Evidence-Based Entrepreneurship (EBE): A Systematic Approach to Cumulative Science

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Abstract

The concept and desiderata of an evidence-based entrepreneurship (EBE) is discussed as a strategy to overcome the divide 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), all of which go beyond individual experience and isolated studies. We argue that meta-analyses can and should be used in entrepreneurship research (and that it should also be used for qualitative work). 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 EBE’s constituents. These include 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 have been developed from science, the application of them 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.

**Keywords:**  Evidence-based entrepreneurship  Entrepreneurs  Systematic Review  Meta-Analysis  Action Plans  Training
“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

As Keynes acknowledged, we assume that scientific knowledge often gets translated into practice without the practitioners even noticing their dependency upon those ideas. The tasks of science are 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 let develop from this knowledge prototypical interventions; these interventions should be derived from the most current scientific knowledge and should be more effective than traditional interventions. Practically useful knowledge needs to be accessible and must be based on the best summary of available knowledge in the field.
In this article, we would like to introduce the concept of EBE, discuss the implications of EBE, and sketch out the opportunities and limitations connected to EBE. Who should be users of evidence based entrepreneurship? At the least, these are users of EBE: The scientists themselves, professionals who deal with entrepreneur, policy makers, students of entrepreneurship, and last but not least the entrepreneurs themselves.

If the development of evidence is the function of science, why should we talk about evidence-based entrepreneurship? 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) which clearly goes beyond individual experience and a few isolated studies. What is the difference between what entrepreneurship science has been doing all along and what constitutes evidence-based entrepreneurship? We argue that evidence-based science and evidence-informed practice is the next logical step of developing science and is, indeed, appreciably different from what science and practice has been doing up to this point. The field of entrepreneurship can be advanced if it uses examples from evidence-based approaches found in the fields of medicine and work and organizational psychology. We are optimistic that it is possible to achieve the ideal of science-informed practice and a scientific approach that provides the best evidence for practitioners and policy makers. Thus, we want to argue that scientific suggestions for practice should be evidence-informed. To do this, the field of evidence-based entrepreneurship (EBE) needs to be developed. This
evidence can then be used to inform practice. Practice can never be fully based on evidence, therefore, we talk about evidence-informed practice and evidence-based research suggestions. We think that evidence-based entrepreneurship provides a great opportunity that is both relevant for practice and policy while strengthening the empirical and theoretical bases of entrepreneurship research (A. Rauch & Frese, 2006).

Scientists can use EBE by targeting new research in a much more precise way. A good summary of the literature in the sense of a meta-analysis, provides clear knowledge on what is known, but also what is not known. One frequent result of meta-analyses is, for example, that the results are heterogeneous and that it is, therefore, useful to search for moderators. Also, it can be established from meta-analyses that a relationship is strong, but often the mediation processes are still unknown. Moreover, there are often gaps in the literature that are shown as a result of meta-analyses. Finally, meta-analyses may show that some relationships are more important than others -- this may imply that theories have to cope with this information and incorporate the size of relationship into their theories. All of this information is useful for scientists to develop new studies and theories. Moreover, science will be profit from EBE by encouraging scientists to do more theory-based interventions and to do evaluate them in a meaningful way.

By developing evidence-based entrepreneurship, we also heed recent calls in general management to advance evidence-based management (J. Pfeffer & Sutton, 2006; Rousseau, 2006; Rynes, Giluk, & Brown, 2007; Tranfield, Denyer, & Smart, 2003) and we think of evidence-based entrepreneurship as one part of
this emergent development. Both management and entrepreneurship show a gap between knowledge and practice -- the knowledge-doing gap (J. Pfeffer & Sutton, 2000). Managers as well as entrepreneurs or professionals who deal with entrepreneurs (such as bank employees, business angels, analysts, policy makers, etc.) do not routinely take note of scientific evidence when making decisions and acting on them. 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. Venture capitalists who 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 negligible outside the knowledge on general industry effects (Rosenbusch, Brinckmann, & Mueller, 2010). This knowledge may encourage venture capital firms to develop new procedures and experiment with them (and evaluate their own experiments).

