META-ANALYSIS AS A TOOL FOR DEVELOPING ENTREPRENEURSHIP RESEARCH AND THEORY

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Compared to other disciplines, the field of entrepreneurship can still be described as young and being in a formative stage (Cooper, 1997). Entrepreneurship research is an area that is characterized by the presence of competing and overlapping concepts and theories, such as entrepreneurial orientation (Covin & Slevin, 1991), cognitive alertness (Gaglio & Katz, 2001; Kirzner, 1997), entrepreneurial management (Brown, Davidsson, & Wiklund, 2001), or opportunity discovery and exploitation (Shane & Venkataraman, 2000). There is still a continuing debate on what entrepreneurship is about and the existence of relationships are hotly debated (Davidsson, Low, & Wright, 2001), e.g., the relationship between personality and entrepreneurial behavior. As a consequence, the field of entrepreneurship struggles to develop practice recommendations, e.g., for entrepreneurs, that are based on well-defined concepts and sound empirical justification.

In general, there are two ways of determining the status of a field: narrative reviews and meta-analysis. Narrative reviews use informal methods for the synthesis of empirical studies. The overall conclusions of narrative
reviews are based on reviewers considered impressions – often guided by a count of significant results based on “critical studies” (Johnson & Eagly, 2000). Narrative reviews are often subject to biases and judgments that are not reproducible (e.g., the judgment which critical study is the best and most believable one). Most reviews in the field of entrepreneurship use narrative methods (see e.g., Chandler & Lyon, 2001; Cooper & Gimeno-Gascon, 1992; Low & MacMillan, 1988). In contrast, meta-analysis uses statistical methods to integrate the results of many studies and is guided by decisions that are public and can be reproduced. The different approaches of meta-analysis and narrative reviews often lead to different conclusions about the validity of concepts.

The purpose of this paper is to suggest the use of meta-analysis as a technique to establish the status of concepts in the field of entrepreneurship. Meta-analysis provides the opportunity to overcome limitations of previous narrative reviews, to assess the validity of theories of entrepreneurship, to develop practice recommendations, and to open new areas of research. The contribution will hopefully stimulate the use of more meta-analyses in order to develop entrepreneurship research and theory.

The chapter proceeds as follows: First, the contributions of meta-analyses are discussed and compared with other review methods. Second, an example of meta-analysis is presented – the personality approach to entrepreneurship. Third, we describe the most important steps of meta-analysis. Forth, potential limitations of meta-analysis are addressed. Finally, we present meta-analysis opportunities to do meta-analyses to advance entrepreneurship theory, research, and practice recommendations.

THE ADVANTAGES OF A META-ANALYTICAL APPROACH TO ENTREPRENEURSHIP

We argue that entrepreneurship research should use meta-analysis to integrate the findings of the field. A meta-analytical approach has several advantages as compared with narrative reviews: First, narrative reviews are likely to bias empirical evidence because they are limited by the information-processing capacities of the reviewers (Tett, Jackson, & Rothstein, 1991). This is often a downward bias leading to the conclusion of little positive knowledge in the field. For example, frequency counts of significant results ignore sampling errors of individual studies, reliability problems of instruments, range restrictions of samples, dichotomization of continuous variables, imperfect construct validity, and extraneous factors (Hunter &
These issues usually result in a higher incidence of Type II errors (i.e., rejecting the hypothesis wrongly). Thus, narrative reviews are more likely to lead to the conclusion that there are no relationships between independent and dependent variables in entrepreneurship when in fact they are (Hunter & Schmidt, 1990; Tett et al., 1991). Second, meta-analysis accumulates studies based on a set of explicit decision rules and, therefore, is less biased by subjective perceptions of the reviewer than narrative reviews. Meta-analyses require judgments as well, e.g., when defining the area of the study or coding moderator variables. However, the decisions are public and open to criticism and replication by other scientists (Johnson & Eagly, 2000). Third, meta-analysis is based on many studies and, thus, avoids the influence of single studies. Fourth, meta-analysis controls for sampling error variance and, thus, controls for power deficits of individual studies (Hunter & Schmidt, 2004). For example, the Brockhaus and Nord (1979) study is frequently cited in the entrepreneurship literature for providing evidence that there is no relationship of personality characteristics with entrepreneurship. However, this study is based on a small sample of 31 business owners and therefore, has serious statistical power problems. Noteworthy, the effect sizes of small samples are less precise in estimating a population value than effect sizes of larger samples. Fifth, meta-analyses can correct many errors of individual studies (Hunter & Schmidt, 2004). Since meta-analyses estimate population correlations between given variables, it is important to correct for errors of studies (e.g., unreliability, range restriction, and sampling error) to achieve unbiased estimates. Sixth, meta-analysis allows an assessment of the magnitude of relationships and, thus, provides more precise and often comparable assessments of the validity of concepts. Thus, meta-analyses support the assessment of the practical significance of findings. Seventh, meta-analysis tests for variations in relationships across studies and, therefore, allows an assessment of the generalizeability of effects. If the size of reported relationships varies considerably between different studies, there will be context conditions that account for these variations. These context conditions are moderators that affect the size of relationships. The moderators may include study characteristics, method moderators, and theoretical moderators. Thus, meta-analyses also help to identify areas for new studies. Finally, meta-analysis techniques allow to test more than one independent and/or moderator variable by using methods based on regression analysis (Lipsey & Wilson, 2001). Using such procedures allows to estimate the independent contribution of variables on results, to control for methodological variables, and to test the interactions between moderator variables.
There are additional theoretical contributions of meta-analytical reviews. Most meta-analyses are mainly interested in the overall effect between independent and dependent variables. However, a meta-analysis should not simply summarize the strength of effects reported in the literature but should provide a theoretical integration and an assessment of the contribution of a concept. Two types of information provide such a contribution. First, meta-analysis should examine moderator variables to assess the context to which identified effects generalize. In this way, meta-analysis allows to test (new) contingency theories as well as comparing theories with competing assumptions. Second, meta-analysis can sometimes provide new evidence and, thereby, contribute to theory development by including moderators that were not studied in the original studies. For example, meta-analysis allows coding for the national context of studies and, thus can test the cross-cultural validity of concepts.

