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Human capital and entrepreneurial success: A meta-analytical review

Jens M. Unger [a,*], Andreas Rauch [b], Michael Frese [c,d], Nina Rosenbusch [e]

[a] University of Giessen, Germany
[b] Rotterdam School of Management, Erasmus University, Netherlands
[c] National University of Singapore, Singapore
[d] University of Lueneburg, Germany
[e] University of Jena, Germany

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ABSTRACT

The study meta-analytically integrates results from three decades of human capital research in entrepreneurship. Based on 70 independent samples ($N = 24{,}733$), we found a significant but small relationship between human capital and success ($r_c = .098$). We examined theoretically derived moderators of this relationship referring to conceptualizations of human capital, to context, and to measurement of success. The relationship was higher for outcomes of human capital investments (knowledge/skills) than for human capital investments (education/experience), for human capital with high task-relatedness compared to low task-relatedness, for young businesses compared to old businesses, and for the dependent variable size compared to growth or profitability. Findings are relevant for practitioners (lenders, policy makers, educators) and for future research. Our findings show that future research should pursue moderator approaches to study the effects of human capital on success. Further, human capital is most important if it is task-related and if it consists of outcomes of human capital investments rather than human capital investments; this suggests that research should overcome a static view of human capital and should rather investigate the processes of learning, knowledge acquisition, and the transfer of knowledge to entrepreneurial tasks.

1. Executive summary

For more than three decades entrepreneurship researchers have been interested in the relationship between human capital – including education, experience, knowledge, and skills – and success. A number of arguments suggest a positive relationship between human capital and success. Human capital increases owners' capabilities of discovering and exploiting business opportunities. Human capital helps owners to acquire other utilitarian resources such as financial and physical capital, and it assists in the accumulation of new knowledge and skills. Although a positive relationship between human capital variables and success is well established, uncertainty remains over the magnitude of this relationship as well as the circumstances under which human capital is more or less strongly associated with success. To date, the literature remains fragmented with studies differing in the conceptualization of human capital, the choice of success indicators, and the study contexts such as industry, country, and age of the business. We address the human capital — success relationship by systematically reviewing the literature and meta-analytically estimating the overall relationship between human capital variables and success. Moreover, we look at specific conceptualizations of human capital attributes to test whether or not they differently relate to business success. We propose that human capital is most important for success if it consists of current task-related knowledge and skills. Finally, we analyze

* Corresponding author. Justus-Liebig-University, Department of Psychology, Otto-Behaghel-Str. 10F, 35394 Giessen, Germany. Tel.: +49 641/99 26012; fax: +49 641/99 26229.
E-mail address: jens.unger@psychol.uni-giessen.de (J.M. Unger).

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moderators of the human capital — success relationship by, investigating contextual conditions under which human capital is particularly important, and analyzing the relationship between human capital and different success indicators.

We use meta-analysis to estimate the effects of human capital on success. Meta-analysis provides a quantitative estimate of a variable relationship on a population level. It allows for the correction of statistical artifacts such as sampling error, and allows for the identification of moderator variables. Our computer-based literature search in specialized databases, manual searches in relevant journals, and the examination of reference lists of studies and theoretical articles yielded 70 independent samples ($N = 24{,}733$) that met our selection criteria.

Our findings showed a significant and small overall relationship between human capital and success ($r_c = .098$). Moderator analyses indicated that the magnitude of the success relationship depends on conceptualizations of human capital, the context of the firm, and the choice of success measures. The human capital–success relationship was higher for knowledge/skills which are outcomes of human capital investments compared to experience/schooling which are direct human capital investments; the relationships were also higher for human capital that was directly related to entrepreneurial tasks compared to human capital with low task-relatedness, for young compared to old businesses, and for success measured as size compared to growth and profitability. The correlation between human capital and success can be as high as, for example, $r_c = .204$ (for outcomes of human capital investments) and $r_c = .140$ (for young businesses).

These relationships are strong enough to draw theoretical and practical implications. Our results may guide practitioners in their evaluation of small businesses and may resolve some of the controversies surrounding investment decisions and human capital criteria. In order to maximize predictive validities, decision making should focus on task-specific human capital and outcomes of human capital investments. Moreover, entrepreneurs should invest in the acquisition of task-related knowledge, because knowledge is more important than past experiences. Finally, human capital criteria appear to be especially useful for predicting success of businesses that are still young.

In addition to the practical implications, the variation of effect size magnitudes reported in our study also demonstrates the theoretical usefulness to redirect human capital research in two ways. First, future research could shift the focus to investigating the processes inherent in human capital theory. Given the dynamics in entrepreneurship and the constant need to learn and to adapt, it may prove useful to look beyond the static concept of human capital and to examine outcomes of actual learning activities and current learning. Second, in addition to focusing on the variance in the individual entrepreneurs, future research needs to address circumstances that affect the size of the relationship between human capital and success. Thus, future researchers should address contingencies in the relationship between human capital and entrepreneurial success. Such efforts may also help in identifying stronger human capital relationships than the ones reported in this study.

2. Introduction

Human capital attributes – including education, experience, knowledge, and skills – have long been argued to be a critical resource for success in entrepreneurial firms (e.g., Florin et al., 2003; Pfeffer, 1994; Sexton and Upton, 1985). Researchers' interest in human capital is reflected in the numerous studies that have applied the concept to entrepreneurship (e.g., Chandler and Hanks, 1998; Davidsson and Honig, 2003; Rauch et al., 2005a). In practice, investors have traditionally attached a high importance to the experiences of entrepreneurs in their evaluation of firm potential (Stuart and Abetti, 1990). In fact, management skills and experience are the most frequently used selection criteria of venture capitalists (Zacharakis and Meyer, 2000). Moreover, researchers have argued that human capital may play an even larger role in the future because of the constantly increasing knowledge-intensive activities in most work environments (e.g., Bosma et al., 2004; Honig, 2001; Pennings et al., 1998; Sonnentag and Frese, 2002).

To date, the interest in human capital continues, and most authors conclude that human capital is related to success (e.g., Bosma et al., 2004; Bruederl et al., 1992; Cassar, 2006; Cooper et al., 1994; Dyke et al., 1992; Van der Sluis et al., 2005). The magnitude of this relationship, however, remains unknown. While some authors argue that the relationship between human capital and entrepreneurial success is commonly overemphasized (Baum and Silverman, 2004), others argue that human capital constitutes one of the core factors in the entrepreneurial process (Haber and Reichel, 2007). Thus, there is disagreement about the relative importance of human capital in entrepreneurship research.

Moreover, the magnitude of the relationship between human capital and success seems to vary considerably across studies. While some studies reported moderate or even high relationships ($r > .40$, Duchesneau and Gartner, 1990; $r > .20$, Frese et al., 2007) other studies reported low relationships (e.g., $r < .06$, Davidsson and Honig, 2003; $r < .10$, Gimeno et al., 1997). One reason for the variance of reported effects may be the presence of moderator variables. For example, an inspection of the literature shows that studies differ in their conceptualizations of human capital, their choices of success indicators, and their study contexts such as industry, country, and age of the business. Thus it remains unclear what kind of human capital should be related to success and under what circumstances. Surprisingly, to our knowledge, no study has systematically investigated moderators influencing the human capital–success relationship.

In this study, we address the human capital–success relationship by meta-analytically integrating the results of more than three decades of human capital research. Meta-analysis provides a quantitative estimate of the population effects, allows for the correction of statistical artifacts, and for the identification of moderator variables (Hunter and Schmidt, 1990). Meta-analysis represents an important step toward evidence-based entrepreneurship (Rauch and Frese, 2006) and is a practical tool for theory development.

The study contributes to the literature in at least three important ways. First, we determine the magnitude of the overall effect of human capital on entrepreneurial success. Second, we test the effects of different human capital attributes, such as task-

relatedness and human capital investments versus outcomes of human capital investments. Finally, we identify conditions that moderate the relationship between human capital and success.