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,
the studies did not examine whether networks were useful for only those businesses that had actively developed their own networks themselves: In these cases an active approach with high initiative is the variable that causes network size and success (Frese, 2009; X.-Y. Zhao, Frese, & Giardini, 2010). These studies also did not examine the reverse causality hypothesis: Maybe social networks of businesses are not the cause of business success but maybe they are the results of business success (successful businesses rise in attractiveness and are, therefore, in more networks or more central in networks). Moreover, the intervention itself was not rigorously evaluated. 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 (of the years 2007--2011) shows that none of the ones we examined even mentioned meta-analyses in their index. This is not surprising because there are very few meta-analyses despite calls for these analyses in the area (A. Rauch & 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; more on this later). Often meta-analyses have direct effects on how students are educated. For example, there has been a debate whether business plans really are useful. Meta-analyses have settled this matter – the evidence is clear that business plans can be useful (Brinckmann, Grichnik, & Kapsa, 2010; Schwenk & Shrader, 1993).
However, the relationship between doing formal business plans and success is highly variable. Thus, there are clearly moderators in this relationship. Thus, students (and educators) should be encouraged to experiment, how to teach business plans and how to do business plans and to evaluate these experiments. Moreover, there may be some plans that have negative consequences -- again students need to know that and be allowed to experiment on these but with the general knowledge that by and large, it is more successful to have a business plan available when starting a business.

Entrepreneurs are the prime targets of EBE: They should know what works and what does not on average. For example, they should know that innovativeness does carry positive results and that these results are larger for new firms and not so important for older firms (Rosenbusch, Brinckmann, & Bausch, 2011, in press). But they should also know that there are many exceptions to this rule (in other words, these correlations are heterogeneous) and that innovativeness is not the most important predictor of growth and income -- for example, the overall stance of entrepreneurial orientation (which includes the attempt to be innovative) may be more important (particularly for young and small enterprises) (Andreas Rauch, Wiklund, Lumpkin, & Frese, 2009).

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 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.

Providing Sufficient Scientific Evidence for Practice

We shall first discuss the usefulness of meta-analyses, then the development of interventions and the rigorous test of them. We shall also acknowledge the constraints of these approaches of evidence-informed practice. Recently, the first author went to a physician for a painful knee condition. The physician prescribed some medicine that he said according to his experience had helped 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 giving 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 at any point in time. 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. In addition, there is also a social science website that is similar to the Cochrane foundation;
however, the Campbell collaboration is unfortunately 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 & 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.

The Usefulness of Meta-Analyses and Systematic Reviews

Meta-analyses (which are quantitative systematic reviews) can be compared to the other major approaches for accumulating knowledge -- the narrative review. The scientific field of entrepreneurship tends to produce many narrative reviews with its accompanying problems: The psychology of decision making has shown conclusively that non-quantitative judgment (also often called clinical judgment) is inferior to statistical decision making (regression analysis based decision making) (Grove & 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 certain journals or even restricting the search to only some journals and not starting out the literature search in a systematic fashion without a handbook of which search terms to use). 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 & Schmidt, 2004). Memory load is very high when summarizing a voluminous literature; we need strategies to reduce memory load; scholars tend to evaluate some studies as better than others and 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). This leads to highly conflicting conclusions of the literature making it difficult for practitioners to rely on scientific evidence (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, Thoresen, Bono, & Patton, 2001; W.H. Stewart & Roth, 2004)).

The defense of narrative reviews often centers on the importance of one or a few particularly good studies -- after all, should we not be just influenced by the very best studies and leave others aside? However, any one study invariably has limitations. 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, internal validity problems, or range restriction, and issues of generalization (Scherpenzeel & Saris, 1997). All of these factors make it unlikely that any one study can overcome all the potential problems. Thus, researchers 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 done). 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. Any given set of studies will show an approximation to a normal curve around a mean of correlations.

As an alternative form to the narrative reviews, reviewers developed systematic reviews without a meta-analysis in which the number of significant results was counted (so-called vote counting). These are clearly useful because they are careful to base conclusions on several studies and they also 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 often leads to the conclusion that many studies did not show significant effects. Most researchers are constrained by lack of time and resources and, therefore, have to rely on small samples. Of course, the significance test is influenced by statistical power, which depends on sample size. Therefore, a high number of non-significant 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 with others (Combs, Ketchen, Crook, & Roth, 2011; Rynes et al., 2007) to deal with these problems by using meta-analyses (which should always include a systematic search for articles): They provide a good summary of several
studies because they reduce these biases (Hunter & Schmidt, 2004; A. Rauch & Frese, 2006).

