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Evidence-based Entrepreneurship: Cumulative Science, Action Principles, and Bridging the Gap Between Science and Practice

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Abstract

The concept and desiderata of an evidence-based entrepreneurship (EBE) is discussed as a strategy to overcome the gap between knowledge developed in the field of entrepreneurship and its use in practice. Evidence constitutes the best summary of knowledge based on several sources of information (several studies, several different research groups, several different methodological approaches, among them the best methods available) which clearly goes beyond individual

experience and a few isolated studies. We argue that meta-analyses can and should be used in entrepreneurship research (and that they should also be used to review qualitative studies). Meta-analyses establish certain relationships; these should then be summarized in well-founded models and theories that can be translated into action principles. These action principles can then be used by various users of EBE. Users of EBE can be scientists, professionals who regularly deal with entrepreneurs (bankers, consultants, venture capital providers), policy makers (e.g., government), students of entrepreneurship, and last but not least the entrepreneurs themselves. Once a set of action principles has been developed from science, their application can be tested with the help of further evidence on the efficacy of interventions (including meta-analyses on the interventions). Evidence-based entrepreneurship (EBE) has the potential to change research, teaching, and practice.

“The ideas of economists and political philosophers, both when they are right and when they are wrong, are more powerful than is commonly understood... Indeed the world is run by little else. Practical men, who believe themselves to be quite exempt from any intellectual influences are usually the slaves of some defunct economist It is ideas, not vested interests, which are dangerous for good or evil.”

(Keynes, 1953, p. 306)

1

Introduction

As described in the quote by John Maynard Keynes above, we assume that scientific knowledge often gets translated into practice without the practitioners even noticing their dependency upon those ideas. The task of science is to generate new knowledge, to answer essential questions, and to develop a good knowledge base that can make practice more effective and efficient and that protects practice from making wrong decisions. To accomplish these tasks, science typically produces scientific models and theories to integrate knowledge, conducts empirical studies, and reports incremental new knowledge. To help these tasks, science provides literature reviews on the current state of scientific knowledge and on the scientific knowledge of the efficacy of interventions. In short, the function of science is to produce evidence for propositions and to integrate this evidence into some kind of systematic theory or model. An important function of science is to support practice in becoming more effective and efficient. To do this it needs to develop good methods of summarizing the current knowledge and to develop interventions; these interventions should be derived from the most current scientific knowledge and should be more effective than traditional interventions.

4 Introduction

In this article, we would like to introduce the concept of evidence-based entrepreneurship (EBE), discuss the implications of EBE, and sketch out its opportunities and limitations. The users of EBE can be the scientists themselves, professionals who deal with entrepreneurs, policy makers whose policies affect entrepreneurs, students of entrepreneurship, and last but not least the entrepreneurs themselves.

As a first definition, evidence is the best summary of knowledge based on several sources of information (several studies, several different research groups, several different methodological approaches, among them the best methods available). Evidence in this sense goes beyond individual experience and a few isolated studies. Basically, what we are suggesting in this article is to go beyond the $N = 1$ of personal experience (N stands for persons involved), the $N = 2 - 3$ of case descriptions or benchmarking (in this case, the N stands for number of companies that form the base for evidence), the $k = 1$ of policy suggestions (k stands for number of studies done), and the idea that the one “good study tells it all”. All too often people rely on their own (limited) experience to make important decisions, they rely on a few successful examples (often in the sense of benchmarks), and policy makers often rely on one study or only a very few that they happen to have commissioned, and scientists all too often believe that only one or a few good studies really explain everything important about an issue.

We shall present an alternative viewpoint — an evidence-based approach that provides practical suggestions and good knowledge for practitioners. Much of the following exposition is related to the idea of meta-analysis. It is sufficient at this point to say that a meta-analysis is a quantitative review of the scientific literature (more details in Section 3). It is a systematic review as the literature is searched systematically and it is a complete review because all the existing empirical literature goes into the review. By providing a quantitative review of several articles, a meta-analysis can help us to decide how strong certain relationships are, how often a relationship consistently appears across studies, and how much we can trust the methodological rigor of the research. A meta-analysis provides the best available type of

evidence because it goes beyond one methodology, one study, and one researcher.

EBE provides a great opportunity that is relevant for practice and policy while strengthening the empirical and theoretical bases of entrepreneurship research (Rauch and Frese, 2006). Practice can never be fully based on evidence; therefore, we talk about evidence-**informed** practice and evidence-**based** research suggestions. By developing evidence-based entrepreneurship, we also heed recent calls in general management to advance evidence-based management (Pfeffer and Sutton, 2006; Rousseau, 2006; Rynes et al., 2007; Tranfield et al., 2003), and we think of EBE as one part of this emergent development. Both management and entrepreneurship show a gap between knowledge and practice — the knowledge-doing gap (Pfeffer and Sutton, 2000). Managers as well as entrepreneurs or professionals who deal with entrepreneurs (such as bank employees, business angels, analysts, policy makers, etc.) often fail to take note of scientific evidence when making decisions. Empirical research has shown that managers often take actions that are uninformed and sometimes even diametrically opposed to empirical evidence (Rynes et al., 2007). In the area of entrepreneurship, one can often hear open disdain for scholarly work because professors have not yet “made their first million” — the foremost argument seems to be that only experience counts. We suggest that professionals who deal with entrepreneurs can profit from evidence-informed practice. For example, venture capitalists often work with models developed from their individual and idiosyncratic experiences as a base for their funding decisions; meta-analyses show that the efficacy of selection of good entrepreneurs of venture capital providers is often very low (Rosenbusch et al., 2010).

Institutions that are supposed to support entrepreneurship often develop policies that have not been adequately empirically tested. For example, the German government spent millions of Euros in East Germany to develop networks for small businesses. This was done as a result of a few studies showing a relationship between social network size and entrepreneurial success. However, there are no systematic meta-analyses on this issue so that one can compare different

approaches of improving entrepreneurship. Moreover, the studies did not examine whether networks were useful for only those businesses owner who had actively developed their own networks: in these cases, an active approach with high initiative is the variable that causes network size and success (Frese, 2009; Zhao et al., 2010b). This is not an isolated example. Many countries invest many millions of dollars into programs for their small business owners. Most of them do not develop evidence on whether or not these programs (or which part of them) are successful.

Similarly, textbooks do not teach EBE. For example, a cursory look at popular textbooks of entrepreneurship (from the years 2007 to 2011) shows that not one single book we examined even mentioned meta-analyses in its index. This is not surprising because there are still few meta-analyses despite calls for these analyses in the area (Rauch and Frese, 2006) (a simple search for entrepreneurship and meta-analysis in Business Source Premier produced a number of published or in press meta-analyses, cf. Table 1.1; more on this later). Often, meta-analyses have direct effects on how students are educated. For example, there has been a controversial debate on whether or not business plans are useful. Meta-analyses have settled this issue — there is clear evidence for business plans to be useful (Brinckmann et al., 2010; Schwenk and Shrader, 1993). However, the relationships between preparing formal business plans and success are highly variable across studies. Thus, it may be necessary to search for moderators of this relationship (moderators are variables that influence the basic relationship between planning and entrepreneurial success in this case). Thus, students (and educators) should be encouraged to experiment, how to teach and learn business plans, and how to implement business plans and to evaluate these experiments. Moreover, there may be some cases in which plans do have negative consequences; one conclusion from a meta-analysis may be that such negative cases need to be studied and respective theories on positive and negative effects of planning need to be developed.

It is surprising how often recommendations, suggestions, curricula, and policies are developed without recourse to rigorous objective studies and meta-analyses. Most of the recommendations in

Table 1.1. Meta-analyses in entrepreneurship research.

References	Meta-analysis or systematic review	Content
Mwasalwiba (2010)	Systematic review, vote counting	$K = 108$, semi-systematic literature review. The study addresses educational objectives, target audience, teaching methods, and impact indicators.
Henrekson and Johansson (2010)	Systematic review, vote counting	$K = 20$, semi-systematic literature review; although different definitions of gazelles exist, segments of all industries have fast growing firms that are usually young.
Westlund and Adam (2010)	Systematic review, vote counting	$K = 65$; study investigates relationship between social capital and economic performance for different levels: on firm level (including households) strong evidence for positive relationship, contradictory results of studies on national and regional levels; results based on narrative review and vote counting only.
<i>Personality and entrepreneurship:</i>		
Stewart and Roth (2001)	Meta-analysis	$K = 14$ samples, the difference between managers and entrepreneurs is $d_c = 0.36$. Moderators identified include type of entrepreneur and type of risk assessment. (Note: d is used here.)
Miner and Raju (2004)	Meta-analysis	$K = 28$ studies, $d = 0.12$, ns. This article opened a meta-analytical dispute with Stewart & Roth (2001/2004) about the risk propensity differences between entrepreneurs and managers. (Note: d is used here.)
Stewart and Roth (2004)	Meta-analysis	This study is a response to Miner and Raju (2004). The combined results of $K = 18$ samples revealed an effect size of $d_c = 0.23$. Notably, projective measures of risk-taking produced negative effects, while objective instruments produced positive effects. (Note: d is used in this study.)
Collins et al. (2004)	Meta-analysis	$K = 41$, need for achievement correlated with career choice $r_c = 21$ and performance $r_c = 0.31$.