3. Theory

3.1 . The concept of human capital

Human capital theory was originally developed to estimate employees' income distribution from their investments in human capital (Becker, 1964; Mincer, 1958). The theory has been adopted by entrepreneurship researchers and has stimulated a considerable body of directly related research (e.g., Chandler and Hanks, 1998; Davidsson and Honig, 2003; Rauch et al., 2005a) and led to an even larger number of studies that include human capital into their prediction models of entrepreneurial success. Researchers have employed a large spectrum of variables — all signifying human capital: formal education, training, employment experience, start-up experience, owner experience, parent's background, skills, knowledge, and others.

Following Becker (1964), we define human capital as skills and knowledge that individuals acquire through investments in schooling, on-the-job training, and other types of experience. Becker's (1964) definition suggests differentiating human capital along with two distinct conceptualizations of human capital attributes: human capital investments versus outcomes of human capital investments and task-related human capital versus human capital not related to a task. Human capital investments include experiences such as education and work experience that may or may not lead to knowledge and skills. The outcomes of human capital investments are acquired knowledge and skills. Task-relatedness addresses whether or not human capital investments and outcomes are related to a specific task, such as running a business venture. The distinction of different human capital attributes is important because it helps to (1) theoretically dismantle cause and effects of human capital attributes and to (2) theoretically derive moderators of the human capital–success relationship.

A learning theoretical perspective specifies the processes by which human capital attributes affect venture outcomes. Although learning processes have been acknowledged from the onset of human capital theory (Becker, 1964; Mincer, 1958), human capital researchers have paid little attention to the psychological processes and mechanisms that lead to human capital effects (cf. Davidsson and Honig, 2003). Central for such a learning approach are acquisition and transfer of human capital (e.g., Reuber and Fischer, 1994; Sohn et al., 2006).

Acquisition is the transformation from experience to knowledge and skills. Experience should not be equated with knowledge because experience may or may not lead to increased knowledge (Sonnentag, 1998). Therefore, human capital investments may or may not lead to outcomes of human capital investments (knowledge/skills). Thus, different processes of knowledge acquisition require a distinction between human capital investments and outcomes of human capital investments.

Transfer is the application of knowledge acquired in one situation to another situation (e.g., Singley and Anderson, 1989). Human capital theory does not explicate the process of transfer of human capital. The theory simply states that human capital investments "improve knowledge, skills, or health, and thereby raise money or psychic incomes" (Becker, 1964, p. 1). From a learning theoretical point of view, human capital has to be successfully transferred to the business owners' situation to increase success. Successful transfer is easier in situations where new knowledge is similar to the task that needs to be performed, as compared to new knowledge that is dissimilar to the task (Thorndike, 1906). Consequently, the task-relatedness of human capital helps explain the differential effects of human capital on success.

3.2 . Human capital and success

Human capital theory assumes that people attempt to receive a compensation for their investments in human capital (Becker, 1964). Thus, individuals try to maximize their economic benefits given their human capital. As a consequence, highly educated people may not choose to become entrepreneurs because entrepreneurship may very well lead to reduced income compared to other employment opportunities (Cassar, 2006; Evans and Leighton, 1989). However, once individuals have entered entrepreneurship, those who have invested more in their human capital are likely to strive for more growth and profits in their business compared to individuals who have invested less in their human capital (Cassar, 2006), simply because they want to receive higher compensation for their human capital investments. Otherwise, highly educated entrepreneurs would choose to dissolve their firms and seek other, more lucrative employment opportunities (Gimeno et al., 1997). The arguments suggest that according to human capital theory, human capital leads to entrepreneurial success.

The entrepreneurship literature provides a number of arguments on how human capital should increase entrepreneurial success. First, human capital increases the capability of owners to perform the generic entrepreneurial tasks of discovering and exploiting business opportunities (Shane and Venkatraman, 2000). For example, prior knowledge increases owners' entrepreneurial alertness (cf. Westhead et al., 2005) preparing them to discover specific opportunities that are not visible to other people (Shane, 2000; Venkatraman, 1997). Additionally, human capital affects owners' approaches to the exploitation of opportunities (Chandler and Hanks, 1994; Shane, 2000). Second, human capital is positively related to planning and venture strategy, which in turn, positively impacts success (Baum et al., 2001; Frese et al., 2007)[1]. Third, knowledge is helpful for acquiring other utilitarian resources such as financial and physical capital (Brush et al., 2001) and can partially compensate a lack of financial

[1] Note that there is a controversial debate about the planning-success relationship in the entrepreneurship literature (Brinckmann et al., 2010; Delmar and Shane, 2004; Honig and Karlsson, 2004; Schwenk and Shrader, 1993).

capital which is a constraint for many entrepreneurial firms (Chandler and Hanks, 1998). Finally, human capital is a prerequisite for further learning and assists in the accumulation of new knowledge and skills (e.g., Ackerman and Humphreys, 1990; Hunter, 1986). Taken together, owners with higher human capital should be more effective and efficient in running their business than owners with lower human capital.

Hypothesis 1. There is a positive relationship between human capital and success.

3.3 . Human capital investment versus outcomes of human capital investments

According to Becker (1964), knowledge/skills are theoretically the result of human capital investments such as education and work experience. Consequently, most studies have used education or work experience to measure the human capital construct as proxies for entrepreneurs' human capital (Reuber and Fischer, 1994). This is a valid approach assuming that there is a relationship between human capital investments and outcomes of human capital investments. Current research suggests that this is in fact the case (Reuber and Fischer, 1994; Unger et al., 2009).

However, we argue that the success relationship is higher for outcomes of human capital investments than for human capital investments because human capital investments are indirect indicators of human capital and are, therefore, one step removed, while knowledge and skills (outcomes of human capital investments) are direct indicators of human capital (Davidsson, 2004). Whether human capital investments lead to knowledge/skills depends on characteristics of the person and the environment (e.g., Gagné, 1985; Quiñones et al., 1995; Reuber and Fischer, 1994). There is no mechanistic one-to-one relationship of human capital investments to outcomes of human capital investments. "It is possible that two individuals can be sent to start separate businesses and thus have equal experiences. However, the outcomes can be dramatically different" (Quiñones et al., 1995, p. 905). Reflective orientation (i.e., a focus on understanding the meaning of ideas and situations that help transfer concrete experience into new information and knowledge; Kolb, 1984) and metacognitive activities (i.e., activities to control one's cognitions; Ford et al., 1998) are two examples of many person variables that facilitate the transformation of experience into knowledge (e.g., Kolb, 1984; Keith and Frese, 2005).

Moreover, the use of the same labels of experience does not mean that they are in fact the same. For example, education is often measured as the years of schooling. Yet what has been learned (knowledge as the result of experience) depends on characteristics of the school (business school or not, quality of the teaching, etc.). In conclusion, human capital conceptualized as an investment may reveal little about the knowledge and skills that a person actually possesses. Human capital conceptualized as outcomes of human capital investments on the other hand has the advantage that it is a direct assessment of human capital representing a learning outcome. Outcomes of human capital investments, such as knowledge and skills, should influence effective actions by the business owner directly. Outcomes of human capital investments should, therefore, yield higher and more consistent positive relationships with success than human capital investments.

Hypothesis 2. The relationship between human capital and success is higher for outcomes of human capital investments than for human capital investments.

3.4 . Task-relatedness of human capital

Human capital leads to higher performance only if it is applied and successfully transferred to the specific tasks that need to be performed. The transfer process should be easier if human capital is related to the current tasks of the business owner. Generally, transfer of schooling to real life works best if old and new activities share common situation-response elements (Thorndike, 1906). It is, therefore, useful to distinguish between human capital that is task-related and human capital that is nontask-related (cf. Becker, 1964; Cooper et al., 1994). Task-related human capital is human capital that relates to the current tasks of the business owner (e.g., owner experience, start-up experience, industry experience, entrepreneurial knowledge). Nontask-related human capital is human capital that does not relate to current tasks of the business owner (e.g., general education, employment experience).