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

An interesting example is the area of personality and entrepreneurship. Narrative reviews have concluded from the literature that personality effects are unimportant for starting a firm and for the success of entrepreneurs (Aldrich & Widenmayer, 1993). Gartner (1989, p. 48) 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.” Gartner’s hypothesis 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 whether people start a company or do not (e.g., comparing managers with owners of start-up firms) and whether personality is related to entrepreneurial success. Most likely the overall correlation between personality and entrepreneurship is small because some personality traits are related to entrepreneurship and some others not. Moreover, different studies probably produce different results; thus, heterogeneity of the correlations is high (and, therefore, moderators should be examined). Meta-analysis has indeed, shown that there are some sizeable correlations but that other correlations with personality are low (A. Rauch & Frese, 2007; H. Zhao & Seibert, 2006). This seems to corroborate the conclusion that it does not pay off to search for
personality factors. However, once one examines potential moderators, the results turn out to be very different. One obvious moderator from personality theory (Tett & Guterman, 2000) is whether a personality factor matches the tasks of the entrepreneur or not. Once this differentiation is made, the results are eye-opening: We asked experts for the field of entrepreneurship which personality factors are matched to the tasks of entrepreneurs and which ones are not. 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 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 & 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 correlations of .30 (need for achievement and business success) and even .38 (generalized self-efficacy and business creation) (Rauch & Frese, 2007). When need of achievement is further differentiated into cultures with high performance orientation and those with low performance orientation, there is a high correlation of need for achievement with starting a company (H. Zhao & Seibert, 2006).

Thus, entrepreneurs are higher in need for achievement, innovativeness, and internal locus of control compared to other populations (Collins et al., 2004;
Rauch & Frese, 2007). These personality traits are additionally related to business success. Thus, the empirical evidence reviewed in this chapter leads to the conclusion that all those who have 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 there simply is lots of distracting "noise" in the data: Some relationships are, indeed, very small, for example, the relationship of risk taking with both business creation and success or the relationship between business creation and broad personality measures. But more importantly, whenever scientists throw all sorts of personality variables and all sorts of dependent variables into a correlation matrix, the correlations appear 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. 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 correlations 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.

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 &
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, Lim, Saltz, & Mayer, 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 done with personality test but instead rough indicators of human capital were preferred that clearly demonstrate much smaller correlations with success (Unger, Rauch, Frese, & Rosenbusch, 2011) than personality.

Conducting Meta-Analyses in the Field of Entrepreneurship

The function of science is to produce evidence without biases; science has forever driven the process to reduce biases. The meta-analytic approach is just one way to help with this endeavor when reviewing the literature. 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 there is a certain degree of homogeneity of measures of the concepts in question and whether there is a large enough body of empirical articles to warrant a meta-analysis. It may also help to ask practicing entrepreneurs’ consultants what question can have potential implications for them. Once the research question has been determined, a systematic search for articles to be included 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 article that are related to the current research question. Also, it is not necessary to do a wide and systematic approach
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). If at all possible, foreign language publications should be included as far as possible. 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, etc. Once, one has assembled the full number of articles, it is necessary to decide which of these articles 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 on the same subject. All criteria that lead to inclusion or exclusion of articles have to be systematically developed and clearly described. In case of doubt, it is makes sense to be as inclusive as possible, because one can 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 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 & 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 a specific hypothesis and its theory based on qualitative material.

Theoretically and empirically, an important question is whether meta-analytic results are homogenous or not. Most frequently the relationships uncovered by meta-analyses in entrepreneurship are heterogeneous. As a matter of fact I have never seen non-heterogeneous meta-analytic results in entrepreneurship research. There are various empirical indicators of the homogeneity of the effect sizes used by meta-analyses (Q-statistics, credibility interval, 75% rule). Heterogeneity of results suggests that it makes sense to search for moderators. This can be done in the meta-analysis but is also required in future original research. For practitioners it means that they can and should experiment which conditions have an effect on their best results. For example, there is a large credibility interval for new firms for the positive effect of innovation (Rosenbusch et al., 2011, in press); although the effect size itself shows that something important is going on that on average it pays off for new firms to be innovative, the heterogeneity of the effect sizes implies that some innovation practices do not really work out well, while others do. So, the entrepreneur could take the advice that innovativeness is useful, but would know that it pays off to experiment to receive even larger returns. A conversion from the $r=0.206$ that was used in this meta-analysis (Rosenbusch et al., 2011, in press)
to Cohen’s d provides us with an estimate of d=.42. Thus, the entrepreneur knows that the average innovation should produce about 42% of a standard deviation better profit rate than a non-innovative procedure.

Moderators are of particularly 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.