(Continued)

Table 1.1. (Continued)

References	Meta-analysis or systematic review	Content
Stewart and Roth (2007)	Meta-analysis	$K = 17$, analysis indicates that entrepreneurs are higher in achievement motivation than are managers; differences are influenced by the entrepreneur's venture goals, by the use of U.S. or foreign samples, and, to a less clear extent, by projective or objective instrumentation; when analysis is restricted to venture founders, difference between entrepreneurs and managers on achievement motivation is substantially larger.
Zhao and Seibert (2006)	Meta-analysis	$K = 23$, classified studies along the Big Five Personality traits. Effect sizes ranged from $d_c = .45$ (conscientiousness) to $d_c = -0.37$ (neuroticism). Some facets of the Big Five Traits produced higher effect sizes (achievement). (Note: d is used in this study.)
Rauch and Frese (2007)	Meta-analysis	$K = 62$ for business creation and $K = 54$ for business success. Effect sizes were stronger for traits matched to the tasks of entrepreneurs (e.g., $r_c = 0.238$ for matched traits and business success and $r_c = 0.027$ for nonmatched traits). The traits matched to entrepreneurship correlated well with entrepreneurial behavior (business creation, business success), such as need for achievement, generalized self-efficacy, innovativeness, stress tolerance, need for autonomy, and proactive personality.
Zhao et al. (2010a)	Meta-analysis	$K = 66$; discusses intention to entrepreneurship and performance of entrepreneurial unit; some overlap with Rauch and Frese, 2007; however, constructs are coded as to where they would fall to the Big Five Factors.
<i>Planning and entrepreneurial success:</i>		
Schwenk and Shrader (1993)	Meta-analysis	$K = 14$, strategic planning correlates positively with growth and return, $d = 0.20$. Further, the results indicate the presence of moderators. However, the authors did not attempt to identify such moderator variables.

(Continued)

Table 1.1. (Continued)

References	Meta-analysis or systematic review	Content
Boyd (1991)	Meta-analysis	$K = 29$; moderate correlations between planning and nine performance measures; the overall effect of planning on performance is $r = 0.151$; largest effect sizes are produced for earnings per share growth ($r = 0.282$) and sales growth ($r = 0.246$); smaller effect sizes are found for return on investment ($r = 0.105$) and return on equity ($r = 0.081$); growth measures revealed very wide ranges of estimates across studies, profitability measures generally yielded smaller, but more consistent effect size measures.
Miller and Cardinal (1994)	Meta-analysis	$K = 26$; planning positively related to growth ($r = 0.17$) and profitability ($r = 0.12$); results suggest that methods factors are primarily responsible for the inconsistent planning-performance findings reported in the literature.
Brinckmann et al. (2010)	Meta-analysis	$K = 51$. Average $d_c = 0.20$ between business planning and firm performance; moderator analyses show that established firms have higher effect sizes $d_c = 0.24$ ($k = 36$) than new firms $d_c = 0.13$ ($k = 15$); there is no difference in effect sizes between business planning outcome (having a business plan) and business planning process (doing planning along the way).
<i>Resources, primarily human resources and success:</i>		
Crook et al. (2008)	Meta-analysis unclear how large SMEs or entrepreneurial companies	$K = 125$, Overall for resources with firm performance $r_c = 0.22$; human resources $r_c = 0.30$, tangible resources $r_c = 0.08$, and intangible resources $r_c = 0.24$.
van der Sluis et al. (2005)	Meta-analysis unusual methods used, combining vote counting with regression-analysis	$K = 203$; results cannot be compared to the usually used corrected correlations. One year additional education in developing countries increases enterprise income by 5.5%.

(Continued)

Table 1.1. (*Continued*)

References	Meta-analysis or systematic review	Content
Unger et al. (2011)	Meta-analysis	$K = 70$, overall relationship between human capital and success $r_c = 0.098$. Effect sizes were higher for human capital outcomes, for task related human capital, for young businesses.
Read et al. (2009)	Meta-analysis, search restricted to JBV 1985–2007	Tests four predictions of effectuation. Means based, better resources lead to better outcomes (tested in what I know, who I am, whom I know) with effect sizes of $r_c = 0.11$ ($k = 24$) to 0.23 ($k = 10$); partnership: $r_c = 0.17$ ($k = 14$); affordable loss: nonsignificant; leverage contingency $r_c = 0.07$ ($k = 5$).
Daily et al. (2003)	Meta-analysis; however, strategy of selecting articles not described and unclear whether and how independence of samples was assured	$K = 241$. Average $r_c = 0.022$ with a high variance; this means that direct relationships of various predictors of underpricing of IPOs are zero (e.g., risk factors and underpricing or prestige of underwriter and underpricing).
Martin et al. (2012)	Meta-analysis	$K = 42$. Average $r_c = 0.217$ for education and training with entrepreneurship-related human capital assets. Education and training with entrepreneurship outcomes $r_c = 0.159$. Nonrandom assignment $r_c = 0.212$ and random assignment $r_c = 0.156$ with entrepreneurship outcomes; thus methodological rigor leads to lower correlations.
<i>Various strategy topics:</i>		
Combs and Ketchen Jr. (2003)	Meta-analysis unclear how large SMEs or entrepreneurial companies	$K = 44$, 10 hypotheses, general support for agency theory; no relationship between franchising and growth; no relationship between resource scarcity and franchising.
Bausch and Krist (2007)	Meta-analysis	$K = 41$, overall relationship between internationalization and performance was low $r_c = 0.059$; US-American companies were more successful ($r_c = 0.128$) than European ($r_c = 0.081$) and Japanese firms ($r_c = 0.009$) to reap benefits from internationalization.

(Continued)

Table 1.1. (Continued)

References	Meta-analysis or systematic review	Content
Song et al. (2008)	Meta-analysis new technology ventures	$K = 31$, 4 years survival rate: 36%; frequently factor meta-analyses are based on very few studies and therefore, confidence interval includes 0; clearest positive results for market scope, financial resources, firm age, patent protection, size of founding team, supply chain partnering ($k < 5$ results not listed here.)
Rauch et al. (2009)	Meta-analysis	$K = 53$ samples, overall relationship between entrepreneurial orientation and performance $r_c = 0.242$. Effect sizes are highest for micro-businesses and for high tech businesses. Additional moderators are suggested.
Rosenbusch, Brinckmann & Bausch (2011)	Meta-analysis	$K = 42$, innovation has a positive effect on the performance of SMEs ($r_c = 0.13$); innovation-performance relationship positively influenced for new ventures (compared to mature firms) and cultures with low/medium individualism. Further moderators are related to type and measurement of innovation: internal/external, innovation process input/innovation process output.
Rosenbusch et al. (2010)	Meta-analysis	$K = 65$, overall a very low but significant correlation of $r_c = 0.075$ of VC money in the firm vs not and returns for these companies. When industry is controlled, this correlation becomes 0 which means that VC firms are not able to predict returns for the firms but are able to predict industry returns.
O'Boyle et al. (2011, in press)	Meta-analytic path model	$K = 95$, there is not relationship between family involvement the firms' financial performance ($r_c = 0.006$) — none of the moderator effects tested by the authors was significant; thus family involvement per se does not produce competitive advantages or disadvantages.
Rosenbusch, Rauch & Bausch (2011, on-line)	Meta-analytic path analysis	$K = 8-73$, this is a meta-analytic path model showing that the effects of the environment (munificence, dynamism, and complexity) on success are mediated by entrepreneurial orientation.

entrepreneurship are either based on individual studies (often completed by the person recommending the policy) or they are based on so-called narrative reviews — reviews that present the considered opinion of somebody who has studied the literature. The narrative reviews often draw conflicting conclusions about the evidence making it difficult for practitioners to rely on scientific evidence.

2

The Concept of Evidence

2.1 Evidence-Based Medicine as an Example

Recently, the first author went to a physician for a painful knee condition. The physician prescribed some medicine and suggested that his experience proved that it would help well. When the first author looked up the medicine in the abstracts of the Cochrane Foundation, he found that this drug had been shown not to be efficacious, and he threw it away (by the way the drug was also shown not to have any negative side effects — thus, the physician may have been right in prescribing it to patients as a placebo — but more likely than not, the physician did not know that it worked only as well as a placebo). This incident provides a good example of how customers of professionals can use information that is accessible and that constitutes the best summary of current knowledge in a field. The publicly accessible abstracts of quantitative reviews on the Cochrane website provide the best available evidence. The Cochrane website displays several thousand systematic reviews (most of them meta-analyses) in medicine; in addition, there are several thousand additional meta-analyses in the other medical literature.¹

¹In addition, there is also a social science website that is similar to the Cochrane foundation; unfortunately, the Campbell collaboration is not as prolific as the Cochrane foundation.

Evidence-based medicine — defined as “the process of systematically finding, appraising, and using contemporaneous research findings as the basis for clinical decisions” (Rosenberg and Donald, 1995, p. 1122) — has quickly developed into an accepted approach to practice in medicine. Similarly, clinical psychology, criminology, nursing, education, and work and organizational psychology have started to use meta-analyses to answer important questions of theory and practice.