Tasks in entrepreneurship that concern all business owners include environmental scanning, selecting opportunities, and formulating strategies for exploitation of opportunities, as well as organization, management, and leadership (Chandler and Jansen, 1992; Mintzberg and Waters, 1982; Shane and Venkatraman, 2000). Human capital needs to be related to these tasks. Task-relatedness of human capital is high if it is process specific (i.e., related to the processes and daily tasks of running a business) and content specific (i.e., related to the industry the owner's business is in) (West and Noel, 2002). Owners with high task-related human capital possess better knowledge of customers, suppliers, products, and services within the context of their business (Gimeno et al., 1997). Such task-related human capital helps in the detection and exploitation of new business opportunities. Task-related human capital should, therefore, be more strongly related to success than nontask-related human capital.

Additionally, human capital that is related to the tasks in the current business context facilitates the acquisition of new knowledge. The more similar prior knowledge is to newly acquired knowledge, the easier it is to absorb the new knowledge (Cohen and Levinthal, 1990).

Overall, research in entrepreneurship appears to support our propositions (Bosma et al., 2004). Task-related industry experience is positively related to business success (Lerner and Almor, 2002). In another study, owners were found to be more successful if their current business was similar to past operations (Srinivasan et al., 1994). Not all studies, however, have yielded

clear-cut results (e.g., Chandler, 1996), thereby reinforcing the need for meta-analysis. Taken together, we suggest the following hypothesis.

Hypothesis 3. The relationship between human capital and success is higher for human capital related to entrepreneurial tasks than for human capital that is not related to entrepreneurial tasks.

3.5 . Context as a moderator of the human capital–success relationship

Contingency theory argues that the prediction of performance is higher if predictors are correctly aligned with certain key variables, such as industry conditions and organizational processes (Lawrence and Lorsch, 1967). Therefore, contingency theory has been important in the development of management science (Venkatraman, 1989). With regard to the human capital–success relationships, industry conditions are prime candidates for such a moderation effect. More specifically, the effects of human capital on success may be especially important in high-technology industries. High-technology industries involve the use of sophisticated and complex technologies, and they typically require extensive knowledge and research in dynamic and uncertain environments (Khandwalla, 1976; Utterback, 1996). Human capital should help particularly in such knowledge-intensive industries because knowledge and valid information reduce uncertainty associated with innovation and dynamic environments (Kirzner, 1997; McMullen and Shepherd, 2006). High-technology industries are more dynamic than low-technology industries and, therefore, owners in these industries have to continually adapt to new developments. Since human capital helps in the acquisition of new knowledge and skills and enables business owners to make better and faster decisions (e.g., Reuber and Fisher, 1999), human capital is more important in high-technology industries than in low-technology industries (Eisenhardt and Martin, 2000; Tyson, 1992).

Hypothesis 4. The relationship between human capital and success is higher in high-technology industries than in low-technology industries.

Human capital can create competitive advantages if it is sufficiently different from competitors (Alvarez and Barney, 2001). Taken to the extreme — if all owners possessed the same human capital, there would be no competitive advantage. In developing countries, human capital is more heterogeneous and rather scarce than in highly developed countries. An example is the literacy rate which is considerably higher in industrial Western nations than in developing countries (see, e.g., UNDP, 1998). Therefore, human capital is more likely to create competitive advantage in the developing world. Moreover, developing countries trigger more “necessity” entrepreneurship (Reynolds et al., 2002) because people are forced into self-employment or starting-up businesses as there are no other alternatives available. Thus, there is higher variance of people's human capital in developing countries.

Another way to look at the same issue is from a methodological point of view. Human capital heterogeneity in the developing world implies higher variances of human capital compared to the developed world. Higher variance makes it easier to detect relationships (Hunter and Schmidt, 1990). Researchers have previously suggested similar explanations for failure to find relationships between education and success. Lerner et al. (1997) explained the lack of relationship between education and success in Israeli business owners by the high and relatively uniform level of education in the country with little variance.

Hypothesis 5. The relationship between human capital and success is higher in less developed than in developed countries.

Human capital has been argued to be especially important in young businesses (Davidsson and Honig, 2003). Young enterprises suffer from the liability of newness, which refers to a higher propensity to fail for young enterprises as compared to older, more established enterprises (Aldrich and Wiedenmayer, 1993; Stinchcombe, 1965). The liability of newness is partially due to skill gaps and lack of information, and, therefore, human capital can reduce the liability of newness (Aldrich and Auster, 1986). For example, owners of young businesses are typically confronted with many different and potentially new tasks. They have to respond to new situations that may require immediate decisions and actions. Routines and strategies, however, have yet to be developed (cf. Bantel, 1998). Thus, accomplishing daily tasks in the business, solving problems, and making entrepreneurial decisions (e.g., decisions to act upon business opportunities) pose cognitive challenges to owners of young businesses. High human capital assists such owners to learn new tasks and roles and to adapt to new situations (Weick, 1996). In contrast, owners of older businesses have a “track record” and routines and established practices they can refer to. Over the years, variables other than the owners' human capital may become more important. Since human capital created legitimacy for young enterprises, owners' human capital should be more important in the initial years of business rather than during later stages.

Hypothesis 6. The relationship between human capital and success is higher for younger business than for older businesses.

3.6 . Human capital and different measures of success

The relative magnitude of effects of human capital may depend on the choice of the success criterion used. Research suggests that success is a multidimensional construct (e.g., Combs et al., 2005). Venkatraman and Ramanujam (1986) distinguish between financial and operational performance of entrepreneurial organizations. Indicators of financial performance reflect the firm's economic achievements while indicators of operational performance (such as innovativeness) are factors that may lead to financial performance.

Human capital theory suggests that people want to be compensated for their human capital investments, assuming that people seek to maximize their economic benefits over their life time. Accordingly, human capital theory was originally developed to explain variations in financial returns of employees. Applied to entrepreneurship this means that entrepreneurs strive to receive financial returns from their venturing activities relative to their human capital investments. Therefore, entrepreneurs' human capital should be positively associated with a preference for venture scale and growth (Cassar, 2006). Consequently, human capital theory is particularly useful in explaining the financial performance. Financial performance can be assessed by different indicators that reflect distinct dimensions (Venkatraman and Ramanujam, 1986). In their meta-analysis, Combs et al. (2005) found evidence on the convergent and discriminant validity of the three performance dimensions: profitability, growth, and stock market performance. In our meta-analysis we cannot include stock market performance because most firms studied in entrepreneurship research are analyzed before going public. Instead, we included firm size as a performance indicator that represents the scale of business operations (Eisenhardt and Schoonhoven, 1990; Frese et al., 2007). The literature does not allow clear theoretical predictions on the relative magnitude of the relationship between human capital and the different indicators of financial performance. Therefore, we do not suggest an a priori hypothesis; instead we pose a research question on the relationship of human capital with the three success indicators.

3.6.1 . Research question

Is the relationship between human capital and success different dependent on which specific concept of success is used (profitability, growth, size)?

4. Method

4.1. Selection criteria

We focused on studies defining entrepreneurship as business ownership and active management (Stewart and Roth, 2001). To be included in the meta-analysis, studies were required to report a correlation between an indicator of human capital and a measure of entrepreneurial success or a statistic that allowed the transformation into a correlation measure. The success measure needed to address the entrepreneurial firm in order to ensure a consistent level of analysis. We considered indicators that measure profitability and growth as dimensions of financial performance (Combs et al., 2005). In addition, we included firm size as a performance indicator for entrepreneurial firms which start from zero (Eisenhardt and Schoonhoven, 1990). We decided not to include studies reporting firm dissolution as the dependent variable. Such measures are often ambiguous because they may or may not signify business failure (Headd, 2003). To avoid bias in our results we excluded studies that only reported significant effects.

