# Does personality influence effectual behaviour?

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**Abstract**

***Purpose:*** *A model is developed to analyse what personality traits impact entrepreneurial cognitive and social strategic decision-making skills, originating from the effectuation framework.*

***Design/methodology/approach:*** *128 participants from an entrepreneurial pre-launch programme were assessed by experienced incubator and business coaches. Personality was measured by a Big Five test. Based on a confirmatory factor analysis, the relationships were analysed between personality and three core dimensions of the effectuation framework: 1) the bird-in-hand principle, 2) the crazy quilt principle and 3) the pilot in the plane principle.*

***Findings:*** *Specific patterns (moderation effects) as opposed to levels of personality traits proved to be relevant. The bird-in-hand and the crazy quilt principles are related to the moderating effect between sensitivity to feedback, sociability and ambition. The pilot in the plane principle was related to the whole pattern of entrepreneurial key qualities embedded in the extraversion domain. Furthermore, relationships of personality with key issues in the effectuation framework were found, examples being reflecting on a high diversity of means or on own talents, conducting a thorough risk analysis and engaging in inspirational networking. The final model revealed a direct positive influence of the capacity to conduct a thorough risk analysis on the overall capacity to apply the effectuation principles.*

***Originality/value:*** *The research results offer deeper insights for the mobilisation and development of complex entrepreneurial behaviours.*

***Key words: decision making, entrepreneurs, innovation, human capital***

***Paper type:*** *Research paper*

**Introduction**

During the last two decades, research has identified two emerging key topics in studying entrepreneurial effectiveness: 1) the capacity to design innovative business models and 2) effectively coping with high uncertainty (Jiang, & Rüling, 2019; Futterer *et al*., 2018; Sarasvathy and Dew, 2013; Read *et al*., 2009). In this light, the sharp increase in popularity of the effectuation framework is hardly surprising, because it offers a strategic decision-making logic in reference to the individual and corporate entrepreneur under conditions of high uncertainty (Jiang and Rüling, 2019; Sarasvathy, 2001).

Central in the effectuation framework is the distinction between causation and effectuation - two different modes of strategic entrepreneurial decision making (Jiang and Rüling, 2019; Chandler *et al.*, 2011; Sarasvathy, 2001). Causation describes a more traditional and rational perspective on entrepreneurial decision-making. When the mode of causation is applied, entrepreneurs are determined and dedicated to one specific goal and then select the means to achieve this selected goal (Sarasvathy, 2001). Causation is characterised by the identification and evaluation of business opportunities, planning, resource acquisition and the deliberate exploitation of opportunities (Fisher, 2012). As opposed to causation, Sarasvathy et al. (2008, pp. 331) describe effectuation as 'a logic of entrepreneurial expertise, a dynamic and interactive process of creating new artefacts in the world'. Based on this definition, in this paper, the terms 'effectual behaviour' and 'effectual skills' will be used interchangeably.

Effectuation suggests that, under conditions of uncertainty, entrepreneurs adopt a decision logic that is different to the traditional, more rational model of entrepreneurship (Perry *et*

*al.*, 2012). Effectuation suggests that entrepreneurs start with a general aspiration towards, and ambitions to develop and implement, an entrepreneurial strategy within a specific commercial framework: for example, delivering organically grown fruit and vegetables to restaurants or hotels. By applying effectuation skills, the strategic goals are emergent and are based on the resources available to the entrepreneur. In addition, the goals are shaped and adjusted by co-creation with partners and contingencies. By focusing on the available set of means, entrepreneurs remain 'in control' under conditions of uncertainty (Sarasvathy, 2001; Fisher, 2012). One may argue that this decision-making logic allows entrepreneurs to cope with uncertainty and ambiguity while developing more innovative business models, which in turn is strongly related to entrepreneurial success (Kuechle *et al.,* 2016; Sarasvathy and Dew, 2013; Venkataraman *et al.*, 2012; Sarasvathy, 2001; 2008; Dyer *et al*., 2008). The explicit focus on the dynamic conditions in which entrepreneurs make decisions distinguishes effectuation from causation (Gregoire and Cherchem, 2019). Another core issue in the effectuation framework is the contingency leverage principle (Read *et al.,* 2009; Chandler *et al.,* 2011). In the effectuation framework, undesired circumstances are considered a source of information and feedback for the (re-)design of new business models. Comprehensive scientific support exists pinpointing the positive impact of effectual behaviour on entrepreneurial success (Kuechle *et al*.,2016; Sarasvathy and Dew, 2013; Venkataraman *et al.*, 2012; Sarasvathy, 2001, 2008; Dyer *et al*., 2008).