2.2 What is Evidence in Entrepreneurship?

“Evidence in the broadest sense, refers to anything that is used to determine or demonstrate the truth of an assertion” (Wikipedia on evidence, <http://en.wikipedia.org/wiki/Evidence>). It corresponds to the term empirical corroboration in scientific theories (Hempel, 1970). Thus, an assertion has to be tested so that there is evidence in the sense of objective and unbiased knowledge. We have already established that good evidence should be based on several studies and several observations rather than only on one observation or on one study. Since every study has its own problems, good evidence needs to be based on a summary of several studies.

Compared with other areas of research, such as medicine, criminology, education, and work and organizational psychology, the area of entrepreneurship has produced comparatively few meta-analyses. This is all the more problematic because entrepreneurship research is often utilized in the support of policy decisions, for example, in tax decisions or in general government decisions.

Apparently, it was easier to introduce evidence-based approaches in medicine. One of the most important events was the article by Antman et al. (1992) that pointed out how many lives could have been saved had medicine used cumulative meta-analysis to test certain drugs, thus allowing an earlier onset of the use of these drugs.

Calls for evidence-based management and entrepreneurship argue that it would help economic development if entrepreneurs, companies, and policy makers would take an evidence-informed approach in their day-to-day management (Pfeffer and Sutton, 2006). However, entrepreneurship research seems to be so different from medicine.

Tranfield et al. (2003) have discussed the differences between medicine and management which also apply to entrepreneurship research. Medicine is not only more cohesive in its epistemological approach but it is also more formalized. In contrast, entrepreneurship research is much less cohesive in its approach; there are lively debates on the best empirical approach in entrepreneurship. Entrepreneurship research emphasizes the influence of the specific context on whether entrepreneurial decisions are effective or not. The most important difference is certainly that medicine examines interventions with the help of randomized controlled experiments — as a matter of fact, many protocols used in the most famous site for systematic reviews and meta-analyses — the Cochrane foundation — eliminate those studies that are not based on controlled, randomized experiments from their database utilized in their meta-analyses. In contrast, most research in entrepreneurship is based on field studies that need to control for alternative explanations — even longitudinal studies are rare in entrepreneurship research. Moreover, large-scale data sources are often “milked” by several research groups, leading to a high alpha error in their research (assuming that something is true although it is not); there is often less emphasis on developing new databases than on developing new theoretical approaches to analyze the same data set again.

When it comes to interventions, there are practically no controlled, randomized experiments that have been done in entrepreneurship research. We agree with recent calls for more of such experiments in management and entrepreneurship (Reay et al., 2009). However, meta-analyses need to utilize the empirical articles that exist; and in entrepreneurship the typical research is based on a correlational approach and only infrequently on interventions. All of this speaks against using the medical analogy in entrepreneurship research. EBE may be better off following the example of other disciplines on how to do meta-analyses; the better model for entrepreneurship research may not be the medical field but work and organizational psychology (Anderson et al., 2001; Hodgkinson et al., 2001). Work and organizational psychology often systematically compares different theoretical approaches and different methods; work and organizational psychology is also often based on nonexperimental field studies or on quasi-experiments; in field

studies, the question is often asked whether a new construct will add explained variance in a dependent variable of importance. It makes sense to ask the question of whether an additional predictor (derived from theory or from empirical evidence) explains additional variance in comparison to known predictors in the area of entrepreneurship research (a good example of this kind of use of meta-analysis in work and organizational psychology is presented by Schmidt and Hunter, 1998).

Theory testing on full models can also be done on the basis of meta-analyses. In order to test whole theories, researchers may choose not only to present correlational results of two variables but also to base meta-analytic regression analyses on meta-analytically derived correlation matrixes that can then support meta-analytic path analyses to test theoretical models. Such meta-analyses are particularly useful for examining mediation effects (Colquitt et al., 2007; Shadish, 1996; Viswesvaran and Ones, 1995) and to test full theories (Cheung and Lau, 2008).

EBE is not restricted to performing meta-analysis; EBE involves tracking good empirical evidence for practical and theoretical questions. But what constitutes “good empirical evidence”? Most evidence-based approaches posit some kind of hierarchy of evidence — often ranging from anecdotal evidence provided by experts, via consensus by experts, up to meta-analysis. We recommend using the ideas developed in clinical psychology (based on (Chambless and Hollon, 1998)):

- The important relationship has to be shown to exist in at least three studies from at least two different research groups.
- Causal analysis has to be done on the basis of longitudinal studies that exclude plausible alternative hypotheses or by developing evidence on the basis of randomized experiments.
- Outcome measures have to come from different sources than the independent variables, and all measures need to be reliable and valid.
- Clear definition of samples has to be given.

- If there is conflicting evidence, meta-analytic evidence possibly explains, with the help of moderators, why conflicting evidence should be provided.
- In addition to quantitative research, there should be qualitative case material that describes the configurational and contextual situations under which a certain intervention may work.

Clearly, we need to be skeptical towards “naïve” forms of evidence. “We’ve ... suggested no less than six substitutes that managers ... often use for the best evidence — obsolete knowledge (college education obtained many years ago, the authors), personal experience, specialist skills, hype, dogma, and mindless mimicry of top performers ...” (such as benchmarking) (Pfeffer and Sutton, 2007, p. 16). In other words, Pfeffer and Sutton thought that the best evidence most managers rely on is often not a good evidence. The most important evidence that people fall back on is most likely own experience — falling back on one’s own experience is an example of the availability bias described by Tversky and Kahneman (1973). Experience per se has been shown to be limited in its usefulness. It largely depends on how broad and intensive the experiences are. If the experiences were relatively uniform, the learning curve levels off after a few months and, thus, little additional learning takes place. Research comparing top performers with average performers has shown that experience is only valuable if it is highly varied (Sonnentag, 1998) or based on so-called deliberate practice — a form of learning strongly oriented toward practicing those parts of the skills that need to be improved for perfecting the skills (Ericsson et al., 1993; Sonnentag and Kleine, 2000; Unger et al., 2008, 2009). Thus, it is highly questionable to use one’s “simple” experience as evidence. Consensus of experts is often also skewed and based on biases; for example, a few years ago a certain consensus was reached among entrepreneurship researchers that personality plays little role for the success of entrepreneurs (prior to the publication of meta-analyses showing this consensus to be false — more on this later).

3

Meta-Analysis

3.1 The Usefulness of Meta-analyses and Systematic Reviews — Comparison to Narrative Reviews

Meta-analyses can be compared to the other major approach for accumulating knowledge — the narrative review. The scientific field of entrepreneurship tends to produce many narrative reviews with their accompanying problems. The psychology of decision making has shown that nonquantitative judgment (often called clinical judgment) is inferior to statistical decision making (Grove and Meehl, 1996). This is also the case when we summarize the literature. Narrative literature reviews put together the literature in an unsystematic and often biased way (e.g., emphasizing or restricting the search to only some journals and not starting out the literature search in a systematic and all-encompassing fashion; not developing a codebook with search terms, etc.). After the articles are assembled for the review, the summarizing of the literature may also be influenced by stereotypes and biases because of our cognitive and emotional constraints (Hunter and Schmidt, 2004). Memory load is very high when summarizing a voluminous literature; we need strategies to reduce memory load. One such strategy is that scholars tend to keep in mind those studies they regard as better

than others. This influences their thinking about the whole body of the literature. Also, reviewers of the literature have theoretical preferences for certain studies, study designs, choice of operationalization, etc. (often colored by their own studies, their own experiences, and their professional background). Narrative reviews tend to produce conflicting conclusions of the literature, making it difficult for practitioners to rely on scientific evidence (please note that meta-analyses can also come to different conclusions; however, since every step of the meta-analysis can be reproduced, these differences can often be resolved (examples include Judge et al., 2001; Stewart and Roth, 2004).

Narrative reviews are often influenced by some particularly good studies — after all, should we not be just influenced by the very best studies and leave others aside? This sounds plausible but it is not. There is simply no perfect study (Hunter and Schmidt, 2004, p. 17), because every study has its own sampling error (random deviations from the true value of the population), error of measurement (both objective and subjective measures include errors), and deviation from high validity; there are internal validity problems, range restriction, and issues of generalization (Scherpenzeel and Saris, 1997). All of these factors make it unlikely that any one study or a set of small, very good studies can overcome all the potential problems. Therefore, reviewers need to include all studies into a meaningful summary of the literature, and they should correct for systematic problems inherent in the studies. Thus, good evidence implies that we need to look at the convergence of knowledge from several studies (and preferably from *all* studies). Any given set of studies will show an approximation to a normal curve around a mean of relationships. The overall set of studies tends to cancel out the weaknesses of each individual study. In other words, the whole set of empirical findings has a higher likelihood to identify the true effect than any single study.