In summary, meta-analyses as compared to narrative reviews have methodological and theoretical advantages that can be used to accumulate knowledge, build theory in entrepreneurship, and develop evidence-based practice recommendations for researchers and professionals in the field.

THE PERSONALITY APPROACH TO ENTREPRENEURSHIP AS AN EXAMPLE FOR DEVELOPING ENTREPRENEURSHIP RESEARCH AND THEORY BASED ON META-ANALYSIS

The personality approach to entrepreneurship provides a useful example for a meta-analytical approach to entrepreneurship. Several meta-analyses have been conducted on entrepreneurs’ traits. Moreover, the personality approach is one of the early approaches to entrepreneurship that has been discussed controversially in the literature. Finally, narrative and meta-analytical reviews came to different conclusions about the usefulness of the personality approach to entrepreneurship theory and research. At the end of 1980s, the personality approach to entrepreneurship was rejected by many scholars in the field (cf., reviews by e.g., Brockhaus & Horwitz, 1985; Gartner, 1989; Low & MacMillan, 1988). This skepticism regarding personality traits was based on narrative reviews. In contrast, recent meta-analytic reviews reported evidence for the validity of entrepreneurs’ personality characteristics (Collins, Hanges, & Locke, 2004; Rauch & Frese, 2006; Stewart & Roth, 2004; Zhao, 2004). Thus, there appear to be relationships between personality traits and entrepreneurial outcomes that are difficult to detect for narrative reviews.
Personality traits can be defined as enduring dispositions that are stable across situations and over time (Costa & McCrae, 1988). Early studies in entrepreneurship assumed direct relationships between personality traits and both business creations and business success. It is important to note that many of these studies were descriptive in nature and based on overly simplistic assumptions. A consequence is an increased likelihood for incorrectly neglecting personality effects in entrepreneurship altogether (Type II error), because the theoretical link between specific personality traits and firm performance was not well established (Tett, Steele, & Beaughard, 2003). More recent models of personality psychology assume that personality traits are not directly related to business outcomes because they influence more specific processes that are proximal to behavior, which in turn relate to business outcomes (cf., Baum, Locke, & Smith, 2001; Johnson, 2003; Kanfer, 1992; Rauch & Frese, 2000). Thus, the effect of personality traits on business creation and success is mediated by more proximal variables. This position complements with theorizing in entrepreneurship that emphasizes the importance of processes in entrepreneurship research (e.g., Shane & Venkataramen, 2000). Moreover, the effects of personality traits are dependent on situational variables (Magnusson & Endler, 1977). As a consequence, meta-analyses on personality traits of entrepreneurs should not only address the strength of relationships but test intervening variables and moderators as well. Moderator variables have been addressed in all meta-analyses of the personality approach to entrepreneurship. These analyses focused either on broad Big Five traits or on specific personality concepts relevant for the domain of entrepreneurship.

The Big Five Personality Traits

The Big Five personality taxonomy (Costa & McCrae, 1988) is one of the most frequently used broad-trait taxonomy in organizational behavior. Meta-analyses indicated consistent positive relationships between the Big Five traits (such as conscientiousness) and employees’ job performance (Barrick & Mount, 1991). In entrepreneurship research such broad-trait taxonomies have been less frequently studied (exceptions are, e.g., Brandstätter, 1997; Wooton & Timmerman, 1999; Ciaverella, 2003). Zhao (2004) could, therefore, not draw directly on Big Five studies but categorized various personality traits on the five-factor model. Results indicated differences between entrepreneurs and managers in conscientiousness, openness to experience, neuroticism, and agreeableness. The effects sizes were small and moderate for conscientiousness (corrected $d = 0.45$). It is
important to note that Zhao (2004) did not directly analyze Big Five traits but assembled studies according to the five-factor taxonomy. As a consequence, the study included both broad traits and traits that are related to the domain of entrepreneurship. Thus, there are different levels of specificity of traits involved in his analysis. The level of specificity or generality between predictor and criterion variables, however, affects the size of the correlation (Epstein & O’Brien, 1985; Wittmann, 2002; Tett et al., 2003). Further, Zhao’s (2004) results indicated the presence of moderators and, thus, more research is needed to determine the circumstances that account for the variations in reported relationships.