Moreover, studies have demonstrated the positive impact of abstract thinking and reasoning on a small firm's performance, on entrepreneurial intention and on entrepreneurial self-efficacy (Bazzy *et al*., 2019; Slater *et al*., 2006). Abstract thinking plays an important role in strategic decision-making processes (Furnham, 2008).

*Five effectuation principles*

Under the effectuation framework, five specific principles are outlined, a categorisation based on the theoretical conceptualisations that differentiate effectuation from causation (Sarasvathy and Dew, 2013):

1) *The bird-in-hand principle:* the creative, cognitive, reflective process of a) analysing a wide range of means to achieve a broader set of goals, turning available means into new ends, b) embedding unique talents and individual capacities in innovative business models and c) using a strong social network as a source of inspiration and resources.

2) *The crazy quilt principle:* the use of inspirational networking skills and leveraging new information and feedback to improve and redesign the emerging business model. Another key issue is forming alliances and thereby enlarging the business' access to resources while securing pre-commitment of business partners.

3) *The lemonade principle:* effective coping with unexpected contingencies and associated frustrations. This principle suggests that effectual decision-making relies more on flexibly dealing with contingencies than it does on analysing pre-existing market knowledge.

4) *The affordable loss principle:* the risk-analysis skill of analysing and anticipating maximum losses (worst-case scenario) and the acceptability and affordability of these losses.

5) *The pilot-in-the-plane principle:* strong goal-directed orientation without loss of flexibility. (Sarasvathy and Dew, 2013; Sarasvathy, 2001).

However, the five-dimensional structure of the effectuation framework seems to contradict research results found in work psychology and human performance literature (Furnham, 2008; Schneider, 2007; Arnold *et al.* 2005). These research results justify a re-categorisation

of these five effectuation principles into three major dimensions. These are: 1) the cognitive, analytic skills central to the bird-in-hand principle, the lemonade principle and the affordable loss principle); 2) the interactive social skills of the crazy quilt principle; 3) personal qualities, closely related to the social construct of personality. The underlying reasoning is that these listed social constructs prove to have satisfying construct validity indices (Furnham, 2008). Therefore, the identification of the underlying dimensions of effectual behaviours is key to this study.

*Understanding antecedents of effectual behaviours*

Considering the (potential) impact that effectuation has on business outcomes, scholarly interest in effectuation is no surprise (Gregoire and Cherchem, 2019). Effectuation seems to be one of the most-cited emerging theories of entrepreneurship (Matalamaki, 2017; Gregoire and Cherchem, 2019).

However, despite its relevance as a predictor of entrepreneurial success under conditions of uncertainty, relatively little is known about the antecedents of effectual behavior (for an overview see: Gregoire and Cherchem, 2019). Much of the research on entrepreneurial capacities is conducted in a corporate venturing context, limiting the impact of research results to the corporate entrepreneur or entrepreneurial teams (Futterer *et al.,* 2018; Chandler *et al.* 2011; Harm and Schiele, 2012).

Our understanding of intrapersonal antecedents is gradually growing. Previous studies have examined antecedents such as entrepreneurial experience (Alsos and Clausen, 2014), entrepreneurial self-efficacy (Engel *et al*., 2014), career motives (Gabrielsson and Politis, 2011) and internal locus of control (da Costa and Brettel, 2011). However, theoretical

consideration of the limitations of research on antecedents of effectual behaviours points to a relatively low relevance of entrepreneurial experience for a broader theoretical understanding of effectual behaviours (Chandler *et al.,* 2011), while the concept of an internal versus an external locus of control has been severely criticised for its low construct validity (Furnham, 2008).

Remarkably, the relationship between personality and effectuation has remained largely unexamined. There is an extensive body of research illustrating that entrepreneurs' psychological character impacts their thinking and acting (Omorede *et al*., 2015). Moreover, research on the person-environment-fit framework (PEF) has demonstrated that personality is an important dispositional variable when complex work-related behaviours are to be mobilised (Furnham, 2008; Schneider, 2007; Barrick, 2005). A dispositional variable forms a strong personal basis, a personal disposition, to effectively mobilise underlying personal qualities needed to perform complex work-related behaviours. The relevance of a deeper understanding of dispositional variables is pinpointed by studies showing that an entrepreneurial effectiveness is positively impacted by reflexivity on personal qualities, as well by timely individual activation of competencies during the pre-launch and launch phases (St-Jean, 2012; Erken *et al.,* 2016).