There are also so-called systematic reviews that do not perform a meta-analysis: such a review uses the same procedure as the meta-analysis that is evident in its attention to finding the studies. However, in contrast to a meta-analysis, it usually counts the number of significant results (so-called vote counting). Systematic reviews are useful because they are careful to base their conclusions on many studies: they

approach the selection of the reviewed studies systematically without leaving out studies that need to be included — inclusion criteria on eligibility and relevance of articles are developed before the start of the literature search. Unfortunately vote counting has disadvantages in comparison to a meta-analysis. Many studies may not show significant effects — this may be less so because in reality there is no correlation in the population but because researchers are constrained by lack of time and resources they, therefore, rely on small samples. Significance tests are influenced by the statistical power, which depends on sample size. Therefore, a high number of nonsignificant findings may be an artifact of the low sample size of these studies. Power is usually not configured into the mental formula that narrative reviews use. We suggest, along with others (Combs et al., 2011; Rynes et al., 2007), that it is better to use meta-analytic procedures (which should always include a systematic search for articles) because they cannot fall prey to the above-mentioned problem of power issues and reliance on vote counting of significant results.

3.2 An Example: Meta-analyses and Narrative Reviews in the Area of Personality and Entrepreneurship

An interesting example is found in the area of personality and entrepreneurship. Narrative reviews had concluded from the literature that personality of the founder/manager/owner are unimportant for starting a firm or for the success of the firm (Aldrich and Widenmayer, 1993). Gartner (1989) concluded from such a narrative review: “I believe that . . . a focus on the traits and personality characteristics of entrepreneurs will never lead us to a definition of the entrepreneur nor help us to understand the phenomenon of entrepreneurship” (p. 48). Gartner’s conclusion can be examined by meta-analysis. First, the meta-analysis would have to establish if there is correlation between personality and entrepreneurship at all; entrepreneurship would be defined according to whether people started a company or did not (e.g., by comparing managers with owners of start-up firms) and whether personality is related to entrepreneurial success. Most likely, the average correlation between all sorts of personality traits and

entrepreneurship is very small because some personality traits are related to entrepreneurship and others are not. Moreover, different studies probably produce different results; thus, heterogeneity of the correlations is high. Meta-analysis has indeed shown that some traits show sizeable correlations but that other correlations with personality are low (Rauch and Frese, 2007; Zhao and Seibert, 2006). This seems to corroborate the conclusion that it does not pay off to search for personality factors. However, once one examines the precise question of Gartner (“understand the phenomenon of entrepreneurship”), the results become more interesting. Personality theory (Tett and Guterman, 2000) suggests that a personality factor can only have a positive effect on entrepreneurial outcomes if the personality factor matches the tasks of the entrepreneur. Once this differentiation is made, the results are eye-opening: Rauch and Frese (2007) asked entrepreneurship researchers which personality factors are matched to the tasks of entrepreneurs and which ones are not (and provided a list of such traits). For example, traits like generalized self-efficacy, need for achievement, and proactive personality were rated by experts to be matched with the tasks of entrepreneurs, while traits such as dogmatism, shyness, and rigidity were not matched with entrepreneurship. When matching to entrepreneurial tasks is used as a so-called moderator in the meta-analysis, the results become quite clear: those traits not matched show a low correlation to business creation and business success, while personality factors that are matched to entrepreneurship produce a sizeable correlation with business creation and business success (Rauch and Frese, 2007). If one looks at the most clearly matched traits — need for achievement, proactive personality, and generalized self-efficacy, the correlations are much higher and reach 0.23 (need for achievement and business success) and even 0.34 (generalized self-efficacy and business creation) (Rauch and Frese, 2007, p. 367). When a further differentiation into cultures with high performance orientation and cultures with low performance orientation is made, there is a higher correlation of need for achievement with starting a company (Zhao and Seibert, 2006) in high performance cultures. It should be added that comparing the results of the meta-analysis on personality and entrepreneurship with, for example, medical meta-analyses shows

personality to have comparably high predictive validity. The correlation between need for achievement or generalized self-efficacy and business success is similar to the relationship of taking sleeping pills and temporary relief of insomnia or of the effectiveness of Viagra for the sexual functioning of men (Meyer et al., 2001); these medications tend to be on the high side of medical interventions.

Thus, entrepreneurs have a higher need for achievement, and they show more innovativeness and internal locus of control compared to other populations (Collins et al., 2004; Rauch and Frese, 2007). These personality traits are additionally related to business success. Therefore, the empirical evidence leads to the conclusion that all of the individuals who called for the end of doing research on personality traits for lack of important relationships with entrepreneurship were clearly wrong. Why have narrative reviews been so wrong? The answer is that simply there is lots of distracting “noise” in the data: some relationships are, indeed, very small. The empirical literature is messy. Many studies just threw all sorts of personality variables and all sorts of dependent variables into a correlation matrix — with the result that all of these correlations appeared to be quite small. Moreover, there are large variations in the size of the reported relationships, and many studies are based on small samples. All of this made it difficult to detect the true relationships. Thus, it was not the inability of the narrative reviewers but the problem of the narrative review itself that led to the erroneous report.

Drawing wrong conclusions from narrative reviews clearly had negative effects on research and practice. Because researchers and practitioners were so convinced that personality plays little role for entrepreneurship (Aldrich and Martinez, 2001), governments invested (like the German government) into developing networks for entrepreneurs without testing the hypothesis that the effects of networks was dependent upon the entrepreneurs’ personality (Klein et al., 2004); obviously, if network effects are a spurious effect of personality, government help for networks would not increase entrepreneurial success. Moreover, selection of entrepreneurs (e.g., for sparse starting capital by banks) was not aided by personality tests; rather rough indicators of human capital

were preferred that clearly demonstrate much smaller correlations with success (Unger et al., 2011) than personality.

3.3 How to Conduct and Interpret Meta-analyses in the Field of Entrepreneurship

The function of science is to reduce biases and in this way to increase the quality of the evidence; history of science shows that there has been a consistent trend to drive the process of reducing biases. Bias is reduced when there is high methodological transparency so that others can reproduce the findings when they use the same procedure. The meta-analytic approach is just one more way to help with this endeavor. The starting point of any meta-analysis is to ask a relevant research and practice question. At this stage, it is often useful to consult with colleagues on whether that particular field is ready for a meta-analysis (e.g., is there a large enough body of empirical articles?) and which differences of measures and concepts may appear. It may also help to ask practicing entrepreneurs or consultants about the questions that are important for them. Once the research question has been determined, a systematic search for articles follows (every meta-analysis implies that there is a systematic search for articles). First, one needs to develop a codebook with all the terms used in scientific articles that are related to the current research question. Also, it is necessary to search widely and systematically to finding both published and unpublished articles (unpublished articles need to be included to be sure that a potential publication bias does not lead to skewed results). Moreover, both methodologically weak as well as strong articles should be included (however, methodological weakness should be coded) — thus, it is counterproductive to search for articles from only prestigious journals or articles utilizing only the most sophisticated methods because it is better to examine empirically whether methods lead to different results — otherwise biases (on what constitutes a good study, etc.) may influence the search process. Once all the articles are assembled, there has to be a clear guideline to aid in determining the articles which need to be excluded: articles that may use the same terminology but

are really based on a different conceptual or operational approach to the research question, articles that do not report effect sizes or equivalent empirical indicators, articles that use the same sample as another article. All criteria that lead to inclusion or exclusion of articles have to be systematically developed and clearly described. In case of doubt, the meta-analysis should be as inclusive as possible because one can empirically test whether different methodology, different operationalizations of the dependent and independent variables, and different conceptualizations of key concepts lead to different results (moderator analysis). In the end, the researcher needs to have a large enough number of independent samples available (a rule of thumb may be that at least 10 independent empirical samples should be available as a literature base for a meta-analysis).

In entrepreneurship research a large body of knowledge is based on qualitative studies. This has led some scholars to argue against meta-analyses because they are solely based on quantitative studies. Fortunately, the instrument of meta-analysis is so versatile that qualitative studies (e.g., case studies) can be coded so that they can also be meta-analyzed (Bullock and Tubbs, 1990; Larsson, 1993). We believe that the instrument of meta-analysis may be even more important for qualitative studies in entrepreneurship than for quantitative ones, so that researchers can move from a knowledge-detecting mode (e.g., in the sense of grounded theory) to examining the evidence for specific hypotheses for qualitative material.

Once the studies are collected, the next task is to combine the empirical material quantitatively. The two most widely used methods in entrepreneurship research are the Hunter/Schmidt and the Hedges/Olkin procedures. Effect sizes come in two forms — in the form of correlation coefficients and in the form of d . In most studies, either Pearson product moment correlations or Spearman correlations are used. The effect size d is often used in experimental studies (a d is defined, e.g., by Cohen as $d = (x_1 - x_2)/s$). Fortunately d and r can be easily transformed into each other. Frequently, other effect size estimates such as t values, F values, z values, or p values can be transformed into Pearson correlations to be used in quantitative integrations. Respective formulas may be found in Hunter and Schmidt (2004) and Rosenthal

and DiMatteo (2001). Hunter and Schmidt (2004) suggest correcting correlations for the various artifacts, the sample size, reliability, and selection effects. The sample size-weighted mean correlation is subsequently tested for significance, usually by means of confidence intervals (Hunter and Schmidt, 2004). All of this then leads to one number — the corrected correlation between two variables across all studies — this relationship is then the best approximation to the true relationship in the population. Newer techniques allow taking into account random and nonrandom measurement errors and also regression coefficients (Cheung and Lau, 2008).