Additionally, because entrepreneurship research is much less cohesive and there are more debates on the right methodological approach than in medicine, the issue of methodological sophistication needs to be addressed explicitly in entrepreneurship research. While medicine often selects only those articles that meet the gold standards of a randomized controlled experiments, work and organizational psychology and the field of entrepreneurship are better off to rate the quality of each article and to use this quality rating as a moderator, testing whether a relationship is more frequently found in “good” articles or in articles of a lower quality. Thus, the issue of what constitutes a methodologically and otherwise good study has to be empirically proven by the authors of meta-analyses (and methodological sophistication of the study is treated as a moderator).

A typical problem for meta-analyses in fields such as entrepreneurship is that different definitions and operationalizations of key variables are employed (this is also true of work and organizational psychology); this implies that meta-
analyses should test explicitly whether differences in theoretical terms and operationalization produce differences in the results (again this is a methodological moderator) (W.H. Stewart & Roth, 2004; H. Zhao & 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 have led to very different inclusion criteria in meta-analyses on risk and entrepreneurship (Miner & Raju, 2004; W. H. Stewart & Roth, 2001; W.H. Stewart & Roth, 2004).

There are different approaches to testing moderators (Hunter & Schmidt, 2004; (Geyskens, Krishnan, Steenkamp, & Cunha, 2009). Both, the subgrouping approach and the regression approach should be used concurrently, because they answer different questions -- the subgroup approach (Hunter & Schmidt, 2004) relates to the size of the correlations for different values of the moderator; the regression approach answers the question how important each moderator is among the set of moderators that were examined in this study (of course, the latter is strongly affected by which moderators can and have been included in this meta-analysis and the relative strength of the moderator effect will strongly depend on which moderators are included).

Meta-analyses help to improve the degree of scientific professionalism in a field and to develop higher standards in an area of science. Because meta-analyses often show quantitatively different effect sizes for well-designed vs. not so well-designed studies (Carlson & Schmidt, 1999), there is 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 use the same samples and variables more than once (because they can only be entered once in a meta-analysis).

Finally, interventions may be suggested on the basis of meta-analyses. However, EBE should not be restricted to meta-analyses.

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). 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, work and organizational psychology, the area of entrepreneurship has produced comparatively few meta-analyses and those that exist have not yet been as influential as they should. This is all the more problematic because entrepreneurship research is often utilized in the support of policy decisions, for example, tax decisions, 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.
(Antman, Lau, Kupelnick, Mosteller, & Chalmers, 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 & Sutton, 2006). However, entrepreneurship research seems to be so different from medicine. Tranfield, Denyer and Smart (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 that they utilize for 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 may not be so); 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, Berta, & Kohn, 2009). However, meta-analyses need to utilize the article present; and in entrepreneurship research the typical research is based on correlations 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, Herriot, & Hodgkinson, 2001; Hodgkinson, Herriot, & Anderson, 2001). Work and organizational psychology often systematically compares different theoretical approaches and different methods; work and organizational psychology is also often based on non-experimental 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 (e.g., in the field of entrepreneurship this may be starting a company or entrepreneurial success). It makes sense to ask the question 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 work and organizational psychology is presented by Schmidt & Hunter, 1998).

Theory testing on full models with the inclusion of mediators can also be done on the basis of meta-analyses. In order to test whole theories, researchers may choose to not just present correlational results of two variables but 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 to examine mediation effects (Colquitt, Scott, & LePine, 2007; Shadish, 1996; Viswesvaran & Ones, 1995) and to test full theories (Cheung, 2008).

EBE is not restricted to doing 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 experienced by experts via consensus by experts up to meta-analysis. We liked the ideas developed in clinical psychology (based on (Chambless & 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 have to be given

• If there is conflicting evidence, meta-analytic evidence, that possibly explains with the help of moderators why there is 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 my years ago, the authors), personal experience, specialist skills, hype, dogma, and mindless mimicry of top performers …” (such as benchmarking) (Jeffrey Pfeffer & Sutton, 2007), p. 16). Probably we should also add that experience per se has been shown to be limited in its usefulness. As long as the experiences are relatively uniform, the learning curve levels off after a few months or years. Research comparing top performers with average performers has shown that experience is only valuable if it is highly varied (Sonntag, 1998) or if so-called deliberate practice -- a form of learning strongly oriented toward practicing those parts of the skills that are underdeveloped (Ericsson, Krampe, & Tesch-Römer, 1993; Sonntag & Kleine, 2000; Unger, Keith, Frese, Hilling, & Gielnik, 2008).
Thus, it is highly questionable to use one’s “simple” experience as evidence. We are also worried when consensus of experts is used as evidence; a few years ago a certain consensus was reached among entrepreneurship researchers that personality cannot be conceptualized to be a factor for success for entrepreneurs (prior to meta-analyses showing this consensus to be false).