Consequently, there are two methodological claims forming the underlying rationale for conducting this study. Firstly, future research on the effectuation framework should identify and specify behaviour indicators of effectuation skills. Secondly, future research should analyse the underlying dynamics of antecedents of individual entrepreneurial capacities in displaying effectual behaviours (for an overview see Gregoire and Cherchem, 2019).

Personality is considered a highly relevant dispositional variable when studying underlying dynamics of entrepreneurial effectiveness (Omerede *et al*., 2015). Research on personality generally addresses relative stable and permanent traits that produce both consistency and individuality in a person's behaviour (Feist and Feist, 2009). During the past two decades, research on the personality-entrepreneurship relationship has primarily adopted the Big Five model of personality to explain and predict entrepreneurial endeavours and successes (Omorede *et al*., 2015). This study aims to enhance understanding of how relatively stable individual characteristics, such as personality, can predict effectual thinking and behaviour. The research findings shed light on the malleability of effectual thinking and behaving and its consequences for the training and development of effectuation skills.

There are three major reasons to analyse and specify behaviour indicators of effectuation skills. Firstly, for an effective mobilisation of complex work-related behaviour meaningful and evidence-based insights into the specific underlying dimensions and their aligned key features are required (Gregoire and Cherchem, 2019; Chandler *et al.,* 2011; Chalofsky and Krishna, 2009). Such evidence-based insights allow entrepreneurs to identify effectuation skills, as opposed to causation skills (Chandler *et al.,* 2011; Chalofsky and Krishna, 2009; Alvarez and Busenitz, 2001).

Secondly, pragmatic and comprehensive insights into relevant behaviour indicators are needed to achieve high learning-goal specificity, another feature necessary to mobilise complex work-related behaviours (for an overview see Locke and Latham, 2002).

Thirdly, visionary insights are needed for double-loop learning. Double-loop learning is defined as a deep learning and development process, embedding strong visions in

underlying features. Single-loop learning is solely targeted at specific developmental goals, not at the underlying features and human qualities needed to develop those goals. Studies have revealed that double-loop learning is superior to single-loop learning when it comes to developing or mobilising complex skills or complex human behaviours in the workplace (Jha-Thakur *et al.,* 2009).

*Personality*

The relationship between effectual behaviour and Big Five personality traits is analysed in this paper. Zhao *et al.* (2010) suggest that the Big Five personality traits are valuable for understanding entrepreneurial behaviour and effectiveness. Moreover, the Big Five model of personality is the central model in research on the PEF framework (Schneider, 2007; Barrick, 2005).

The Big Five framework measures five main personality traits called domains:

(1) *neuroticism/emotional stability* (including facets like anxiety, sensitivity to feedback, despondency, stress resistance);

(2) *extraversion* (including facets like self-directedness, sociability, assertiveness, self-initiative, sociability (enjoying social interaction in bigger groups), excitement seeking);

(3) *agreeableness* (including facets like trustfulness, modesty, cognitive and emotional empathy);

(4) *openness to new experiences* (intellectual curiosity, including facets like openness to different values, change and new, creative ideas);

(5) *conscientiousness* (including facets like orderliness, goal-directedness, planning, ambition, structuring tasks).

Based on research by Zhou *et al.* (2019), it will be tested whether patterns (combinations), as opposed to only higher or lower levels of one specific personality trait, enhance the quality of the final model, analysing the relationship between effectual behaviour and Big Five personality traits. Therefore, in addition to combining Big Five domain (major) dimensions, special attention will be given to (combinations of) Big Five sub-dimensions, labelled as the facets. Research has strongly supported the relevance of studying facets alongside domains (Hensel and Visser, 2018; Hensel, 2010; Furnham, 2008; Schneider, 2007).

The two core research questions in this paper are:

*1) Is there statistical support for the assertion that the social construct of the effectuation framework and the application of effectual logic can be identified by the five effectuation principles?*

*2) Is there statistical support for a model showing that patterns of Big Five personality traits are related to specific effectuation principles?*

In this paper, we will mainly focus on the pre-launch phase. This is based on the insight that the effectuation framework is especially relevant during the strategic decision-making process, a process key to the pre-launch phase (Read *et al*.; Duening *et al*., 2012; Dyer *et al.,* 2008).