**Specific Personality Traits of Entrepreneurs**

Most studies in entrepreneurship research analyzed more specific, criterion-validated personality characteristics rather than the Big Five traits. Broad personality traits, such as the Big Five are distal and aggregated constructs and they may predict aggregated classes of behavior (Epstein & O’Brien, 1985), such as overall supervisor ratings for employees (Barrick & Mount, 1991). In entrepreneurship research, the validity of specific traits may be higher than the validity of the broad Big Five traits because entrepreneurship research frequently uses more specific performance concepts, such as sales growth and accounting-based criteria (Rauch & Frese, 2006). Thus, the validities should be higher, if there is a match between personality and the task of entrepreneurship. Traits that have been discussed to be specifically related to the domain of entrepreneurship are need for achievement, risk-taking propensity, and innovativeness.

**Need for Achievement**

Need for achievement describes one’s preference for new and better ways to work, for feedback, for personal responsibility for outcomes, and for challenging tasks rather than routine or extremely difficult tasks (McClelland, 1961). McClelland (1961) related need for achievement to economic outcomes, such as wealth creation, business creation, and business performance. Thus, the concept seems to be particularly relevant to the domain of entrepreneurship.

Two meta-analyses addressed correlations between the need for achievement and different sets of outcome variables (Collins et al., 2004; Rauch & Frese, 2006). A first set of analyses revealed that need for achievement differentiated between entrepreneurs and non-entrepreneurs. The sample size weighted correlation was around .220 (Collins et al., 2004; Rauch & Frese,
2006, respectively). Such an effect size is moderately high (Cohen, 1977) and as high as the effect size between TAT scores on achievement motivation and spontaneous achievement behavior (Meyer et al., 2001). Both analyses revealed that entrepreneurs’ need for achievement was positively correlated with business success ($r = .260$ (Collins et al., 2004) and corrected $r = .314$ (Rauch & Frese, 2006)). Thus, we can conclude that the need for achievement is moderately related to entrepreneurial outcomes. However, tests of heterogeneity revealed the presence of moderator variables. The meta-analysis by Collins et al. (2004) identified several potential moderators (e.g., level of analysis, career choice, and performance studies versus career choice studies). No meta-analytic results showed homogeneous effects (Collins et al., 2004; Rauch & Frese, 2006). Thus, future research should address the context to get a better understanding of conditions under which the need for achievement leads to business creation and business success.

**Risk-Taking Propensity**

Risk-taking is one of the classical concepts that has been related to entrepreneurship (Mill, 1954; Knight, 1921) and has received a considerable amount of empirical attention. On a theoretical level, there are arguments for curvilinear as well as for direct relationships between risk-taking propensity and entrepreneurial outcomes (see, e.g., Stewart & Roth, 2001). The theoretical controversy about the function of risk-taking propensity in entrepreneurship has been continued in meta-analytic reviews – the dispute between Miner and Raju (2004) on the one hand and Stewart and Roth (2001, 2004) on the other hand can be seen as an example that meta-analysis is not immune to controversy. We agree with Stewart and Roth (2004) that there are problems in Miner and Raju’s (2004) meta-analysis: they included studies with dependent samples, contaminated comparison groups (e.g., founders included in the control group), irrelevant variables, and measurements with questionable construct validity. Without these problems, Stewart and Roth (2004) showed that there was a difference in the risk-taking propensity of entrepreneurs and managers ($d = 0.23$). Moreover, variations in effect sizes were fully explained by different instruments used to measure risk-taking propensity: objective measures produced higher effect sizes than projective measures. The second meta-analysis (Rauch & Frese, 2006) found a relationship between risk-taking and business performance of $r = .092$. This relationship was of the same size as the relationship found by Stewart and Roth (2004) and it was moderated by type of performance assessment. The hypothesis of curvilinear relationships between risk-taking and success has not been addressed in enough studies to do a meta-analysis.
Innovativeness