4.2. Collection of studies

The goal of our study collection was to identify all empirical studies that match the scope of the study described above. This is necessary to allow breaking down studies into different categories (Lipsey and Wilson, 2001). Therefore, we used a number of different strategies to identify studies reporting relationships between human capital and entrepreneurial success Glass et al., 1981; Rauch and Frese, 2006): first, we initiated a computer-based literature search in specialized databases for all years available, such as PsycINFO (1987–2008), ABI/Inform (1971–2008), EBSCO (Business Source Elite, 1985–2008), SSCI (Social Science Citation Index, 1972–2008), EconLit (1969–2008), and ERIC (Expanded Academic Index, 1985–2008). We used variations of keywords of entrepreneurship (e.g., entrepreneur, business owner, small business, venture, small firm), of human capital (e.g., human capital, education, schooling, knowledge, skills, ability, competence) and of entrepreneurial success (e.g., success, performance, growth, profit, income, size, sales, ROI, ROE, ROA, ROS). Second, we manually searched relevant journals such as the Journal of Business Venturing (1995–2008), Entrepreneurship Theory and Practice (1985–2008), Journal of Small Business Management (1985–2008), Academy of Management Journal (1985–2008), Journal of Applied Psychology (1985–2008), Administrative Science Quarterly (1985–2008), and the Entrepreneurship and Regional Development (1989–2008). The third strategy we applied was to search the conference proceedings of the Academy of Management (1984–2008) and the Babson College Entrepreneurship Research Conference (1981–2008). Finally, we examined the reference lists of located articles for additional studies not identified before.

Our search resulted in 495 studies. We applied a hierarchical screening procedure in order to decide whether to include a study or not: in a first step, we rejected all studies that were not empirical papers ($k = 51$). We additionally rejected papers that included case studies or other qualitative research ($k = 24$). In a second step, we inspected the method section of each remaining study to check whether or not the study met the scope of our meta-analysis. We excluded 210 studies that did not meet our criteria for inclusions: of these, 196 studies did not provide an indicator of human capital and/or an indicator of success; 14 studies did not sample business owners and active managers. Additionally, 22 studies did not address the relationship between owners' human capital and firm performance (e.g., a comparison of different types of entrepreneurs, or comparing income between entrepreneurs and employees). Of the remaining 188 studies, 123 studies did not provide the statistical information required to calculate an effect size (e.g., only multivariate regressions reported). We contacted the authors of these studies and asked them for the bivariate data yielding 9 additional correlation matrices or data files (in fact, we received only 62 replies, and the majority of authors indicated that the data was no longer available to them or that they were not able to create the correlation matrix due to time constraints). Following this procedure, we identified 74 studies; double publications reduced this number to a total of 70

Table 1
Samples included in the meta-analysis.

	Author name (year)	Publication status	Conceptualization of human capital (HC)	Success indicator	Country of origin	Industry	Age (in years)	Sample size
1	Alvarez, R. and Crespi, G. (2003)	Published	HC investment (task related and nontask related)	Size, profitability	Chile	Industrial sector	Not specified	1091
2	Autio, E. et al. (2000)	Published	Outcome of HC investment (task related)	Size	Finland	Electronic industry	14.85	59
3	Baum, J.R. and Locke, E. (2001, 2004)	Published	Outcome of HC investment (task related)	Growth, size	North America	Architectural woodwork	3.58 approx 9.58	307 229
4	Baum, J.A.C. and Silverman (2004)	Published	HC investment (task related)	Growth	Canada	Biotechnology	Not specified	675
5	Begley, T.M. (1995)	Published	HC investment (nontask related and task-related)	Size, profitability, growth	USA	Mixed	20.89	239
6	Begley, T.M. and Boyed, D. (1986)	Published	HC investment (nontask related and task-related)	Growth, size	USA	Mixed	24.73	471
7	Bian, Y. (2002)	Published	HC investment (nontask related)	Size	China	Not specified	29.44	188
8	Bosma, N. et al. (2004)	Published	HC investment (nontask related and task-related)	Size, profitability	Netherlands	Mixed	Not specified	1151
9	Box, T.M. et al. (1996)	Published	HC investment (nontask related and task-related)	Growth	Croatia	Low-technology firms	Not specified	187
10	Box, T.M. et al. (1993)	Published	HC investment (nontask related and task-related)	Growth	USA	Manufacturing	Not specified	95
11	Bruce, D. (2002)	Published	HC investment (nontask related)	Profitability	Not specified	Mixed	Not specified	731
12	Brush, C.G. and Chaganti, R. (1998)	Published	HC investment (nontask related and task related)	Growth, size, profitability	USA	Mixed sample of non high-technology firms	15.15	195
13	Chandler, G. and Jansen, E. (1992)	Published	HC investment (nontask related and task related)	Growth, size	USA	Mixed	6.07	134
	Chandler, G. (1996)		Outcome of HC investment (task related)				6.07	134
	Chandler, G. and Hanks, S. (1998)						3.52	102
14	Chandler, G. and Hanks, S. (1994)	Published	Outcome of HC investment (task related)	Growth, size	USA	Low technology	8.35	155
15	Chrisman, J. et al. (2005)	Published	HC investment (task-related and nontask related)	Size	USA	Mixed	5.2	159
16	Ciavarella, M.A. et al. (2004)	Published	HC investment (task related)	Size	USA	Mixed	Not specified	140
17	Cliff, J. (1998)	Published	HC investment (task related and nontask related)	Size	Canada	Mixed	Not specified	229
18	Davidsson, P. and Honig, B. (2003)	Published	HC investment (task related and nontask related)	Size, profitability	Sweden	Mixed	(Nascent) 1.19	380
	Delmar, F. and Shane, S. (2004)							223
19	Davidsson, P. (1991)	Published	HC investment (task related and nontask related)	Growth, size	Sweden	Mixed	Not specified	408
20	Deivasenapathy, P. (1986)	Published	HC investment (nontask related)	Profitability	India	Low-technology firms	Not specified	98
21	Duchesneau, D. and Gartner (1990)	Published	HC investment (task related)	Profitability	USA	Low-technology firms	Not specified	26
22	Edelman, L.F. et al. (2005)	Published	Outcome of HC investment (task related and nontask related)	Growth, size	Not specified	Mixed	Not specified	192
23	Fasci, M.A. and Valdez, J (1998).	Published	HC investment (task related and nontask related)	Profitability	USA	Accounting Firms	Not specified	604
24	Florin, J. (2005)	Published	HC investment (task related and nontask related)	Profitability, growth	USA	Mixed	7.22	277
25	Forbes, D. (2005)	Published	HC investment (task related and nontask related)	Size	USA	Internet firms	1.95	108
26	Frese, M. et al. (2007)	Published	HC investment (nontask related)	Size, growth	South Africa	Mixed	6	126
27	Frese, M. et al. (2007)	Published	HC investment (nontask related)	Size, growth	Zimbabwe	Mixed	5	215

(continued on next page)

Table 1 (*continued*)

