs.

This work suggests that a major re-orientation is necessary in terms of how entrepreneurship researchers view and use the construct of human capital. Human capital represents the collection of knowledge and skills – derived from education or experience – that an entrepreneur possesses and can put to use in the context of particular venturing efforts. This collection is most appropriately represented by not only jointly considering the relevant sources of knowledge and skills but also understanding how these sources are combined in individual entrepreneurs. In a way, the term "capital" is misleading as it superimposes a notion of a homogenous medium that is characterized largely by its amount, just like financial capital. The original conception of human capital was introduced in order to measure the returns to years of education and experience, on the assumption that each year of accumulation represented a unit that is consisted and interchangeable across different domains of experience. The time has come to acknowledge the limits of the capital analogy and consider that the human application deals with different dimensions. Thus, although financial capital can have many sources, they are ultimately assembled in the same bank account: $10 million of financial capital can be assembled from different sources, all to the same effect. In contrast, the sources of human capital each feed into different pockets of accumulation and thus various knowledge and skills: 10 years of total experience can amount to qualitatively different capacities depending on the individual experience of which they are composed (e.g. education, industry, managerial, entrepreneurial).

This call for a qualitative understanding of human capital is not new. Indeed, Dimov and Shepherd (2005) demonstrated that the source of experience for venture capitalists was essential for understanding their investment performance; there were important nuances to the broader labels of "general" and "specific" as applied to human capital. Similarly, Unger *et al.* (2011) distinguish outcomes of human capital investments (knowledge or skills) from the human capital investments themselves (education or experience), with the former exhibiting overall stronger effects on entrepreneurial performance. The current paper contributes to this line of thought both by making a case for a different theoretical logic (i.e. configurational) in discussing human capital and by demonstrating the advantages of a different methodological approach to match it.

There is a need to move the empirical representation of human capital away from a single score that captures quantity rather than quality towards a qualitative combination of various human capital indicators. Using human capital variables (i.e. quantities) enables us to focus on and analyse a large number of cases, at the expense of depersonalizing each individual case and removing it from its context. This is due to treating each unit of human capital as identical replication, regardless of its source. As a result, the relationships that such measures represent tend to subsume much heterogeneity to weaken their effects (Unger *et al.*, 2011) and, thus, to be difficult to apply to or understand in particular cases. In contrast, the qualitative comparative analysis framework discussed in this paper allows appreciation of the complexity of individual cases while also retaining the ability to examine a large number of cases.

The contribution of QCA analysis is threefold. First, through the use of calibration, it draws a distinction between theoretically relevant and irrelevant variation, as separated by the threshold of full membership in a case category. For example, if we consider ten years to be a threshold beyond which any one would be considered very experienced, then the difference between 15 and 30 years of experience should be considered theoretically irrelevant (i.e. both cases are very experienced). And yet, in a quantitative sense, they are different by a factor of 2. While the differences in experience between 1 and 2 years, between 3 and 6 years, and between 8 and 16 years are represented by the same factor of 2, we intuitively feel that they are not the same. In this regard, calibration provides alignment between our theoretical arguments and empirical measures. It enables quantitative measures to be recast in terms of the shades of quality that signify theoretical relevance.

Second, the QCA methodology enables us to address the issue of limited diversity, i.e. the fact that the full combinations of variable values are not observed in our empirical settings (Ragin, 1987). Related to this is the asymmetry in the operation of a factor, namely that the effect of its presence is qualitatively different from the effect of its absence. In a linear modelling framework, this asymmetry is lost as the effects of increasing and decreasing the value of a factor are considered mirror images of one another. Thus, when an effect is positive, one automatically presumes that increasing the value of the factor will increase the value of the output; and that decreasing the value of the factors is deemed to decrease in the value of the output. With calibration one can pinpoint whether an effect is due to the increase of a positive factor or a decrease of a negative factor. As QCA emphasized equifinality – i.e. reaching the same outcome through different configurations of factors – it is possible that different degrees of particular experiences can be effective when put in combinations with other experiences. Thus, we should not automatically assume that if more entrepreneurship experience is better then less entrepreneurial experience necessarily makes things worse. Someone who lacks such experience may find compensating qualities in other aspects of their education or professional experience.

Finally, the QCA methodology offers a new tool for dealing with configurations of factors. While the idea of configurations is not new, its methodological application has been restrained by modelling limitations. For instance, Wiklund and Shepherd (2005) model configurations as a three-way interaction within a linear model framework. This approach effectively limits the number of interacting variables to three and does not consider whether the interaction values are theoretically relevant or map out the full combinations of their components. Similarly, De Clercq *et al.* (2010) model configurations as deviations from an ideal typology of three factors. Due to the need to covert the deviations into numerical values, this approach assumes that the high-high-high combination is the best, thereby limiting the empirical exploration of the data. In addition, no distinction can be made between low-high-high, high-low-high, and high-high-low combinations if they produce the same deviation scores. Thus, while the variance decomposition approach employed in linear modelling is methodologically rigorous, it downplays the meaning of the numerical representations it employs. In contrast, the QCA method – through its emphasis on calibration and reliance on different analytical logic – retains the complexity and theoretical meaning of its representations.

In conclusion, the construct of human capital has been central in entrepreneurship research, reflecting the intuitive notion that entrepreneurs are different in terms of what they bring to the table. How to conceptualize and operationalize such differences has long been limited by a notion of capital grounded in economics thinking and in the procedural rigour of multivariate modelling. By highlighting the qualitative nature of human capital as a constellation of experiences and discussing a new logic for

its representations and analysis, this paper hopes to open up new conversations about the role of human capital in the entrepreneurial process. The recent growth of the QCA community within the Academy of Management (and beyond) is a testament that this is indeed a very productive direction.

Note

1. Based on the PSED bibliography, updated July 2015 and available at: www.psed.isr.umich.edu/psed/documentation

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