The notion of the importance of innovations in the entrepreneurial process has already been addressed in Schumpeter’s theory of economic growth (Schumpeter, 1935). Innovation can be conceptualized at the level of the firm (innovation implementation) and at the level of the individual (Klein & Sorra, 1996). Firm-level innovation has been studied in a meta-analysis by Bausch and Rosenbusch (2005), who reported a positive and significant correlation between innovation and performance of $r = .136$. Innovativeness at the individual level was studied as individual innovativeness (Patchen, 1965). A meta-analysis indicated that innovativeness is related to business creation ($r = .235$) and business success ($r = .220$) (Rauch & Frese, 2006). The relationship between innovativeness and business success was homogeneous, indicating that it was not moderated by other variables. Moreover, the relationship between entrepreneurs’ innovativeness and success seemed to be higher than the relationship reported between firm-level innovations and success (Bausch & Rosenbusch, 2005). It would be interesting to know whether firm-level innovativeness reflects entrepreneurs’ success in forcing innovativeness in the whole firm. Technically speaking, firm-level innovations might be a mediator in the relationship between entrepreneurs’ innovativeness and success.

Conclusion and Future Prospect of the Personality Approach to Entrepreneurship

These examples show the validities of selected personality characteristics. There are additional personality traits that are related to entrepreneurial behavior across studies, such as initiative, autonomy, stress tolerance, and self-efficacy (Rauch & Frese, 2006). Narrative reviews came to different conclusions because some of these effects are small and most relationships are moderated by third variables and, therefore, difficult to detect. For example, random influences of small-scale studies might be overestimated in narrative reviews. Thus, meta-analyses provided evidence for the validities of personality traits for business creation and business performance. This indicates that an overall theory of entrepreneurial success needs to include owners’ personality characteristics as extraneous variables.

However, the size and the variance of some of the reported relationships between personality traits and entrepreneurship behavior indicate that there are additional issues that need to be addressed empirically. First, the effect of personality traits is not direct. Thus, the personality approach to entrepreneurship needs to develop theories on moderators. There are theoretical as well as empirical models that suggest the need to study business strategy,
environmental conditions, competencies, and organizational variables as moderator variables (Baum, 1995; Sandberg & Hofer, 1987; Rauch & Frese, 2000). Second, there is theoretical and empirical support for the view that the relationship between personality and entrepreneurial outcomes is mediated (see above) and, therefore, the validities should be higher if one includes such mediators in the prediction of success. Candidates for such mediators are cognition and behavior (Kanfer, 1992) e.g., the processes by which individuals recognize and exploit opportunities (Shane & Venkataraman, 2000). Third, the effects of entrepreneurs’ personality may depend on more than one or two single traits. Therefore, the multiple effects of several relevant personality traits will produce higher relationships with entrepreneurial behavior than any single trait. Moreover, it may very well be possible that the effects of some traits overlap with each other. Thus, we need multivariate analyses of personality traits that take the intercorrelations of traits into account. Fourth, studies and meta-analyses have paid little attention to the problem of causality. Broad Big Five traits are in part genetically determined (Jang, Livesley, & Vernon, 1996) and, therefore, might affect the decision to become self-employed. However, more specific personality variables can be changed, such as self-efficacy (Eden & Aviram, 1993) and achievement motivation (McClelland, 1987). Therefore, we need more longitudinal studies to test for reverse causality. Fifth, the personality approach to entrepreneurship needs to include new individual differences concepts, such as passion for work (Baum & Locke, 2004) and counterfactual thinking (Baron, 1999). Meta-analysis has not addressed these variables because there were not enough studies on these concepts. New individual differences concepts can be evaluated by comparing their contribution to the field of entrepreneurship with the contribution of concepts that have been established for a longer period of time. Thus, the validity of new concepts (e.g., passion for work) should be compared with the validities of established concepts (e.g., need for achievement). If new concepts do not explain incremental variance, they will probably not be very important for entrepreneurship theory. Thus, cumulative evidence on more or less established concepts to entrepreneurship can be used to assess the contributions of more recent concepts.

DESCRIPTION OF META-ANALYSIS

A basic purpose of a meta-analysis is to provide a review of the literature based on statistical analysis (Glass, 1976). Thus, meta-analysis can be used
to calibrate the relationships between a set of variables. Ultimately, this means that meta-analysis can be used to develop and validate theories in the area of entrepreneurship. To achieve these targets, a meta-analysis requires five important steps: the definition of the theoretical propositions and the scope of the study, the location and collection of studies, the creation of a meta-analytic database, meta-analytical data analysis, and the interpretation and integration of results (Johnson & Eagly, 2000).

**Theoretical Analysis of the Constructs under Investigation**

The goal of this step is to specify as exact as possible the theoretical relationships between constructs and the definition of variables whose relationships are under investigation (Johnson & Eagly, 2000). Thus, this step requires theoretical and operational considerations to establish the boundaries of the study. The theoretical considerations include the definition of the research question, the identification of theoretical constructs that represent the independent and the dependent variable, the identification of moderators and mediators and, importantly in entrepreneurship, the populations that are studied and to which the researcher wants to generalize the results. The operational considerations refer to the acceptability of studies in terms of the operationalizations of the constructs under investigation (e.g., sample definitions, measures of dependent and independent variables, type of effect size to be used, and methodology). The operational considerations result in a list of criteria for the inclusion of studies into the meta-analysis. Thus, the first step of a meta-analysis in entrepreneurship requires a comprehensive definition of entrepreneurs, of constructs under investigation, and of the type of entrepreneurial behavior being addressed.