	Author name (year)	Publication status	Conceptualization of human capital (HC)	Success indicator	Country of origin	Industry	Age (in years)	Sample size
28	Frese, M. et al. (2007)	Published	HC investment (nontask related)	Size, growth	Namibia	Mixed	8	87
29	Fung, H.-G. et al. (2007)	Published	HC investment (nontask related)	Profitability	China	Not specified	6.5	2105 (cross-sectional) 1697 (longitudinal)
30	Gimeno, J. et al. (1997)	Published	HC investment (task related and nontask related)	Size	USA	Mixed	Less than 6 years	1547
31	Gomez, R. and Santor, E. (2005)	Unpublished	HC investment (nontask related)	Profitability	Canada	Not specified	Not specified	702
32	Haber, S. and Reichel, A. (2007)	Published	HC investment (task related and nontask related), Outcome of HC investment (task related)	Growth, size, profitability	Israel	Tourism	Not specified	305
33	Honig, B. (1998)	Published	HC investment (task related and nontask related)	Profitability	Jamaica	Manufacturing and repair	Not specified	215
34	Honig, B. (2001)	Published	HC investment (task related and nontask related)	Profitability, size	West bank	Manufacturing	12	64
35	Judd, L.L. et al. (1985)	Published	HC investment (nontask related)	Profitability	USA	Retail	Not specified	379
36	Klinkerfuss, C. (2005)	Unpublished	HC investment (task related), Outcome of HC investment (task related)	Growth, size, profitability	Germany	Mixed	Not specified	62
37	Koenig, C. et al. (2007)	Published	HC investment (task related and nontask related), Outcome of HC investment (task related)	Growth	China	Mixed	Not specified	103
38	Koenig, C. et al. (2007)	Published	HC investment (task related and nontask related), Outcome of HC investment (task related)	Growth	Germany	Mixed	Not specified	154
39	Kundu, S.K. and Katz, J.A. (2003)	Published	HC investment (task related)	Size	India	Software	11.43	47
40	Lanjouw, P. et al. (2001)	Published	HC investment (nontask related)	Profitability	Tanzania	Not specified	Not specified	1572
41	Larsson, E. et al. (2003)	Published	HC investment (nontask related)	Size	Sweden	Mixed	Not specified	223
42	Lee, C. et al. (2001)	Published	HC investment (task related)	Growth, size	Korea	Technological firms	4.18	137
43	Lerner, M. and Almor, T. (2002)	Published	HC investment (task related) Outcome of HC investment (task related)	Size, profitability	Israel	Not specified	10.6	220
44	Lerner, M. and Haber, S. (2000)	Published	HC investment (task related and nontask related) Outcome of HC investment (task related)	Profitability, size	Israel	Tourism	Not specified	53
45	Lussier, R.N. and Pfeifer, S. (2001)	Published	HC investment (task related and nontask related) Outcome of HC investment (task related)	Profitability	Croatia	Mixed	Not specified	117
46	Lussier, R.N. (1995)	Published	HC investment (task related and nontask related) Outcome of HC investment (task related)	Profitability	USA	Mixed low-technology firms	5.65	216
47	Meziou, F. (1991)	Published	HC investment (task related and nontask related)	Size, profitability	USA	Manufacturing	Not specified	176
48	Minguzzi, A. and Passaro, R. (2001)	Published	HC investment (nontask related)	Size	Italy	Food and fashion industry	Not specified	104
49	Muse, L. et al. (2005)	Published	HC investment (task related and nontask related)	Growth, size, profitability	USA	Mixed	15.31	4637
50	Peña, I. (2004)	Published	HC investment (task related and nontask related)	Growth	Spain	Not specified	2.76	114
51	Rauch, A. et al. (2005a)	Published	HC investment (task related and nontask related)	Growth, size	Germany	Mixed	2.31	119
52	Rauch, A. et al. (2005b)	Unpublished	HC investment (task related Outcome of HC investment (task related)	Growth, size	Germany	Mixed	Not specified	52
53	Ray, J.J and Singh, S. (1980)	Published	HC investment (nontask related)	Growth	India	Farming	Not specified	200
54	Reuber and Fischer (1994)	Published	Outcome of HC investment (task related)	Growth	Canada	High-technology firms	13	43
55	Saffu, K. and Manu, T. (2004)	Unpublished	HC investment (task related) Outcome of HC investment (task related)	Size	Ghana	Not specified	12	171
56	Sapienza, H.J. et al. (2004)	Published	HC investment (task related)	Growth, size	Finland	Manufacturing, technical service	5	54

Table 1 (*continued*)

	Author name (year)	Publication status	Conceptualization of human capital (HC)	Success indicator	Country of origin	Industry	Age (in years)	Sample size
57	Senjem, J. (2002)	Unpublished	HC investment (task related)	Growth, size	USA	High-technology firms	10	113
58	Shrader, R. and Siegel, D.S. (2007)	Published	HC investment (task related)	Growth, profitability	USA	High-technology ventures	Not specified	196
59	Tamasy, C. (2006)	Published	HC investment (nontask related and task related)	Profitability	Germany	Mixed	Less than 8	315
60	Unger, J.M. et al. (2008)	Published	HC investment (nontask related) Outcome of HC investment (task related)	Growth, size	South Africa	Mixed	8	90
61	Unger, J.M. et al. (2008)	Unpublished	HC investment (nontask related and task related)	Profitability, size	Peru	Mixed	14	88
62	van Gelder, J.L. et al. (2007)	Published	HC investment (task related and nontask related)	Growth	Fiji Islands	Mixed	7.1	71
63	Wasilczuk, J. (2000)	Published	HC investment (nontask related and task related) Outcome of HC investment (task related)	Growth	Poland	Manufacturing	Not specified	93
64	Watson, W. et al. (2003)	Published	HC investment (nontask related, task related)	Size, growth, profitability	USA	Not specified	12.64	350
65	Weinstein, A. (1994)	Published	HC investment (nontask related, task related)	Size	USA	Technology-based industries	Not specified	203
66	West III, G.P. and Noel, T.W. (2002)	Unpublished	Outcome of HC investment	Profitability	USA	Manufacturing	Not specified	32
67	Westhead, P. et al. (2005)	Published	HC investment (task related)	Growth, profitability	Great Britain	Mixed	Not specified	326
68	Wright, M. et al. (2008)	Published	HC investment (nontask related, task related)I	Growth	China	High technology	4.9	349
69	Zhao, X. et al. (in press)	Published	HC investment (nontask related), outcome of HC investment (nontask related)	Growth, size	China	Not specified	5.28	131
70	Zhao, X. et al. (in press)	Published	HC investment (nontask related), outcome of HC investment (nontask related)	Growth, size	China	Not specified	6.94	74

independent samples that were included in our meta-analysis. Table 1 displays the characteristics of the studies included in our analysis.

4.3. Variable coding

The coding of human capital investments included all human capital conceptualizations that are based on past experiences. The coding of outcomes of human capital investment integrated direct assessments of entrepreneurs' knowledge, skills, and competencies. Table 2 displays our coding of measures applied in the studies included in the meta-analysis and the frequencies of the human capital indicators that were used. The first observation of our coding is that the majority of studies used measures of human capital investments rather than outcomes of human capital investments. The most frequently employed indicators of human capital investments were education (used 69 times), start-up experiences (31 times), industry specific experience (22 times), management experience (21 times), and work experience (12 times). Most assessments of outcomes of human capital investments measured entrepreneurial skills, competencies, and knowledge. In the category of task-related human capital start-up experience (31 times), industry specific experience (22 times), and management experience (21 times) were the most frequently used operationalizations of human capital. Other predictors of task-related human capital included having a self-employed parent or indicators of specific experiences in trade, technology, or small business ventures. Education (69 times) and work experience (12) were most frequently used to assess nontask-related human capital.

We further coded the study context. The country of the businesses under investigation was coded as belonging to the developed or less developed part of the world (countries receiving development assistance and aid in 2003; cf. Organisation for Economic Co-operation and Development, Manning, 2005). We further coded whether the business operated in a high-technology sector (e.g., computer, biotechnology industry) or a low-technology sector (e.g., gastronomy, wood manufacturing). Moreover, we classified businesses as young businesses if studies included businesses that existed for less than 8 years on average and as old businesses if businesses existed for more than 8 years on average (cf. Bantel, 1998; McDougall and Robinson, 1990). Measures of entrepreneurial success were classified in line with the entrepreneurial and organizational performance dimensions mentioned in the literature (Combs et al., 2005; Eisenhardt and Schoonhoven, 1990): profitability, growth, and size. The coding of performance

Table 2
Coding and frequencies of human capital variables.