Theoretically and empirically, an important question is whether meta-analytic results are homogenous or not. Homogeneity implies that the relationship is generalizable across different studies. In other words, the differences between the studies are due to random factors or due to statistical artifacts but not due to real differences. In other words, homogeneity implies that all of the studies are sampled from the same population of studies. There are various empirical indicators of the homogeneity of the effect sizes used by meta-analyses (Q -statistics, credibility interval, and the 75% rule discussed above). The 75% rule of thumb means that statistical artifacts account for 75% or more of the variance of observed correlations and the remaining variance is then assumed to be likely due to artifacts not corrected for (Hunter and Schmidt, 2004). If a population of correlations can be considered homogenous, it is unlikely that methodological or substantive moderator variables have caused variation in the correlations and, therefore, results are generalizable across studies.

However, most frequently the relationships uncovered by meta-analyses in entrepreneurship are heterogeneous. As a matter of fact, most of us have seen primarily heterogeneous relationships in our meta-analytic entrepreneurship research. Once heterogeneity of results is established, it makes sense to search for moderators (and it makes sense for researchers in the area to search for moderators in future research). For practitioners, it means that they can and should experiment with which conditions have an effect.

Moderators are of particular importance in entrepreneurship because the context often decides whether a certain idea will work

or not. For example, human capital is more important for success in developing countries than in the developed world (Unger et al., 2011). Therefore, the role of moderators is essential in entrepreneurship research. There are different approaches for testing moderators (Hunter and Schmidt, 2004; Geyskens et al., 2009). One approach is to split the moderator at meaningful points and then to calculate the correlations for each subgroup. Since the moderator is a moderator on studies, the studies need to be grouped into meaningful subsets and for each subset the average correlation is then established. Specific moderator variables are confirmed to cause effect size variation if true score correlations differ meaningfully across meta-analytic subsets and if, on average, a higher percentage of variance is accounted for by artifacts across subsets than in the respective superordinate set. For example, there are some studies that examine the correlation of human capital with entrepreneurial success in developed countries and some studies that use the same design in developing countries. One can thus compare the correlations between these two groups of studies and find that, indeed, human capital is much more important (significantly) in developing countries than in developed countries (Unger et al., 2011).

The alternative approach for moderator analysis within a meta-analysis was proffered by Hedges and Olkin (1985) and involves regression analyses. In this case, the correlations of the samples are used as dependent variables while the moderators (e.g., study and sample characteristics such as type of method applied or type of firm studied) serve as predictors in the regression equation. The key strength of this approach lies in analyzing the moderator variables simultaneously in the same model. Since the moderators may be correlated with each other, the relative explanatory power of each contingency variable can be adequately assessed (an example is Miller and Cardinal, 1994).

Both the approaches, i.e., to produce subsets and to report their average correlations and the regression approach, can and should often be used concurrently, because they provide answers to different questions — the subset approach (Hunter and Schmidt, 2004) relates the size of the correlations for different values of the moderator; the regression approach answers the question of how important each

moderator is among the set of moderators that were examined in this particular study. Since the regression approach is strongly affected by the moderators which can and have been included in this meta-analysis, the relative strength of the moderator effect strongly depends on the moderators which are included. Every meta-analysis is constrained by the studies that exist. When people do the studies, they do not design them with these moderators in mind. Therefore, only a certain set of moderators can be used in each meta-analysis, and they do not represent the full universe of potential moderators. For example, there are many more studies that have been carried out on new technology industries in entrepreneurship (this makes it difficult to compare the old vs. new technology industries easily) or there are many more studies in the USA and in Europe (thus, one is often constrained in comparing these studies with those of non-USA and non-Europe). For this reason, in entrepreneurship research, the subset approach is more important and needs to be included in each meta-analysis.¹

Entrepreneurship research is much less cohesive, and there are more debates on the right methodological approach than in medicine; therefore, methodological sophistication needs to be addressed explicitly in entrepreneurship research. Medical meta-analyses often select only those articles that meet the gold standards of randomized controlled experiments; in contrast, the field of entrepreneurship requires the researcher to code the quality of the articles included into the meta-analysis and to use this quality rating as a moderator, testing whether a relationship is stronger in “good” articles or in articles of a lower quality; it is useful to code this variable in an objective fashion (codebook).

¹This suggestion differs from Geyskens et al. (2009) who have argued for the superiority of the regression approach because it tests the relative strength of moderators. We like the article but disagree with this particular suggestion by Geyskens et al. because moderators are not sampled from a universe of moderators, and there is never a complete universe of moderators in any meta-analysis. This is different from original studies which should include at least the most important potential controls and the controls are usually developed and designed into the study from a theoretical approach. In meta-analyses, the moderators are always developed post-hoc (even if they are developed theoretically) after the studies have already been finished and, therefore, the normal arguments for including the theoretically relevant set of variables into a regression analysis cannot be applied to the meta-analytic regression.

In this way, what constitutes a methodologically and otherwise good study can be empirically examined with the help of meta-analyses. So, for example, Martin et al. (in press, 2012) used the subset approach to compare studies that are particularly well-designed with studies that are less well-designed in the area of education. Another important methodological issue often tested in meta-analyses is which measure shows the highest correlations; for example, a meta-analysis on entrepreneurial orientation found that the classical measurement approach actually showed lower validity than newer measures of entrepreneurial orientation (Rauch et al., 2009). A typical problem is that different definitions and operationalizations of key variables are employed; meta-analyses should test explicitly whether differences in theoretical terms and operationalizations produce different results (Stewart and Roth, 2004; Zhao and Seibert, 2006). Moreover, it is sometimes fruitful to code the theoretical orientation of the authors and examine whether the theoretical orientation has an influence on the results. For example, different theoretical orientations led to different inclusion criteria in meta-analyses on risk and entrepreneurship (Miner and Raju, 2004; Stewart and Roth, 2001, 2004).

Thus, meta-analyses help to improve the degree of scientific professionalism in entrepreneurship and may help to develop higher standards. After a meta-analysis has been done, there may be pressure on researchers to utilize better designs. Moreover, the use of meta-analyses leads entrepreneurship journals to provide all relevant statistical data (particularly M, SD, intercorrelations of variables) that can be used as raw material for additional analyses. Last but not least, meta-analyses reveal when authors do ethically dubious double publications by using the same samples and variables more than once (of course, they can only be entered once in a meta-analysis).

Meta-analysis is usable not only for studying theoretically and practically relevant relationships in more detail. The findings resulting from meta-analyses can also be used to understand theoretical models better. An example of this is found in the study by Rosenbusch, Rauch, and Bausch (2011) which described a theoretical mediation model and showed that this model had a good fit to the meta-analytically derived correlation matrix.

3.4 Examples of Meta-analyses in Entrepreneurship Research

Table 1.1 describes a number of meta-analyses that were developed in the area of entrepreneurship. This is not an exhaustive table. It is also not meant to provide all the information. However, the table shows that there are already some meta-analyses in entrepreneurship and that this number is growing rapidly. The first meta-analyses appeared in the 1990s. However, the number of early meta-analyses is small; we could only identify three meta-analyses conducted before 2000. This number increased to seven meta-analyses published from 2000 to 2005 and, subsequently, the number increased to 16 meta-analyses conducted from 2006 to 2011. Thus, there is an increasing interest to quantify the empirical evidence in the domain of entrepreneurship similar to the general trend found in other disciplines (Dalton and Dalton, 2008).

There seemed to be a few dominant themes that have been addressed in meta-analytical reviews. As many as eight meta-analyses have addressed the role of personality characteristics in entrepreneurship. All these meta-analyses were motivated by controversial debates in the entrepreneurship literature about the impact of personality on entrepreneurship and venture performance. It is important to note that these repeated meta-analyses on personality traits did not simply replicate each other. They have used different frameworks to classify personality traits (compare, e.g., Zhao and Seibert, 2006; Rauch and Frese, 2007) and different dependent variables, such as career choice (Stewart and Roth, 2001; Zhao and Seibert, 2006) and performance (Rauch and Frese, 2007; Zhao et al., 2010a; the latter article is primarily a replication of Rauch and Frese, 2007). Finally, two meta-analyses were embroiled in an empirical dispute about how data quality and coding affects meta-analytical outcomes on the relationship between risk-taking and performance (Miner and Raju, 2004; Stewart and Roth, 2004). In this way, these meta-analyses incrementally contributed to theory building in entrepreneurship research. The empirical evidence supports the proposition that traits specifically related to the tasks of entrepreneurs, such as achievement motivation, are related to the decision to start an enterprise as well as to venture success

(Collins et al., 2004; Rauch and Frese, 2007). Another area that has stimulated a high degree of controversy in entrepreneurship is the role of a business plan. Planning is an interesting issue because here meta-analysis is used to evaluate how well a potential intervention works: getting people to develop business plans is routinely done in business schools. In practice, there are numerous business plan competitions that attract potential entrepreneurs and the media. A popular example is the “meet the dragon’s project”, which allows potential entrepreneurs to pitch their business plan globally to investors. So the big question is: Is the business plan worth its hype? Some academic scholars argue that fully developed business plans are not correlated with success (Honig and Karlsson, 2004; Sarasvathy, 2004) and that entrepreneurs should not waste their time on developing a business plan but should better proactively and quickly exploit their business idea. As Table 1.1 shows, there are four meta-analyses on the effectiveness of business plans. These meta-analyses show that the effect size is small to moderately large (around $r_c = 0.20$, Brinkmann et al., 2010) and that effect sizes vary considerably across studies. Moderator analyses showed that effect sizes are larger for established enterprises as compared to young enterprises. It follows from these meta-analyses that discrediting business planning in general is clearly wrong. Rather, after acknowledging these meta-analyses, scholars need to carefully describe under which conditions business plans are more useful and under which conditions they are not (after all the correlations are heterogeneous); in addition, experiments need to be done to test whether business plans causally lead to higher success (more on this later). Blanket and generalized critique of business planning is no longer legitimate once such meta-analyses have been done.