**Location and Collection of Studies**

Typically, a meta-analysis attempts to locate every study of the defined population (Lipsey & Wilson, 2001). Any specific sample includes sampling bias, which affects the generalizability of reported results. Moreover, most meta-analyses analyze moderators that require the break down of studies into different subsets. Therefore, a broad strategy for study locations is recommended that includes computer database searches, hand searches in important journals and conference proceedings, the inspection of reference lists of articles and reviews, and the use of the network of researchers that are active in the relevant area. The last strategy for study location is important to identify and include unpublished studies as well. The method for
locating the studies should be documented in detail including criteria for inclusion or exclusion of studies.

Creation of a Meta-Analytic Data Base

The creation of a meta-analytic data base requires the calculation of effect sizes and the coding of moderator variables. The calculation of effects includes the selection of an effect size index and the transformation of effects of individual studies into a common effect size statistic. Moderators can only be tested if there are enough studies in each subcategory suggested by the moderator analysis. Three types of moderators deserve careful observation: study characteristics, methodological moderators, and theoretical moderators. Study characteristics are typically coded in any meta-analysis (e.g., year of publication, study quality). Methodological moderators are important to test e.g., the validity of different instruments (see e.g., Collins et al., 2004; Stewart & Roth, 2004). Finally, theoretical moderators are derived from theory.

Meta-Analytical Data Analysis

The goal of the meta-analytical data analysis is to establish the overall effect size and to explain variations in reported effect sizes either by sampling error variance (and other study artifacts) or by moderator analysis. The data analysis starts with the aggregation of effect sizes across studies. These effects should be corrected for attenuation (Hunter & Schmidt, 2004). For example, low study reliabilities and range restriction systematically bias effect sizes downwards. Therefore, one should correct for such biases when testing the validity of concepts. Moreover, the aggregated effect size needs further examination in order to test whether or not reported effects are homogeneous across studies. If effect sizes are heterogeneous, which means that there is a significant amount of variation in the size of reported effects, further moderator testing is indicated. The meta-analytic data analysis ends when all of the variance of reported relationships is explained by sampling error variance, which implies that the effect sizes on the subsets of the moderator variable need to be homogeneous as well.

The Hunter and Schmidt (1990) method is widely used and has been shown to deliver accurate estimations of the effect sizes (Hall & Brannick, 2002). The technique, however, has its limitations regarding tests of dependent effect sizes, multivariate effects, and more than one moderator at the same time. For example, the method requires independent effect sizes. However, often researchers want to include a study more than one time in a meta-analysis
e.g., when the construct under investigation consists of more than one dimension. Gleser and Olkin (1994) developed a method for such situations, where reviewers want to meta-analyze-dependent effect sizes. Moreover, meta-analysts need to develop correlation matrices that are established with meta-analytical techniques and that allow for testing the multivariate effect of a set of predictors on entrepreneurial outcomes. Finally, meta-analyses often test more than one single moderator variable. Regression analysis can be used to test whether moderators are confounded and which of the multiple moderators are most important (Lipsey & Wilson, 2001). Thus, future meta-analyses in entrepreneurship research need to apply meta-analytical techniques beyond those described by Hunter and Schmidt (1990).

Interpretation and Integration of Results

The study-level analysis and the high aggregation of characteristics have implications for the interpretation and integration of results. The interpretation of the magnitude of effects is as important as the interpretation of its variance (Lipsey & Wilson, 2001). A frequently used rule of thumb considers effect sizes of $r \leq .10$ as small, $r = .30$ as medium, and $r \geq .50$ as large effects (Cohen, 1977). However, Cohen (1977) did not provide any systematic analysis to justify the rule of thumb. Therefore, the effect should be compared with other effect sizes found in a similar or different research domain. For example, one might compare the effect size of achievement motivation with the one of risk-taking and conclude that the magnitude of the effect size of risk-taking is relatively small. There are other more systematic ways for determining the practical significance of an effect size (compare, e.g., Rosenthal & Rubin, 1982). The magnitude of effect sizes should not be interpreted without careful examination of the variance of effect sizes. The interpretation of meta-analytical results is relatively straightforward if all of the variance can be explained by sampling error variance; in this case the meta-analytical results can be generalized broadly. If effect sizes are heterogeneous, then one needs to know why studies differ.

Even though meta-analysis is well suited for cumulating evidence in a field, scholars must be aware of limitations and critique of this method. Some potential limitations are now addressed.