Human capital investment	N	Outcomes of human capital investment	N	High task relatedness	N	Low task relatedness	N
Education, general	69	Entrepreneurial skill	6	Start-up/owner experience	31	Education, general	69
Education, level	46	Entrepreneurial competence	6	Industry specific experience	22	Education , level	46
Education, years	11	Entrepreneurial knowledge	5	Management experience	21	Education, years	11
Education, non-formal	1	Management skills	3	Management exp., yes/no	10	Education, non-formal	1
Education, parent	1	Specific social skills	3	Management exp., years	5	Education, parent	1
Start-up/owner experience	31	Business skills	2	Management exp., level	4	Work experience	12
Industry specific experience	22	Marketing skills	2	Management exp., number positions	2	Meta-cognitive skills	2
Management experience	21	Meta-cognitive skills	2	Business education	7		
Management exp., yes/no	10	Decision skill	1	Parent entrepreneur	7		
Management exp., years	5	Expertise	1	Entrepreneurial skill	6		
Management exp., level	4	Industry skills	1	Entrepreneurial competence	6		
Management exp., number positions	2	Managerial competencies	1	Entrepreneurial knowledge	5		
Work experience	12	New resource skill	1	Deliberate practice	3		
Business education	7	Opportunity skill	1	Marketing skills	3		
Parent entrepreneur	7	Organization skill	1	Management skills	3		
Deliberate practice	3	Technical skills	1	Specific social skills	3		
Marketing experience	3			Business skills	2		
International experience	2			International experience	2		
Related work experience	2			Meta-cognitive skills	2		
Similar business experience	2			Marketing skills	2		
Specific learning experience	2			Related work experience	2		
Specific vocational training	2			Similar business experience	2		
Technological experience	2			Specific learning experience	2		
Combined index of experiences	1			Specific vocational training	2		
Finance experience	1			Technological experience	2		
Knowledge intensity	1			Combined index of experiences	1		
Large firm experience	1			Decision skill	1		
Leadership experience	1			Expertise	1		
Learning orientation	1			Finance experience	1		
Learning strategy	1			Industry skill	1		
Marketing courses	1			Knowledge intensity	1		
Related production experience	1			Large firm experience	1		
Small firm experience	1			Leadership experience	1		
Technical training	1			Learning orientation	1		
				Learning strategy	1		
				Managerial competencies	1		
				Marketing courses	1		
				New resource skill	1		
				Opportunity skill	1		
				Organization skill	1		
				Related production experience	1		
				Small firm experience	1		
				Technical skills	1		
				Technical training	1		

measures displayed in Table 3 indicates that the size was measured predominantly by number of employees (used 28 times) and sales volume (15 times). Similar to what was reported by Delmar (1997), growth was most frequently assessed by sales growth (16 times) and employment growth (15 times). Profit was the most frequently used indicator of profitability (14 times). Finally, we coded each study according to whether it was published or not, which enabled us to statistically control for publication bias (Hunter and Schmidt, 1990).

4.4. Analytical approaches

Our analysis was based on the meta-analytic procedures developed by Hunter and Schmidt (1990). Effect sizes were based on Pearson product-moment correlations (r). When r was not reported but other statistics were available (e.g., t-test, chi-square, etc.), we converted these values into the r statistic (using META5.3 by Schwarzer (1989)). Whenever studies reported multiple correlations between human capital and performance we aggregated the effects within studies by using the mean value. To prevent including double publications in our meta-analysis, we applied a search strategy to all identified publications and compared them with regard to specific criteria (sample size, country of origin, and authors). By applying this strategy we were able to identify three studies that published overlapping or identical samples seven times. In order to utilize all information possible without violating sample independence (Petitti, 2000), we also computed the mean effect size across those studies that were based on the same sample, thus including them only once into the analysis.

Table 3
Coding and frequencies of success variables.

Size	N	Growth	N	Profitability	
Number of employees	28	Growth in sales	16	Profit	14
Sales volume	15	Growth in employment	15	Income	7
Expert rating	5	General business growth	8	Revenues	5
Equipment value	4	Growth in profits	6	ROA	4
Scale organizational success	3	Growth in revenues	3	ROS	3
Business volume	1	Growth in assets	2	ROI	2
		Growth in market share	2	Sales per employee	2
		Growth in cash flow	1	Cash flow (net)	1
		Growth in output	1	Earnings	1
		Growth in ROS	1	Owner's salary	1
				Return on cash flow	1

For estimating the overall relationship between human capital and success we computed the sample weighted average effect across all studies. Moreover, we corrected dependent and independent variables for measurement unreliability. Since not all studies included information concerning the reliability of measurements, we computed the average reliability of human capital and success measures across the sample. Whenever a study did not indicate reliabilities for either human capital or success we used the average reliability of this variable as the best estimate (Hunter and Schmidt, 1990). The average reliability for human capital was $r = .768$ (based on 22 studies) and $r = .774$ for success (based on 17 studies). While we note that our reliability estimate is based on a small number of reported reliabilities, the reliability corrected effect size most likely reflects the true correlation more precisely than the sample weighted effect size. Therefore, Lipsey and Wilson (2001) suggested collecting whatever reliability information is reported, even if a large proportion of coefficients is not available for individual effect sizes (p. 110). In Table 4 we report both the reliability corrected and the sample size weighted correlations. The statistical tests of significance, heterogeneity, and moderator effects are based not on the reliability corrected values but only on the sample size weighted effect sizes (however, note that the statistical tests are mostly invariant to reliability correction; see Hunter and Schmidt, 1990).

To determine whether an effect size was different from zero, we computed a 95% confidence interval around the estimated population correlation. If the lower boundaries of the 95% confidence intervals are greater than zero, effects are significant (Judge

Table 4
Results of meta-analysis on human capital (HC) and success.

Variable	K	N	r_c	r	s_r^2	s_e^2	% variance due to sampling error	95% confidence interval	95% credibility interval	z-value
H_1: Overall	70	24,733	.098	.076	.005	.003	54.65	.059 to .093	−.019 to .170	
Random	70	24,733	.063	.049	.012	.003	23.76	.023 to .074	−.138 to .235	
H_2: Outcome of HC investment versus HC investment[a]										
Outcome	23	3232	.204	.158	.019	.013	34.99	.101 to .215	−.062 to .379	2.91**
Investment	65	23,828	.090	.070	.005	.003	55.62	.053 to .087	−.021 to .161	
H_3: Task relatedness										
High	52	18,413	.109	.087	.005	.003	62.18	.069 to .106	.006 to .169	2.14*
Low	49	21,386	.069	.056	.007	.002	34.57	.033 to .078	−.073 to .184	
H_4: Industry										
High technology	9	1883	.109	.086	.002	.005	190.82	.053 to .118	n.a.	.62
Low technology	23	6568	.130	.100	.006	.003	59.17	.069 to .132	.005 to .196	
H_5: Developed versus less developed										
Developed	43	16,733	.084	.065	.004	.003	59.26	.045 to .084	−.018 to .147	1.71†
Less developed	26	7957	.122	.094	.005	.003	60.31	.067 to .123	.004 to .185	
H_6: Age of business										
Old	18	7494	.056	.044	.003	.002	70.10	.016 to .071	−.019 to .106	2.40*
Young	18	4738	.140	.107	.009	.004	41.04	.063 to .151	−.033 to .246	
H_7: Success measure										
Size	41	14,400	.119	.091	.004	.003	67.55	.075 to .108	.019 to .164	2.09*[,a]
Growth	36	11,539	.069	.054	.008	.003	38.72	.025 to .083	−.083 to .192	.54[b]
Profitability	26	15,460	.057	.044	.004	.001	47.43	.021 to .067	−.041 to .128	−3.11**[,c]
Publication bias										
Published	61	22,380	.100	.077	.005	.003	53.28	.059 to .094	−.017 to .170	.61
Unpublished	9	1420	.069	.053	.013	.006	48.29	−.022 to .127	−.111 to .214	

Note. k = number of samples, N = sample size $\sum N_i$, r_c = reliability corrected and sample size weighted mean effect size, r = sample size weighted mean effect size, s_r^2 = variance in effect sizes, s_e^2 = sampling error variance, z-value: statistic based on test for significance of difference in effect sizes. †$p < .10$, *$p < .05$, **$p < .01$. [a]Size versus growth, [b]growth versus profitability, [c]profitability versus size.

et al., 2002). To estimate the severity of publication bias, we conducted file drawer analyses according to Rosenthal (1979). The findings of these analyses indicate the number of studies with an effect size of zero needed to reduce the mean effect size to the point of nonsignificance. Therefore, this estimate provides information on whether the observed effect size is spurious or not (Lipsey and Wilson, 2001).