## Methodology

### *Participants*

128 individuals participated in a university-led pre-launch entrepreneurship programme and were assessed by experienced incubators and business coaches. The effectuation framework was the theoretical foundation on which the programme was designed. To avoid heterogeneity problems, a specific pre-launch entrepreneurship programme in higher vocational education was approached, with the aim of collecting data from a cohort with a strong homogeneity of (limited) entrepreneurial experience. The assessment was implemented primarily to gather data to execute this study, with the additional benefit of providing feedback to the participants of the programme.

### *Measures*

All the participants of this study were assessed by a specific assessment instrument at the end of the programme. The valid assessment of individual capacities in displaying effectual behaviours was key. All the measures are aligned with the effectuation framework. All the assessors were trained to provide a reliable judgement using the 'here and now' situation during the assessment for their judgements. Personality was measured by a Big Five personality test. This Big Five test was developed, completely structured and aligned with the official, globally applied Five-Factor Model (FFM) of personality (Barrick, 2005; Barrick *et al*., 2001).

### *Model development and testing*

A structural equation methodology was chosen to specify core dimensions and their underlying key features. By applying this methodology, the construction of core dimensions

is theory-based rather than data-based (Van de Schoot *et al*., 2012). Moreover, a structural equation methodology tests for a strong theoretical alignment of the residuals (unexplained variance) with the explained variance. Consequently, when a theoretical framework is key in designing dimensions, a structural equation methodology should be preferred over other methodologies (Van de Schoot *et al.* 2012; Cheung, 2008).

*Testing for significant relations of Big Five personality traits with effectual behaviour*

The only personality traits that will be included in the model are those for which research on the PEF framework has revealed strong relationships with human performance in work environments demanding: 1) initiative, high-quality social interaction, 2) innovative capacities and 3) goal-directed behaviours (Barrick *et al.,* 2001; Schneider, 2007; Zhao *et al.,* 2010). These latter personal qualities are relevant for entrepreneurial success (Zhao *et al.,* 2010). Consequently, domain-level dimensions and their facets of the following domains will be embedded in the model: 1) *extraversion*, because it measures entrepreneurial qualities like self-initiative, assertiveness, sociability and susceptibility to risk; 2) *openness*, because it measures intellectual curiosity for new visions, unknown ideas and perspectives; and 3) *conscientiousness*, which measures proactivity and goal-directed behaviours. Moreover, contradictory research results were found for the *agreeableness* domain. *Agreeableness* is positively related to sensitivity to customer needs and strong customer friendliness (Barrick *et al.,* 2001). On the other hand, studies point out that there seems to be a negative correlation between higher *agreeableness* and entrepreneurial intellectual autonomy in designing innovative business models (Baum *et al*., 2014). The same holds for the *neuroticism* domain. Lower averages of *neuroticism* are associated with more effectively

coping with stress, while the same lower averages for this domain are also associated with lower capacity to cope intellectually with high complexity and ambiguity (Hensel and Visser, 2018; Hensel, 2010). Consequently, the relevancy and especially direction of the domains and facets of *neuroticism* and *agreeableness* will be tested to identify the underlying dimensions of the success criterion – an (out-)performance in executing effectual behaviours – a five-factor model will be compared to a three-factor model. As explained earlier, a five-dimensional structure is suggested by the designers of the effectuation framework (Sarasvathy and Dew, 2013) and a three-dimensional structure is based on the categorisation originating from literature on human performance and work psychology (Govaerts *et al*., 2013).