LIMITATIONS AND CRITIQUE TO META-ANALYSIS

While we argued that the scope of a meta-analysis should be defined as detailed as possible, this advice needs to be modified in many situations. If
the scope is defined too narrowly, studies are really replications, and the meta-analysis will suffer from too few studies that match the criteria for the inclusion. If the scope is defined too broadly, studies will differ on a number of study characteristics. For example, when a meta-analysis on entrepreneurs includes quite different types of participants (owners, starters, CEOs, and key managers), the participants differ in a number of characteristics, such as age or experience. This might cause difficulties to draw clear conclusions from this meta-analysis because the inclusion criteria mix apples and oranges (Johnson & Eagly, 2000). Of course, overgeneralizations occur just as easily in narrative reviews; however, one can actively deal with this problem in a meta-analysis: study characteristics are made explicit (e.g., in a table) and thus, meta-analysis allows for reanalysis based on narrower criteria for inclusion. Moreover, meta-analysis allows to code for different levels of scope and, therefore, to control for the apples and oranges problem. For example, one might calculate effect sizes for owners, starters, CEOs, and managers separately and then compare these effect sizes with an overall effect size that combines owners, starters, CEOs, and managers.

Second, meta-analytical results are just as good or bad as studies included in the analysis. If studies included are flawed on a number of characteristics or, even worse, if there are no good quality studies, resulting effect sizes will hardly reflect the true validity of concepts. If there is enough variation in study characteristics one can statistically control for study quality by coding and examining the effect of quality characteristics on the magnitude of outcomes.

The problem of confounding variables affects not only quality issues but theoretical moderator variables as well. Sometimes, moderator variables are correlated (e.g., age and size of business), and in this case it is difficult to draw strong conclusions about effects. Therefore, meta-analysis should examine the relationships between moderator variables, for example by hierarchical moderator analysis (Hunter & Schmidt, 2004) or by modified weighted least square regression analysis (Lipsey & Wilson, 2001). Thus, a good meta-analysis actively examines potential confounding variables.

Another potential limitation of meta-analytic results is caused by sampling bias and systematic bias due to difficulties in finding studies. This bias is problematic when there is a publication bias in a field (e.g., that null-findings are not publishable) or the meta-analyst systematically selects a certain type of publication (e.g., only “good journals”). Meta-analyses can better deal with sampling bias than narrative reviews because they actively try to access unpublished studies. Therefore, they can estimate whether or not there is a publication bias in the literature. Moreover, it is a good practice to estimate the number of studies with null results needed to reduce
the effect size to insignificance (file save N) (Rosenthal, 1979). However, the file drawer problem is a consistent problem; therefore, the best strategy to deal with it is to be careful in selecting and identifying all studies.

Thus, there are potential limitations to the validity of meta-analysis that need to be minimized by carefully identifying and sampling all studies that are relevant regarding the scope of the study, by statistically analyzing potential confounding variables and by explicitly documenting all decisions and steps involved in the meta-analysis.

META-ANALYSIS AS A TOOL FOR DEVELOPING EVIDENCE-BASED ENTREPRENEURSHIP

Meta-analysis has not been used frequently in entrepreneurship research, but this method had a fundamental impact on other disciplines such as medical research. For example, in medicine meta-analyses have addressed the effects of particular drugs or therapeutic interventions. One can get meta-analytically established information about the risk and the effectiveness of a particular vaccine and use this information to base one’s decision about whether or not to use this vaccine. Moreover, based on meta-analytical results one may calculate how many lives would have been saved if a particular drug would have been used (Antman, Lau, Kupelnick, Mosteller, & Chalmers, 1992). Today, the Cochrane Collaboration provides online access to more than 1000 meta-analyses in medicine (http://www.cochrane.org). Medical practitioners and researchers (and private persons) can access this database and the updated meta-analytical results and use this information to improve professional decision making.

Following the idea of the Cochrane Collaboration, Frese, Schmidt, Bausch, Rauch, and Kabst (2005) recommended an evidence-based approach for the domain of entrepreneurship. Such an approach requires both empirically sound analysis and theoretical validation of identified relationships. The necessary steps include three major activities (Frese et al., 2005). First, entrepreneurship research need more meta-analyses. The general objective of these analyses is to get evidence on the size of the conceptualized relationships as well as an assessment about the context to which these effects can be generalized. If effect sizes are homogeneous, the results can be generalized throughout the field of entrepreneurship. If effect sizes are heterogeneous, subsequent analyses and original research need to specify the context by performing moderator analyses. A second step of evidence-based best practices is to establish cumulative evidence-based models in
entrepreneurship research. The models have to describe the variables of concern and the models should include all variables that add variance explained in the criterion variable in comparison to simple models. This step allows the field of entrepreneurship to develop strong evidence-based theoretical frameworks. We assume that different models exist for start-up activities of would-be entrepreneurs, for predictors of success, and for prevalence rates of business start-ups. Moreover, there are always contextual influences or moderators in entrepreneurship. Finally, entrepreneurship needs to develop manuals of evidence-based best practices how to intervene in given situations. Once meta-analyses have been done and empirically validated models have been developed, one should use the evidence to write manuals of how to intervene, such as manuals for planning, human resource practices, financial support, and internationalization. Such manuals need to be explicit enough to be useful for practitioners and entrepreneurs and need to be science based. These manuals can be complemented by case studies that explain how the manuals can be used. The manual can be experimentally evaluated. The first step is to test whether companies that use the manuals perform better. The second step is to measure, how much the company conforms to the manuals. If there is no indication that commitment to the manual is superior to other practice interventions, then the manual is not optimal and needs to be revised.