Meta-analyses require an assessment of the boundaries of established relationships. Almost all meta-analyses described above reported heterogeneous effect sizes challenging the generalizability of results. Notably, one third of the meta-analyses listed in Table 1.1 did not make an attempt to identify moderators to explain the variance in reported relationships; some meta-analyses did not report information on the heterogeneity of results (e.g., Read et al., 2009). It is probably safe to assume heterogeneity of relationships in nearly all meta-analyses

in entrepreneurship. This means that none of the results should be taken to mean that a certain strategy or process derived from the meta-analyses works in all environments. Indeed, entrepreneurship is highly contextual. What works in one environment may not necessarily work in another one. What works with one dimension of goals does not necessarily work with other goals, etc. For practice, this is important, because it implies that entrepreneurs should know what the typical results are but that they can deviate from the typical approach thereby improving (or reducing) success appreciably. For researchers, the knowledge of heterogeneity of meta-analytic results means that moderators of relationships need to be examined in future original studies.

Obviously, it is difficult to detect moderators in meta-analyses (Dalton and Dalton, 2008). Some moderators might be due to the methodological quality of primary studies included in the analysis. Surprisingly, publication bias does not seem to play a substantial role in entrepreneurship research. Three meta-analyses were tested for publication bias and reported insignificant results (Brinckmann et al., 2011; Rauch et al., 2009; Rosenbusch et al., 2011). Rauch and Frese (2007) reported even a negative publication bias: peer-reviewed publications reported smaller effect sizes than studies not published in peer-reviewed journals. Another methodological moderator variable extensively discussed in the entrepreneurship literature is the assessment of the dependent variable venture performance (Shepherd and Wiklund, 2009). Accordingly, a number of meta-analyses coded the type of performance assessment. While some of these meta-analyses reported significant differences in reported effect sizes depending on the type of performance assessment, the direction of results does not seem to provide a consistent pattern. It seems to be that key informant ratings produce higher effect sizes than more objective performance assessments, such as archival data (Miller and Cardinal, 1994; Rauch et al., 2009; Rauch and Frese, 2007). On the other hand, Brinckmann et al. (2010) reported higher effect sizes for objective as compared to subjective performance assessments. Different levels of analysis between the assessment of the independent and the dependent variables may account for some of these results (Collins et al., 2004). Importantly, the fact that effect sizes

vary for different performance assessments suggests that meta-analyses should analyze different dimensions of venture performance separately (Boyd, 1991).

Theoretical moderator variables particularly relevant in the domain of entrepreneurship research are venture age, venturesize, industry, maturity of markets, and culture. Both venture size and venture age produce different liabilities that entrepreneurs need to address in order to start and run a business venture successfully. Innovation and entrepreneurial orientation are particularly important for new and small firms (Rosenbusch et al., 2010; Rauch et al., 2009, respectively), supporting the proposition that these firms should quickly exploit new opportunities in the environment. Planning, on the other hand, is less efficient for new firms as compared to more established firms, possibly because planning allows better decisions and control only when the environment becomes more predictable and less uncertain (Brinckmann et al., 2010). Technologically advanced industry often shows different kinds of relationships than “older” industries, e.g., in the relation of entrepreneurial orientation and success (Rauch et al., 2009). Mature markets may have developed a generalization of how things are done — in these cases, there will be a lower relationship with success; e.g., there is a marginally significant lower correlation of owners’ human capital with success in developed countries than in underdeveloped ones (Unger et al., 2011). Additionally, it makes sense that different cultures may require different effects of planning on success (Rauch et al., 2000) or of culture on the relationship between innovation and success (Rosenbusch, Brinckmann, and Bausch, 2011).

In summary, our investigation of published meta-analyses shows that the empirical evidence in the domain of entrepreneurship is improving. Much more effort needs to be exerted to produce good evidence for policy makers, banks, and entrepreneurs. Entrepreneurship theory assumes that business success is determined by multiple factors and mediating mechanisms (Baum and Locke, 2004; Rauch and Frese, 2000). As a consequence, theory testing in entrepreneurship would require combining meta-analytic techniques with structural equation modeling (Viswesvaran and Ones, 1995). Only one of the meta-analyses we found and displayed in Table 1.1 used such an approach for theory

testing (Rosenbusch, Rauch, and Bausch, 2011, on-line). This is a fruitful avenue for future meta-analyses Shadish (1996).

Can the evidence be used in practice? The answer is yes. For example, the meta-analyses on planning show that it makes sense for entrepreneurs to produce a business plan and to plan while managing a firm — there are only very few cases, where business planning has negative effects (although they do exist). The moderator analysis shows, in addition, that having a business plan available is effective for starting a firm but that it is also useful to plan during the management of the firm. However, some reservations need to be described, as well: first, the evidence shows that having a business plan and managing with clear plans is better for established firms than for new ones. This may be a time effect — it pays off long term; therefore only established firms profit more highly from having a business plan. Additionally, communication in the firm is easier when one has clear plans available — and that may be more important in the established firms than in the new firms. Also, established firms may need more financing through banks and, consequently, need to produce business plans. Thus, theoretical and practical issues often related to questions of mediation: which factors are responsible for producing the positive (or negative) effects of business planning. Second, one has to acknowledge that there are very few controlled randomized experiments that test whether business planning has a positive effect on success (most studies are not based on randomized experiments in this area). Thus, the present evidence has not yet established causality. A longitudinal study has shown that planning leads to success and success leads to more planning (Van Gelderen et al., 2000); thus, both causal effects may be operative to produce long-term effects of the kind shown in the meta-analysis. However, this is only one longitudinal study — more of them need to be conducted; moreover, in the last analysis, experiments could be done and could produce better data on the effectiveness of an intervention, such as teaching business planning. Thus, many additional studies need to be performed to understand the mechanism of how business plans lead to higher performance and to understand those rare occurrences of negative planning effects. For example, it makes sense to develop more experiments on teaching business plans — we could test whether a certain way of teaching is

more effective than another way. We could examine whether quality of the business plan is related to success. We could find out what type of planning is more successful than other types of planning (compare, e.g., the rough planning processes at GE with those of other companies that have more detailed plans). We could also analyze cultural factors that may play a role for the efficacy of planning. But, in the meantime, people still need to find an answer to the question, whether or not business planning should be taught in business schools. Given the results of meta-analyses, the answer should be: yes, it makes sense to teach business plans (and for entrepreneurs, to get to know how to do business planning and use this skill) although the mechanisms of how business planning works is not yet known well enough and the exact processes of how plans are successful need to be developed. Once the mechanisms (mediation processes) have been studied more adequately, teachers of business plans can gear their teaching to the right issues that need to be taught.

Unfortunately, not every meta-analysis has clear-cut implications for practice. For example, is it much more difficult to determine what an entrepreneur can learn from the evidence on personality discussed above? Unfortunately, it is unlikely that people will change their personality traits — it is not impossible but a difficult undertaking, because traits are partly genetically determined (Judge et al., 1999) and, in general, personality effects are stable across time with relatively little change (Costa and McCrae, 1997; Roberts et al., 2006). However, it may be possible to *manage* one's personality. One of the best ways to manage one's personality is to integrate others into the firm and to get people who can compensate for one's weaknesses. Indeed, having partners is useful for success, as has been shown in a recent meta-analysis (Read et al., 2009). It is also possible to change more specific behavioral traits. For example, the meta-analysis by Rauch and Frese (2007) has shown that generalized self-efficacy and achievement motivation is important for predicting performance. Task-specific self-efficacy can be changed by training entrepreneurs' self-efficacy, for example, on how to attract customers (Eden and Aviram, 1993). Similarly, achievement motivation can be increased by training (Miron and McClelland, 1979).

Thus, some research questions can be translated into practice more easily than others. It pays off to develop theories that are explicit on the mediating mechanisms that lead to positive effects. One of the best known theories in this regard is the theory of goal setting. Specifically, this theory suggests that high and specific goals lead to higher performance, is explicit about the mediation and moderator processes, and has been summarized in a meta-analysis (Latham, 2004; Wood et al., 1987).

4

Bridging the Knowledge-Doing Gap: How can Knowledge be Made Actionable?