**Results**

*Confirmatory factor analysis*

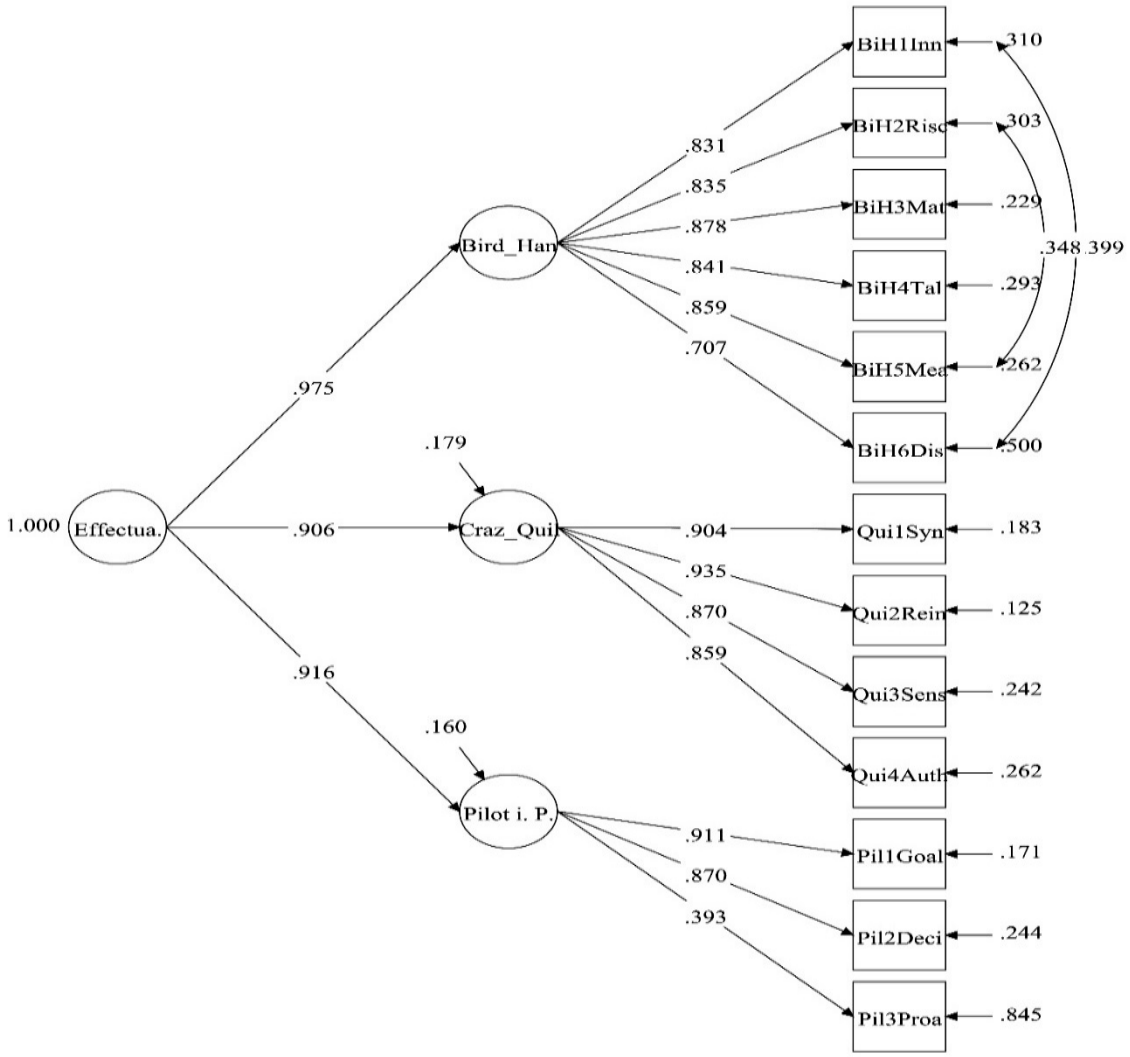
The explorative and subsequent confirmatory factor analysis revealed strong/acceptable support for the use of only three (3) endogenous dimensions of the effectuation framework (RMSEA: 0.087; CFI: 0.96/TLI:0.95; SRMR:0.037): 1) the bird-in-hand principle, 2) the crazy quilt principle, and 3) the pilot-in-the-plane principle.

The fit indices of the five-factor solution proved quite disappointing: RMSEA: 0.14; CFI:0.82/TLI:0.79; SRMR:0.14. This justifies a rejection of the five-factor solution (Van de Schoot *et al.* 2012; Cheung, 2008).

Measurements of the lemonade principle loaded very unclearly just as two measurements of the affordable loss principle loaded: the affordability and acceptability of future losses. Only

the exogenous measurement ‘conducting a thorough risk analysis’ loaded satisfactorily for the bird-in-hand principle. The full measurement part of the model is presented in Figure 1.

Figure 1.