META-ANALYSIS AS A TOOL FOR DEVELOPING THEORY, RESEARCH, AND PRACTICE

Our discussion indicates that the use of meta-analysis provides opportunities for the field of entrepreneurship for explaining phenomena, such as business creation, opportunity recognition, and business success. Meta-analysis can be used to develop entrepreneurship theory, research, and practice recommendations.

Theory Development

There are many areas where the field of entrepreneurship developed knowledge through the use of meta-analysis. These meta-analyses addressed the education of owners (Van der Sluis, Van Praag, & Vijverberg, 2006), formal business plans (Schwenk & Shrader, 1993), innovation (Bausch & Rosenbusch, 2005), internationalization (Bausch & Krist, 2004), entrepreneurial orientation (Rauch, Wiklund, Lumpkin, & Frese, 2005), and
franchising (Combs & Ketchen, 2003). The example of the personality approach to entrepreneurship indicates the usefulness of a meta-analytical approach to entrepreneurship. Five meta-analyses in the domain addressed personality characteristics of entrepreneurs (Collins et al., 2004; Miner & Raju, 2004; Rauch & Frese, 2006; Stewart & Roth, 2004; Zhao, 2004). These efforts indicate that entrepreneurship research is at a stage where it could develop theory by using a meta-analytical approach.

Entrepreneurship areas that have not been addressed by using meta-analysis to our knowledge are, e.g., cognitive approaches, market strategy, entrepreneurial clusters, environmental conditions, cultural factors, size and age issues, differences between different types of businesses (e.g., family business, high-growth businesses), or venture capital decisions. It would also be interesting to test the validity of different types of criterion variables in entrepreneurship research. The validity of the dependent variable is a recurring discussion in entrepreneurship research because each single criterion variable has different problems and errors (cf. e.g., Delmar, 1997; Weinzimmer, Nystrom, & Freeman, 1998). Meta-analysis can contribute to this discussion by analyzing the interrelationships of different types of dependent variables, such as growth, accounting-based numbers, perceived success, and survival and, moreover, by estimating the differential validity regarding the correlations between different sets of predictor variables and different sets of criterion variables. Moreover, entrepreneurship is concerned with business populations as well as with business owners and, therefore, additional meta-analyses need to test theories at different levels of analysis (Davidsson & Wiklund, 2001). For example, business-level strategy has rarely been tested by using meta-analysis (the exception is innovation). It would be interesting to test, e.g., Porter's (1980) generic strategies in entrepreneurship by using meta-analytical methods.

In order to contribute to theory development, meta-analysis needs to test more moderators in entrepreneurship research. All meta-analyses discussed above found heterogeneous effects, indicating that many relationships in entrepreneurship are not direct. However, only a few meta-analyses addressed theoretical moderators (exceptions are, e.g., the meta-analysis by Bausch & Rosenbusch, 2005; Rauch & Frese, 2006; Rauch et al., 2006). For developing entrepreneurship theory, we need more meta-analyses that address theoretical moderators. For example, it is well established that formal business planning is related to success (Schwenk & Shrader, 1993). However, the planning–success relationship is heterogeneous (Schwenk & Shrader, 1993) indicating that moderators impact on the size of the relationship. Therefore, entrepreneurship research needs to know more about
the situations, where planning–success relationships are high or low. Another useful example is the internationalization–success relationship. There is a theoretical discussion whether internationalization success is an incremental process (Johanson & Vahlne, 2003) or whether there is an advantage to newness in the internationalization process (Autio, Sapienza, & Almeida, 2000). One meta-analysis has addressed such hypothesis (Bausch & Krist, 2004) and found that younger firms were more successful in internationalization than older firms. In this way, meta-analysis can usefully contribute to theory development in entrepreneurship research. Many approaches in entrepreneurship hypothesize contingency models and, therefore, meta-analyses need to address the hypothesized moderators.

Entrepreneurship is an interdisciplinary field that uses multiple predictors to explain the phenomenon of entrepreneurship. Therefore, meta-analyses need to test cumulative models that suggest that strategy, environmental conditions, competencies, and organizational variables all affect entrepreneurial outcomes (Baum, 1995; Sandberg & Hofer, 1987; Rauch & Frese, 2000). Moreover, it would be useful to test which predictors explain incremental variance beyond the variance explained by personality variables.