Examples of the use of Meta-Analysis in EBE

Table 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.

One area that has stimulated a high degree of controversy in entrepreneurship is the role of a business plan. This is also an interesting issue because here meta-analysis is used to evaluate how well a potential intervention works: Getting people to develop a business plan, as 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 globally to pitch their business plan 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 functional to success (Honig & Karlsson, 2004; Sarasvathy, 2004) and that entrepreneurs should better proactively and quickly exploit their business idea. As Table 1 shows, there are two meta-analyses on the effectiveness of business plans (Schwenk & Shrader, 1994; Brinkmann et al., 2010). These meta-analyses show
that the effect size is moderately large (c. r=.20) and that effect sizes vary considerably. Moderator analyses showed that effect sizes are larger for established enterprises as compared to young enterprises.

Can this evidence be used in practice? The answer is yes. The meta analysis shows that it makes sense for entrepreneurs to produce a business plan and to plan in the process of managing a firm -- there are only very cases, where business planning has negative effects (although they do exist). The moderator analysis shows in addition, that it both having a business plan available is as effective as it is to do planning during the management of the firm.

However, but some reservations need to be described, as well: First, the evidence shows 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. There may be a second reason: 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. These are questions of mediation: Which factors are responsible for producing the positive 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 the causal structure. Fortunately, a longitudinal study has shown that planning leads to success and success leads to more planning (Van Gelderen, Frese, & Thurik, 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 done; 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. But the overall practice implication is clear from this meta-analysis: Teach business plans (and for entrepreneurs, get to know how to do business planning and use this skill).

Unfortunately, not every meta-analysis has clear-cut implications for practice. For example it is much more difficult to determine what an entrepreneur can learn from the evidence on personality discussed above? Unfortunately, it is highly unlikely that one can change one’s personality traits -- it is not impossible but an extremely hard undertaking, partly because they are genetically determined (Judge, Higgins, Thoresen, & Barrick, 1999) and partly because personality effects are stable across time (Costa & McCrae, 1997; Roberts, Walton, & Viechtbauer, 2006). However, it may be possible to manage one’s personality. One of the best ways is to manage one’s personality by integrating others into the firm and to get people who can compensate one’s own weakness. Indeed, having partners is useful for success, as shown by a meta-analysis (Read, Song, & Smit, 2009). It is also possible to change more specific behavioral examples of traits. For example, the meta-analysis by Rauch and Frese (1997) has shown that generalized self-efficacy and achievement motivation is important to predict performance. Task-specific self-efficacy can be changed by training entrepreneurs’ self-efficacy, for example, on how to attract customers (Eden &
Aviram, 1993). Similarly, achievement motivation can be increased by training (Miron & McClelland, 1979). Moreover, bankers, professionals who work with entrepreneurs will profit from the knowledge on personality effects.

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 which suggests that high and specific goals lead to higher performance and is explicit about the mediation and moderator processes and has been summarized in a meta-analysis (Latham, 2004; Wood, Mento, & Locke, 1987).

**Bridging the Knowledge-Doing Gap: How to Make Knowledge Doable**

All forms of evidence including meta-analyses provide the basis for the development of effective interventions. Once there is evidence for a relationship, interventions that change the target variable should be attempted (e.g., teaching personality management or selecting people to receive support for their entrepreneurial unit based on their personality). Of course, each new intervention needs to be empirically evaluated as part of evidence-based entrepreneurship. 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; a second group of participants -- the control group -- does not get the intervention, but provides data on their development. The two groups have to be randomly divided. Often the control group gets the same intervention at an appropriate time (e.g., after a year). Once a number of interventions studies have
been done, they can also be meta-analyzed. Meta-analyses can, e.g., examine how far courses of personality management are positively related to success, whether they generalize across situations, across people, and across methods of teaching. Often new research needs appear as a result of such meta-analyses of interventions (e.g., is it possible to improve methods of teaching personality management).

A similar approach can be used in policy making. Recommendations to policy makers should be based on meta-analyses. Policy makers are also often interested in knowing which factors are the most influential. This can only be accrued across studies, because no individual study can investigate all relevant variables. When there is good meta-analytic evidence for a specific variable to have a high influence, then it is useful to develop an intervention through policy changes (Campbell, 1969).