All forms of evidence, including meta-analyses, provide the basis for the development of effective interventions. Once there is meta-analytic evidence for a relationship, interventions that change the target variable should be attempted (e.g., teaching business plan development effectively or selecting people to receive support for their entrepreneurial unit based on their personality and ability). Of course, each new intervention needs to be empirically evaluated as part of EBE. The best instrument to examine such interventions is the randomized controlled experiment (Reay et al., 2009). This means that an intervention is given to one group while a second group of participants — the control group — does not get the intervention, but provides data on their development. Often the control group is a *waiting* control group that eventually gets the same intervention at an appropriate time (e.g., after a year). The two groups have to be randomly divided. The beauty of the randomized assignment to experimental and to control groups is that in this way both groups are the same on all variables — not only on variables that we can observe but also on those, that we cannot observe or that we have not measured. Thus, randomization deals with the endogeneity problem that is so pervasive in management and

entrepreneurship research (Antonakis et al., 2010). For example, one problem is often the selection effect. People chose to participate in a training procedure. Those who chose to participate may be the more successful ones in the first place. Therefore, training entrepreneurs in entrepreneurial skills will be related to success because those who are successful are more likely to participate. Only randomization makes sure that such selection effects cannot be used to explain the results. There are often personality, social class effects, general mental ability, etc. effects that can explain differences between two groups (e.g., highly selected business schools cannot assume that it was their teachings that produced positive effects on the income of their alumni — the alternative explanation is that only those people were admitted who showed high determination and high general mental ability and that was the important factor that contributed to their career success).

Once a number of interventions studies have been done, they can also be meta-analyzed (Keith and Frese, 2008). Meta-analyses can, for example, examine which type of training to develop business plans and which types of business planning are positively related to success and whether these trainings generalize across situations and across people. Often, new research ideas can be developed as a result of such meta-analyses of interventions (e.g., to improve methods of training or person-training interactions Bell and Kozłowski, 2008).

A similar approach can be used in policy making. If there are enough studies available in a research area, recommendations to policy makers should be based on meta-analyses of this scientific material. Policy makers are also often interested in knowing which factors are the most influential. Such knowledge can only be accrued across studies, because no individual study can investigate all relevant variables, and studies may show considerable variance around one mean even if the results are relatively homogenous (Hunter and Schmidt, 1996). It is also true that when there is good meta-analytic evidence for a specific variable to have strong influence, then it is useful to develop an intervention through policy changes in this area (Campbell, 1969).

Unfortunately, it sounds much easier than it really is to decipher clear policy implications or other interventions from meta-analytic results. There is always a hiatus between knowledge and action.

A meta-analysis may provide the answer to which variable needs to be changed; however, it does not necessarily provide the answer about how this can be done. Action is, by necessity, situationally embedded; the meta-analytic evidence is often abstracted from the situational conditions. We suggest developing implementation manuals as explicit manuals of how knowledge can be translated into practice. They would correspond to the treatment manuals in medicine based on evidence-based medicine.

4.1 Action Principles and the Use of Implementation Manuals

Good evidence should lead to good practice. We suggest that good practice and good intervention research can be supported by implementation handbooks (similar to treatment handbooks in clinical psychology; Luborsky and DeRubeis, 1984). These implementation handbooks are based on solid empirical evidence including meta-analysis and describe how implementation can be accomplished in entrepreneurial firms. Implementation manuals should describe the evidence and the theoretical foundation. It is also helpful if they include qualitative cases of successful implementation of a policy. These cases should comprise potential pitfalls and difficulties when implementing evidence-informed ideas and policies. Thus, the manual needs to describe the contexts in which changes take place and how such changes can be supported.

One of the main concepts that help to put theory into practice is the concept of action principle (Frese et al., 2003) (a good example of a book that develops action principles from theory has been edited by Locke (2004). Examples for action principles are provided for goal setting theory which argues that goals need to be high and specific. These are clearly action-guiding ideas and are both theoretical as well as practical (Latham, 2009). Thus, the manuals should be based on principles of action that have been shown to be important for successful implementation of evidence. Importantly, the manuals should explain how the success and failure of the procedures can be measured; owners should attempt to get this feedback so that they can recognize whether they are on the “right track” or not. Such manuals may be

accompanied by interviews with owners who have successfully implemented a certain idea or policy and who describe the problems that needed to be solved on the way toward the goal. We foresee that there will be a big market for such implementation manuals in entrepreneurship in the future. The big difference to the self-help books that exist for entrepreneurs is that the evidence is explicitly stated in the implementation manuals and that the manuals have been evaluated and are constantly evaluated and updated (much like medical procedures in surgery).

Implementation manuals are not trivial results of known empirical relationships. Rather, additional evidence and theoretical concepts have to be considered, most often in the form of action principles that explain how to translate a theory into effective action. These action principles can then be translated into action hypotheses — hypotheses of which actions produce which effects — and then entrepreneurs or policy makers can make choices about which conditions they need to change to affect changes (Bamberg and Schmidt, 2001).

Implementation manuals can be evaluated with a true experimental or at least a quasi-experimental design (Shadish and Cook, 2009). Companies that participate in the study can be matched to other companies that function as the control group. Additional process measures examine how much companies conform to or deviate from the implementation manuals; crucial changes in the companies' behaviors and cognitions can be described. If the implementation manual is useful, a higher degree of conforming to the implementation manual should lead to better results, and the experimental group should show better results in important theoretical variables (e.g., profitability) than a control group. Similar approaches have been used in clinical psychology (DeRubeis et al., 2000). Research has shown that cognitive behavioral interventions for depression started to work when patients developed certain cognitions (that had been theoretically expected) and when the therapists conformed to the implementation manuals (Hollon et al., 1987; Tang et al., 2005). Potential positive effects of deviation from the implementation manuals can lead to additional research on which aspects of the implementation manuals are not successful; this may lead to changes in theory, in implementation manuals, and eventually to calls

for new meta-analyses (in which these changes are conceptualized as moderators).

In one series of publications we have tried to walk through the full process from developing evidence, via developing a meta-analysis, to developing an implementation manual, to testing such a manual with the help of a randomized experiment. We developed the concept of owners' proactive approach (and personal initiative) and showed that it was related to success of the owners' firms (Koop et al., 2000; Krauss et al., 2005) and that there is a relationship of proactivity with performance in general (Tornau and Frese, 2012). In a second step we developed a theory of proactive behavior of entrepreneurs (Frese, 2009). In a further step we developed a training procedure. This included two aspects. First, it included an action training procedure which implied the development of action principles from theory and using it directly to influence action patterns of individuals (Frese et al., 2003). This was then used to develop an intervention for entrepreneurs that was evaluated in a randomized controlled experiment (Glaub et al., 2012). The experiment proved that the intervention was successful — over the course of a year the experimental group increased its success in comparison to the waiting control group. The most important test of the theory was to examine whether those who actually learned most in the intervention were also the ones who had the highest success. A mediation model was shown to be correct: enhancing owners' proactive behavior by the intervention fully mediated the relationship between the intervention and the increase of business success. Similarly, meta-analyses on internationalization (Bausch and Krist, 2007; Schwens and Kabst, 2009a,b) can be used to develop an implementation manual on how to internationalize a firm.

4.2 Translating Knowledge Into Practice: Using Evidence as Entrepreneur

Recent publications have pointed out the gap between scientific knowledge and how little it is translated into practice (Pfeffer and Sutton, 2000, 2006; Rousseau and McCarthy, 2007; Rynes et al., 2007). “Many companies and leaders show little interest in subjecting their business

practices and decisions to the same scientific rigor they would use for technical or medical issues” (Pfeffer and Sutton, 2006, p. 12). Pfeffer and Sutton (2006) give example-after-example in the area of management to illustrate the desirability and even the necessity for managers to utilize evidence based approaches. Rynes et al. (2007) show how often practitioners of management do not have the right knowledge — putting the right policies into place may be an even less frequent occurrence.

Owners can use information from EBE in three ways: First, they can get inspiration and knowledge directly from empirical evidence, multiple studies, systematic reviews, and meta-analyses. Most commentators on evidence-informed management have shown that it is unlikely that many business owners will have the time and expertise to read the scientific literature. It is somewhat more likely that owners might take a theoretical statement and use it to inspire organizational practices. Sources of such models and theories may be journals that translate scientific findings or courses in business schools or science informed consultants. Consultants play a large role in this transmission although the knowledge of consultants may be as old as the knowledge of the business owners. The second transmission process from theory to practice could be implementation manuals in the near future. We urge entrepreneurship researchers to produce such implementation manuals as a way of making evidence applicable. Third, business owners can collect evidence themselves. Pfeffer and Sutton (2006) provide a number of examples on how industry uses quantifiable evidence that exist in most firms. Examples include evidence on the efficacy of advertisements, of different presentations of a homepage, or of HR strategies of hiring and retaining the best employees. Google proves that true experiments can be done, for example, around issues of presentation of computerized material for customers.

4.3 Translating Knowledge Into Practice: Using Evidence as A Policy Maker

Policy makers are often professionals and they can, therefore, in principle, translate scientific knowledge into practical approaches. Moreover,

they often work with a selected group of scientists to put scientific knowledge into practice. Thus, it is a promising route for EBE to influence policy makers so that they demand scientists to provide good evidence and that the scientists develop ideas together with the policy makers on how the evidence can be translated into practice. This is not just true of policy makers in the public policy arena but also of bankers who develop policies towards funding entrepreneurs.