Several steps were taken to test moderator hypotheses. We first examined homogeneity of all study effects. Homogeneity was assessed by applying Hunter and Schmidt's (1990) 75% rule and calculating 95% credibility intervals. Effects are considered homogenous if more than 75% of the observed effects' variance is explained by sampling error variance and if the 95% credibility interval does not include zero (Judge et al., 2002). We took care not to underestimate effect heterogeneity. To assess heterogeneity we, therefore, did not take the average effect size of each study but rather randomly selected one effect from each study. This ensured that effect heterogeneity *within* studies was also considered. We report both confidence and credibility intervals. While confidence intervals estimate variability in the mean correlation, credibility intervals estimate variability in the individual study correlations. In other words, confidence intervals tell us whether an estimated effect is different from zero.

When effects were heterogeneous we tested for moderators. The existence of a moderator was indicated if effect subgroups were homogenous and if homogeneity averaged across the moderator subgroups was higher than homogeneity of the overall effects. To examine the statistical significance of the difference between each moderator pair we calculated *z*-statistics. The sum of studies for some moderator tests differs from 70 because some studies reported effects on both sides of the moderators. Thus, the assumption of independent effect sizes is diminished in the moderator analysis (Crook et al., 2008; De Dreu and Weingart, 2003).

5. Results

Our results supported Hypothesis 1 which proposed a positive overall relationship between human capital and success (Table 4). The sample size weighted and reliability corrected overall effect across studies was $r_c = .098$. Moreover, the boundaries of the 95% confidence were $r = .059$ and $r = .093$ (Table 4), indicating that the overall effect was significant. File drawer analysis according to Rosenthal (1979) indicated a required number of $K = 5778$ studies with zero effects to make the effect insignificant. Heterogeneity of the effects for the overall relationship between human capital and success pointed to the existence of moderating variables. Sampling error estimated from a series of randomly selected effects explained 23.67% of the overall variability across the 70 studies and 524 effects. The credibility interval included zero (Table 4).

Next, we tested moderator hypotheses. The success relationship was higher for outcomes of human capital investments ($r_c = .204$) than for human capital investments ($r_c = .090$) supporting Hypothesis 2. The variance due to sampling error increased substantially, although variance explained by sampling error did not exceed the 75% criterion. Both credibility intervals included zero, thus suggesting further moderating influences.

Task-relatedness moderated the relationship between human capital and success. In support of Hypothesis 3, human capital indicators that were related to entrepreneurial tasks showed higher relationships than indicators of human capital with low task-relatedness ($r_c = .109$ and $r_c = .069$, respectively). Neither confidence interval included zero. As indicated by the increased percentage of variance due to sampling error, homogeneity was higher compared to the overall study effects. The 75% criterion was not reached; therefore, further moderators exist.

According to Hypothesis 4, the technological environment of the business influences the effect size. In contrast to this hypothesis, human capital relationships with success were equally strong in both high ($r_c = .109$) and low-technology industries ($r_c = .130$). Effects in the group of high-technology businesses were homogeneous; effects in the low-technology group remained heterogeneous, suggesting that it would be useful to search for moderators.

Hypothesis 5 postulated a higher human capital–success relationship for businesses operating in less developed countries than for businesses in developed countries. The moderator effect was only marginally significant ($z = 1.71$, $p < .10$) with a human capital–success relationship of $r_c = .122$ in less developed compared to $r_c = .084$ in developed countries. Although sampling error accounted for an increased percentage of variance, Hypothesis 5 was rejected.

We hypothesized age of business to moderate the human capital–success relationship (Hypothesis 6). In support of Hypothesis 6, human capital effects were higher in young businesses ($r_c = .140$) than in old business ($r_c = .056$). The moderator effect was significant ($z = 2.40$, $p < .05$). The 75% criterion suggested homogeneity in the group of old business and heterogeneity in the group of young businesses. The credibility intervals included zero indicating that further moderators may exist.

The relationship between human capital and success varied with the choice of success measurements used in the studies (Research question). The relationship for size ($r_c = .119$) was significantly higher than for growth ($r_c = .069$) and profitability ($r_c = .057$). There was no difference in effects between growth and profit oriented measures of success. While the variation in the effects was homogenous for size, it remained heterogeneous for growth and profit.

Finally, we found that publication bias did not affect our results; both published and unpublished studies reported effect sizes of similar size ($z = .61$, ns).

6 . Discussion

We integrated over 30 years of human capital research in entrepreneurship in our meta-analysis; the analysis is based on 70 studies with an overall sample size of 24,733. The magnitude of the population effect between human capital and entrepreneurial success was estimated to be $r_c = .098$. Thus, we can conclude that there is an overall positive relationship between human capital and entrepreneurial success. However, this effect is low given the high amount of attention the concept of human capital has

received in the entrepreneurship literature. The success relationship of human capital is smaller than those of personality (Rauch and Frese, 2007) or entrepreneurial orientation (Rauch et al., 2009).

The overall effect, however, should be interpreted carefully. A number of variables moderated the success relationship. While the effects remained positive and distinct from zero under all moderating conditions, the size of effects varied significantly (cf. next paragraph), thus demonstrating the usefulness of a moderator approach to investigating human capital.

Moderators in our studies can be divided into three groups: conceptualizations of human capital, the context of the firm, and the choice of success measurements. The first group included moderators that were derived from learning theory (human capital investments versus outcomes of human capital investments and task-relatedness). The effects were higher for human capital conceptualized as outcomes of human capital investments ($r_c = .204$) than for human capital conceptualized as human capital investments ($r_c = .090$). Moreover, the correlations were higher for human capital related to entrepreneurial tasks ($r_c = .109$) than for human capital variables with low task-relatedness ($r_c = .069$) and, thus, they support the importance of specific human capital as compared to general human capital. The second group of moderator variables included moderators that were context related. Effects were higher for young than for old businesses ($r_c = .140$ and $r_c = .056$, respectively). High versus low-technology did not make a difference for the relationship between human capital and success. The moderator developed versus less developed countries as the study context proved to be only marginally significant. This implies that there may be a moderator in this area which we were unable to uncover in this meta-analysis. Finally, moderators related to the choice of success measurement produced different effect sizes. Size oriented success measures yielded higher relationships with human capital than profit and growth oriented measures of success ($r_c = .110$, $r_c = .057$, and $r_c = .069$, respectively).

6.1. Implications for future research

The small overall effect size of human capital as well as the heterogeneity of reported effect sizes clearly requires additional explanation. First, human capital has to be task-related and directly related to knowledge and skills. The increase in effect sizes when human capital is measured at a higher level of specificity (e.g., number of times performing a task) was found in a previous meta-analysis of employees' work experience (Quiñones et al., 1995). Our findings suggest shifting research on human capital away from a static view of entrepreneurship to a process view. Past experience as an indicator of human capital may not be the most useful variable because experience per se does not lead to knowledge — in this context other third variables are likely to have an impact, such as individual differences or the richness of the learning environment (Reuber and Fischer, 1994). Current knowledge is more directly related to effective behavior by the entrepreneur and, therefore, produces higher effect sizes than measures of pure past experiences (Davidsson, 2004). Our results suggest that future research should address learning processes and should focus on learning from experience. Such a learning perspective can explicate the processes that lead to acquisition of knowledge and skills from experience. Learning goals and learning behavior may play an important role in this context. A process point of view on learning will also acknowledge that, in the face of rapidly changing environments, any specific knowledge is likely to have a decreasing shelf life (Reuber and Fisher, 1999). Some skills and knowledge will even have to be unlearned, that is, replaced by other and better knowledge and skills. Thus, a firm's willingness, effort, and capability to learn fast and continuously are likely to be a key to sustained competitive advantage. Besides learning behavior, other human capital aspects may become more relevant such as the construct of adaptive expertise (Smith et al., 1997) or the stream of experience (e.g., events that happen, which Reuber and Fisher (1999) contrast to the stock of experience).