Unfortunately, it sounds much easier than it is to decipher from meta-analytic results clear policy implications or other interventions. There is always a hiatus between knowledge and action. A meta-analysis may answer which variable needs to be changed; however, it does not necessarily answer how this can be done. Even if there is meta-analytic evidence how something needs to be changed, action is by necessity situationally embedded; the meta-analytic evidence is often highly abstracted from the situational conditions. For this reason, we suggest to develop implementation manuals as explicit manuals of how knowledge can be translated into practice.
**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 & DeRubeis, 1984)). These implementation handbooks are based on good 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, Beimel, & Schoenborn, 2003) (a good example of a book that develops action principles from theory has been edited by Locke (Locke, 2004). Examples for action principles are provided by 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 the future.

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 which actions produce which effects -- and then entrepreneurs or policy makers can make choices which conditions they need to change to affect changes (Bamberg & Schmidt, 2001).

Such implementation manuals can be tested with a true experimental or quasi-experimental design. Companies that participate in the study can be matched to other companies that function as 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 (DeRubeis, Tang, & Gelfand, 2000). 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. Research has shown that cognitive behavioral interventions for depression started to work when patients developed certain cognitions and when the therapists
conformed to implementation manuals (Hollon, DeRubeis, & Evans, 1987; Tang, DeRubeis, & Beberman, 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 and calls for new meta-analyses.

We have tried in one series of publications 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, De Reu, & Frese, 2000; Krauss, Frese, Friedrich, & Unger, 2005). 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 a procedure of action training based on the development of action principles from theory and using them directly to influence individual behavior (Frese et al., 2003). This action training was then used to develop an intervention for entrepreneurs evaluated with a randomized controlled experiment (Glaub, Fischer, Klemm, & Frese, 2011). The experiment proved that the intervention was successful -- over time the experimental group increased its success and the waiting control group reduced its success. The most important test of the theory was to examine whether those who actually learnt 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 & Krist, 2007; Schwens & Kabst, 2009a, 2009b) can be used to develop an implementation manual on how to internationalize a firm.

**Translating Knowledge into Practice: Using Evidence as an Entrepreneur**

Recent publications have pointed to the gap between scientific knowledge and how little it is translated into practice (J. Pfeffer & Sutton, 2000; J. Pfeffer & Sutton, 2006; Rousseau & 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 & 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 -- actually putting the right policies into place may be even less frequent.

Owners can use information from EBE in three ways: First, they can get inspiration and knowledge directly from empirical evidence, from 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 from such a theory. Sources of such models and theories may be journals that translate scientific findings or courses in business schools or
science informed consultants. The second approach is to use implementation manuals. We urge entrepreneurship researchers to produce such implementation manuals as a way of making evidence practical. Third, business owners can collect evidence themselves. Pfeffer and Sutton (2006) provide a number of examples 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.

Limitations of the EBE Approach

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 “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 on 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. Second, they can test whether more recent studies (possibly based on better methodology) have similar results to older ones. Third, meta-analyses should correct for certain problems in the literature, for example, unreliability of measures. Fourth, a meta-analysis can examine whether good (reliable, valid) measures show similar effects to not so good measures. Thus, meta-analyses should include a number of methodological moderators to examine such issues.

- Non-significant 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 studies) 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 non-significance (Rosenthal, 1979).

- One-size-fits-all. Meta-analyses often aggregate across various industries, measures, 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 the different effects. In principle, these differences can be examined with meta-analyses as well (and
often meta-analyses will actually find such effects) or at least point out the need for future moderator studies. However, the danger of a one-size-fits-all approach exists. 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.

- Entrepreneurship often implies that an owner does something different from 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 both empirically and meta-analytically.

**Implications for Entrepreneurship Research and Practice**

Evidence-based entrepreneurship is full of new opportunities. Relevant consumers of EBE are scientist, consulting firms, CEOs, board of directors, banks, institutions for developing nations (e.g., the 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-
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 for an empirical relationship. We have emphasized meta-analyses because they can be used in those areas of entrepreneurship in which several studies are available (a rule of thumb may be that more than 10 empirical studies should be available as a literature base for a meta-analysis). We do not want to equate EBE with only meta-analyses because some areas of entrepreneurship are not mature enough to produce enough empirical articles. Therefore, we think that any type of triangulation should be used to derive evidence from empirical studies. 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 & McCarthy, 2007). 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, Certo, Dalton, & Roengpitya, 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 of an investor’s belief that a certain idea 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.
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