The United Kingdom seems to be far advanced in developing evidence-based public policies (Davies et al., 2000, although this book does not include a chapter on entrepreneurship). There are, of course, public policies for fostering entrepreneurship in most countries, but there is up to this point, relatively little evidence-based public policy (e.g., in Europe, Leitao and Baptista, 2009). While there is a large discussion in the entrepreneurship community on policy support for entrepreneurship (e.g., special issue published by *Entrepreneurship: Theory and Practice* Volume 32, Issue 5, September 2008), there is as yet very little discussion on evidence-based approaches in policy support (Storey, 2002).

This discussion can be led from a supply as well as a demand perspective. What kind of supply of scientific knowledge exists that is relevant for policy makers? And what kinds of demands can be voiced by policy makers? To use an example that we referred to before: public policy has often attempted to increase the social networks of entrepreneurs. Thus, from a supply perspective, science has to supply good meta-analyses on the relationship between social networks and entrepreneurial success. Moreover, since public policy often has to decide where to put public money, the public policy makers need to know how high the relationship is between social networks and entrepreneurial success in comparison to other approaches to fostering entrepreneurship (e.g., training, selection of entrepreneurs, etc.). A third issue that needs to be researched is the cost side (or utility) and costs of alternative programs of increasing entrepreneurial success. All of that hinges of course, on the final question: are the causal relationships well-developed enough (particularly with regard to the third variable hypothesis — e.g., personality driving both the network and the success)? We are sceptical that the latter question will soon be

answered with the help of meta-analyses because at least 10 studies need to exist that actually tested the causal effect and alternative causal models (particularly the reverse effect model and third variables causing both the putative independent and dependent variable). What we can expect is that the latter will most likely be answered by only a few studies, and policies will probably have to rely on these few causal studies. Even better, however, randomized controlled experiments would test different approaches against each other to answer the question on the highest yield of each approach. However, even these studies will most likely be based on selected samples (e.g., not on random samples but on samples of volunteers who may be very different from nonvolunteers; thus even highly sophisticated intervention studies can only be generalized to volunteers) and, moreover, there needs to be some information on whether owners who receive one treatment will also add new employees to an economy rather than just squeeze out those firms whose owners who did not receive the treatment (Storey, 2002). It becomes immediately obvious that many of the questions that policy makers need answers to are interdisciplinary in nature and go well beyond a meta-analytic treatment of relationships.

However, it is often the case that too high aspirations are actually counterproductive because they make the problem seem unsolvable. Therefore, we want to argue here very specifically that even the current state of knowledge — once it is better organized in the sense of meta-analyses — can be helpful for policy makers. Obviously, once policy makers can compare the size of relationships (on the basis of meta-analyses) and have a rough estimate of the costs of certain treatments, the decisions will be better and more evidence-based than if one waits for all the necessary studies to be carried out and leaves everything as it is (meaning nonevidence-based). Thus, there is no reason to give up action just because science has not done enough to supply enough evidence.

Moreover, policy makers can and should attempt to develop evidence themselves and, therefore, every policy treatment should be evaluated with an approach that allows clear conclusions. Finally, policy makers are often in a position to demand better knowledge in certain areas and should, therefore, fund or encourage enough studies in areas

that are important to their policy decisions (Puttick, 2011). Again, it is unlikely to be useful if the policy makers get too involved in the decisions on how these studies should be done, but they should rather encourage competing methodological approaches of evidence development to allow for triangulation.

5

Limitations

These are the potential limitations of an EBE approach:

- Garbage-in/garbage-out: if badly designed studies define an area, the resulting meta-analysis will also lead to incorrect results. Cochrane meta-analyses often use inclusion criteria such that only “good” studies are included into their meta-analyses — true experiments with random control and experimental groups and double-blind conditions. Their reviews are, therefore, often based on only a few studies. Hunter and Schmidt (2004) warn of this procedure because invariably biases may creep into the decision about which articles to delete. This is particularly so in entrepreneurship. We, therefore, suggest a different procedure for entrepreneurship — the following safe-guards should be used: first, meta-analyses should differentiate between methodologically “sound” and not so good studies and test empirically whether the results are the same for the “good” and “bad” studies (cf. Martin et al., in press). Second, meta-analyses should correct for certain problems in the literature, for example, unreliability

of measures. Third, a meta-analysis can examine the construct validity of measures. Thus, meta-analyses should include a number of methodological safeguards to examine the garbage-in/garbage-out problem.

- Nonsignificant results are often not published and this may lead to biases in meta-analyses. Two countermeasures are used: first, reviewers attempt to find as many unpublished studies as possible (often doctoral dissertations) and compare their results to the published ones. Second, a so-called fail-safe index calculates how many unpublished null-effect studies would be needed to reduce the current results to nonsignificance (Rosenthal, 1979). Third, journals should accept short research notes of nonsignificant findings.
- One-size-fits-all: meta-analyses often aggregate across various industries, measures, and contexts. In contrast, entrepreneurship research often emphasizes the contextual dependency of entrepreneurship concepts. There are so many differences in owners, industries, consumer tastes, etc. Often the same strategies in different contexts may lead to different effects. In principle, these differences can be examined with meta-analyses as well or at least point out the need for future moderator studies. However, the danger of a one-size-fits-all approach exists, particularly when the results are taken as recipes or formulas for future action. Therefore, we suggest that implementation manuals should be combined with case studies and careful consideration of context variables. Moreover, we suggest developing theories of configurations and examining them empirically. Moreover, meta-analyses can be combined with qualitative reviews of contextual issues in the literature. Finally, we want to clearly warn against the use of meta-analyses or implementation manuals as recipes for actions that should be thoughtfully implemented. They are supposed to enhance the knowledge and the knowledge base for decisions but they should not be taken as a one-size-fits-all approach towards actions. We certainly do not want to

encourage the use of action principles as formulaic proposals only to be used in a set way.

- Entrepreneurship often implies that an owner does something different than others. Particularly, small fledging entrepreneurial units use a niche approach that may be directly opposed to the typical approach of doing things. We agree with this statement. Fortunately, meta-analyses often examine processes and not the content of decisions. Success may come from being different in content but not necessarily different in processes from others. But obviously, this hypothesis needs to be tested empirically.

6

Conclusion and Implications for Entrepreneurship Research and Practice

Evidence-based entrepreneurship (EBE) is full of new opportunities. Relevant consumers of EBE are scientists, consulting firms, CEOs, board of directors, banks, institutions for developing nations (world bank), governments, and last but not least individual entrepreneurs. EBE does not mean that professional knowledge is invalidated (APA-Presidential-Task-Force-on-Evidence-Based-Practice, 2006); EBE is a necessary add-on for consultants, banks, entrepreneurs, etc. who should consider the knowledge reported within EBE and then make their own autonomous and considered decisions.

Evidence-based entrepreneurship is not the same as empirical entrepreneurship research. Evidence implies that there is more than one source, one method, one best study, or one approach leading to an empirical relationship. We have emphasized meta-analyses because they can be used in those areas of entrepreneurship research in which several studies are available. But we warn against equating EBE with only meta-analyses because some areas of entrepreneurship are not mature enough to produce a sufficiently strong corpus of empirical articles to be meta-analyzed. Therefore, we think that any type of triangulation should be used to derive evidence from empirical studies

(Cook, 1985; Tashakoori and Teddlie, 2003). Triangulation implies that several different methods are used to arrive at a conclusion on some relationship or some effect that is studied empirically. Several studies (preferably with different methodology and from different authors and from different industry and cultural contexts) should be taken to derive evidence. The same also applies for qualitative studies. Rating procedures can be used in a similar way as meta-analyses to test whether evidence across different case studies can be accrued. Moreover, a set of studies that leads to similar findings can be taken as evidence in entrepreneurship research.

An evidence-based approach will change research and teaching in entrepreneurship (for teaching, please consult Rousseau and McCarthy (2007) who discuss evidence-based management. There are easy connections between evidence-based management and EBE. However, specific approaches that are more akin to entrepreneurship may complement the approach of evidence-based management. For example, bets may be placed on certain approaches, much like business angels place bets on certain entrepreneurial ideas. For example, an approach based on an implementation manual for an initial public offering may lead to better share prices than an approach that is not evidence based (Daily et al., 2003). Investors may place bets on certain approaches by investing in approaches that are evidence based. One step beyond this idea, investing itself may be conceptualized to be evidence for the belief of an investor that a certain idea and a certain approach may be viable in the future much like the share price is a bet on future viability of a firm (Sarasvathy, 2001). Future research could establish the relationship of such bets and whether the behavior of the firms conforms to scientifically derived evidence and how deviations might be explained.¹

Evidence-based approaches have a strong impact on the science of entrepreneurship itself. We hope that EBE will contribute to a higher degree of professionalism in empirical studies, will improve the quality of studies, and will improve the way we do research, for example, with a stronger track to study moderators and mediators, once meta-analyses

¹We are grateful to Saras Sarasvathy for this idea which came up in a discussion with her.

have been performed on certain relationships. We do not suggest that the hammer “meta-analysis” is just used to nail down everything that sticks out, but that we use EBE to improve our understanding of entrepreneurship and to develop solid knowledge in this field.

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