Finally, meta-analysis can also address changes over time, for example by coding for the development of the business or the year in which the data were collected (Taras & Steel, 2005). Thus, meta-analysis can be used to analyze process issues in entrepreneurship.

**Research**

Meta-analysis may force researchers to do more rigorous research in entrepreneurship by identifying weaknesses in research and publication practices and by opening new avenues in research. Meta-analyses can test for moderator effects of study characteristics (e.g., published versus unpublished) and for methodological moderators (e.g., objective versus projective measurements). In this way, meta-analysis is able to detect invalid predictors, inadequate measurements, and publication bias. Moreover, meta-analysis opens new areas for research. For example, the meta-analysis by Schwenk and Shrader (1993) found heterogeneous relationships between formal planning and success. Thus, future studies need to identify moderators that impact on planning–success relationships.

Since entrepreneurship is a relatively new field, there are often not enough studies in some areas of entrepreneurship research. This indicates that entrepreneurship research needs more constructive replication studies that show when and how hypothesized relationships hold (Davidsson, 2004). Once
enough replication studies are done, subsequent meta-analysis can establish more information about the size and the generalizability of the relationships. Moreover, improved publication practices and access to data should support the use of meta-analysis to develop research and theory in entrepreneurship. According to our experiences, roughly a third of the published studies relevant for a specific meta-analysis do not provide the necessary statistics required for transforming the study results into effect sizes. This is not just true of descriptive studies but, surprisingly, also of studies using multivariate analyses, such as multiple regressions. Meta-analyses require a description of the sample and clear statistics on sample size, means, standard deviations, and intercorrelations of all variables (including controls). This information is sufficient for most of the meta-analytical methods discussed in the literature. Doing more meta-analyses in entrepreneurship research should be supported by improving access to data from published and unpublished studies. This can be achieved by developing standards for archiving the data of empirical research and to allow for outside use of the data by other scientist in the field. The Inter-University Consortium for Political and Social Research (ICPSR) at the University of Michigan developed some useful guidelines for data archiving (ICPSR, 2000) and in entrepreneurship research the Global Entrepreneurship Monitor (Reynolds, Bygrave, Autio, Cox, & Hay, 2002) is committed to such standards. More such data archives would allow to include unpublished technical reports and published studies that did not present the required statistics and to reanalyze data to include variables that have not been reported in the original publication.

**Practice Recommendations**

The empirical basis for practice recommendations in entrepreneurship can often be strengthened (Davidsson, 2004). Frequently, what is considered best practices may be a result of fads. Meta-analysis does not only contribute to research and theory development but results additionally in evidence-based practice recommendations (Frese et al., 2005). Examples of practice recommendations of meta-analyses are numerous. First, practice recommendations can guide policy makers. For example, the German government introduced in 1994 the so-called IchAG. The goal of the program was to support entrepreneurship. One of the most important criteria for attending the program was a formal registration of unemployment. An evidence-based approach can provide valid advice whether unemployment is a valid predictor of a successful business start-up. Meta-analytical results of today would have suggested to use, at least additionally, education, achievement
motivation, and innovativeness as criteria for attending the program. Second, meta-analysis results can guide training and education. Entrepreneurship curricula can be developed based on the empirical evidence provided by meta-analysis. For example, the extensive use of formal business planning courses in entrepreneurship curricula may reflect an overestimation of its effectiveness as the mean relationship between business planning and success is only moderate ($d = 0.42$; Schwenk & Shrader, 1993). Moreover, analyses should show, which type of formal business planning is related to which type of dependent variables. Third, meta-analyses can be used by consultants and by business angels. All these practice recommendations can be put together in a synthetic program (e.g., for a business school). For example, the importance of a business plan for success is known and can be compared to the effect size of other predictors of success. Thus, entrepreneurship research is able to provide synthetic evidence-based practice recommendations.

**CONCLUSION**

Cumulating empirical evidence is central to entrepreneurship in order to verify the status of concepts discussed in the literature. In entrepreneurship research, meta-analysis has been mainly used for determining the overall relationship between predictors and entrepreneurial outcomes. This chapter has advanced to use meta-analysis for theory development and for developing practice recommendations as well. The personality approach is presented as an example of how to use meta-analysis to establish empirical evidence of concepts in entrepreneurship. In contrast to narrative reviews, meta-analysis showed that personality characteristics, such as need for achievement, are useful to distinguish entrepreneurs from non-entrepreneurs and are positively related to business performance. The authors believe that more meta-analyses should be used to advance the field of entrepreneurship by estimating the validity of concepts and by systematically addressing theoretical moderators, potential confounds, and by comparing competing theories. Thus, meta-analysis can be used fruitfully to establish shared knowledge in the field of entrepreneurship including its theoretical and practical consequences.

**NOTE**

1. We report two frequently used effect size indexes: the standardized mean difference “$d$” and the correlation coefficient “$r$".
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