Our results suggest strengthening the moderator approach to human capital. This is in line with Shane and Venkatraman (2000) who argued that successful opportunity recognition and exploitation depends on individual and situational characteristics. Future studies on human capital of entrepreneurs should not focus on the individual entrepreneur alone and thereby ignore situational characteristics that may affect the relationship between human capital and success. The moderator approach has important implications for a contingency theory of human capital. Potential contingencies may be the degree of other resources, such as financial resources (or presence of venture capital). The relationship between human capital and success may also depend on characteristics of the individual entrepreneurs themselves. For example, human capital can only result in high growth if the entrepreneur has the aspirations to expand the business (Wiklund and Shepherd, 2003). Moreover, people have different performance thresholds (Gimeno et al., 1997) that are in turn dependent on motivation (DeTienne et al., 2008). In general, the heterogeneity of effect sizes reported in our study suggests the necessity to specify the boundaries of the human capital–success relationship.

Our analysis yielded no difference of human capital effects between high and low-technology industries. Apparently, human capital is important in low as well as in high-technology industries. This result is in line with a study that did not find stronger human capital–success relationships in knowledge-intensive industries as compared to other industries (Bosma et al., 2004). While we do not suggest, that low and high-technology industries require the same kind and level of human capital, both industries may need a similar level of adaptability resulting in similar magnitudes of human capital–success relationships. However, human capital may very well lead to competitive advantages within certain industries in contrast to others because factors other than technology may play a role. It would further be interesting to investigate three-way-interactions. For example, a high degree of required specialization in high-technology industries may lead to higher effects of task-related human capital in high compared to low-technology industries.

The meta-analytic results revealed that effect sizes varied depending on the type of success measure — size was more highly related to human capital than growth or profitability. As far as we know, this has not been suggested by the literature. Thus, all of our remarks here are, by necessity, speculative. If human capital advantages accumulate over time, they should affect firm

performance in each consecutive year. Size may signify accumulated success or growth since start-up — at least for business owners who are also founders of their firm (Frese et al., 2007). Thus, it can be argued that size is an appropriate measure of success in newly founded businesses that start from zero (Eisenhardt and Schoonhoven, 1990). However, there are limitations involved in the prediction of size, for instance, size depends on the age of the enterprise as well as on the life cycle of the industry, issues that need to be addressed when predicting firm size. Profitability had the smallest relationship with human capital in our analysis. Most studies included in our analysis used a cross-sectional design. Moreover, most studies also operationalized profitability by measuring the firm's absolute profit levels instead of using relative profitability indicators such as ROS or ROA (cf. Table 3). Human capital may not affect immediate profits. Human capital affects opportunity exploitation, planning, and venture strategy (Baum et al., 2001; Frese et al., 2007), and such processes affect performance over time. Thus, if the effects of human capital evolve over time, using current profits as the success measure may represent a time-lag that is too short in the evaluation of how human capital affects success. Our research suggests that human capital theory might want to develop a more specific theory of how human capital relates to the different criteria of success.

Future operationalization of human capital should take the specific task requirements of the entrepreneurs into consideration. Studies included in our meta-analysis used measures of general education and general work experience in 81 cases. Such an assessment of general human capital is probably useful for predicting success of entrepreneurs throughout their life time. However, entrepreneurial success is often context specific and, therefore, needs to be predicted with task-specific human capital. Moreover, we found only 37 studies that measured outcomes of human capital investments. Direct assessments of knowledge and skills should be done more often, particularly if the goal is to evaluate a specific enterprise or whether or not an entrepreneur has the potential to run a high growth company. Such a knowledge and skills test requires a high degree of analysis of the specific tasks at hand in a particular environment.

6.2. Limitations

While meta-analysis is an answer to many problems inherent in narrative reviews of the literature it is not a remedy for all problems. Potential limitations include scope, influence of confounding variables, and publication bias. We took several measures to counteract potential problems. First, we limited our analysis to the population of active owners or copartners with main responsibility in the business and to human capital attributes included in the literature that can be experientially acquired. Second, we did a number of tests on potential confounds and discovered that these confounds did not produce artificial differences — these were not directly reported in our results; for example, there were no differences between dichotomous and continuous variables of success and between small and medium-sized firms. Third, file drawer analysis indicated that publication bias was not a problem. Moreover, we included many studies that merely used human capital as control variables: this is useful because these studies had no agenda with respect to proving a certain hypothesis.

Other potential limitations are linked to the limitations of primary studies. For example, none of the primary studies included an analysis of the survivor bias. This is, in principle, an important methodological issue because firm survival itself may be determined by human capital. The literature is controversial: some authors argue that owners with low human capital are more likely to fail (e.g., Bruederl et al., 1992). Other authors found that owners with high human capital and high performance thresholds are more likely to discontinue (Gimeno et al., 1997). This may result in lower reported effect sizes of human capital–success relationships. If both mechanisms are happening, the variance of the surviving firms is truncated. Reduced variance leads to reduced correlations of the variables (Hunter and Schmidt, 1990). Findings are therefore limited to surviving firms.

Our meta-analysis did not include survival and failure as success measures because there were not enough studies that operationalized survival and failure appropriately. While some studies suggest that there is a significant positive relationship between human capital variables and survival (e.g., Bruederl et al., 1992; Evans and Leighton, 1989; Gimeno et al., 1997), others have reported insignificant relationships (Bates, 1990; Cooper et al., 1994; Kalleberg and Leicht, 1991; Stuart and Abetti, 1990). However, many of these studies did not distinguish between success and survival and between failure and successful closure (Headd, 2003). Our results, thus, cannot be generalized to survival and failure of business ventures. A related problem inherently present in most of the included studies is the confusion of the level of analysis in human capital research (Davidsson and Wiklund, 2001). If human capital is an individual level construct, the entrepreneur would try to maximize individual level returns. Individual level returns are not necessarily achieved by firm-level performance (Gimeno et al., 1997). For example, some entrepreneurs may maximize their return by having multiple enterprises or even employment on the side. On the other hand, if the dependent variable reflects firm-level performance, human capital may be better assessed at the level of the firm and should, thus, examine the human capital level of the employees (Davidsson and Wiklund, 2001).

7. Conclusion

This meta-analysis provides a useful estimate of the true relationship between human capital and entrepreneurial success. The overall effect size was .098. While this effect size is small by statistical standards (Cohen, 1977), it is as high as, for instance, the correlation between planning and success ($r = .10$; Brinckmann et al., 2010). While traditional statistical reasoning may argue against the practical importance of such correlations, these correlations may well have important implications, as the field of medical meta-analyses has shown (Meyer et al., 2001). As a matter of fact, a correlation of .10 may well translate into a difference of a two times higher success rate in business owners with a high degree of human capital in comparison to those with a low degree of human capital (Rosenthal and Rubin, 1982).

Our study may guide practitioners in their evaluation of small businesses and may resolve some of the controversies surrounding investment decisions and human capital criteria. Investors are well advised to carefully choose from the pool of available human capital indicators. Just using any human capital indicator may be a poor advice given the overall effect size reported in our analysis. Our analysis suggests to rely on knowledge and task-related human capital and, thereby, considering the specific contextual requirements of the entrepreneur.

Future studies could build on our distinctions of human capital to directly assess incremental validities of different types of human capital. In addition to other success predictors selected human capital indicators may also increase the accuracy of prediction models and help practitioners in their decision process.

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