All of the (effectual) behaviour indicators listed in Figure 1 proved to have good measurement indices. All were used as judgement criteria by the assessors. The selected indicators embedded in the final model are presented below:

Bird-in-hand principle:

BiH1Inn: *innovative capacity to explore business opportunities*

BiH2Risc: *conducting a thorough and well-scrutinised risk analysis*

BiH3Mat: *a strong entrepreneurial vision that matches the value proposition in the business model to consumer needs*

BiH4Tal: *capacity to embed own unique talents and capacities into the business model*

BiH5Mea: *designing a broad set of means and reflecting on their possible effects on a wide range of goals*

BiH6Dis: *capacity to design disruptive business models.*

Crazy quilt principle:

Qui1Syn: *attaining a mutual synergy with strategic stakeholders*

Qui2Rei: *achieving a mutually reinforcing effect when communicating business ideas*

Qui3Sens: *strong sensitivity to the feedback and social signals of discussion partners*

Qui4Auth: *surprising others by introducing authentic and innovative perspectives and views.*

Pilot-in-the-plane principle:

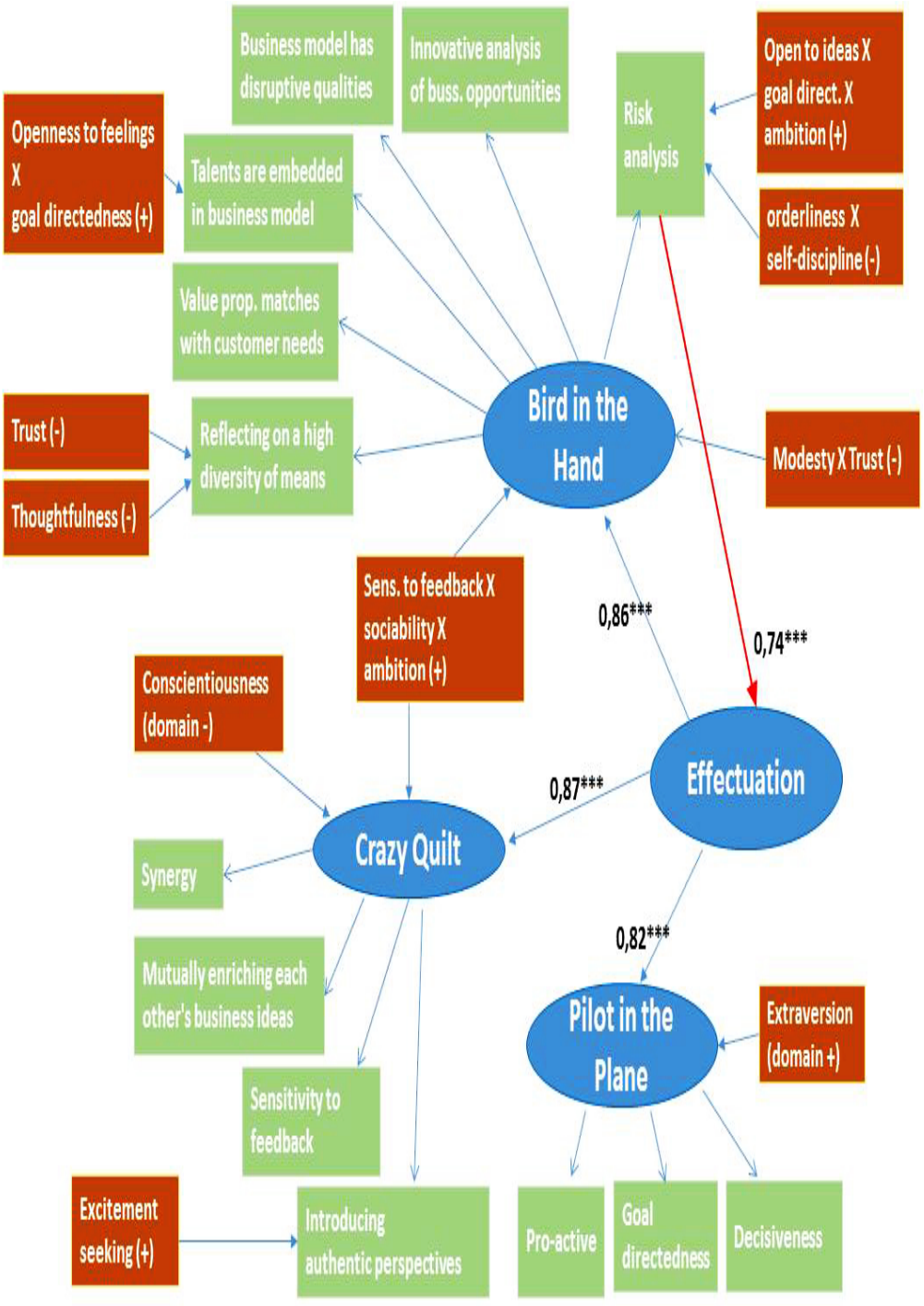
PiP1Goal: *being goal-oriented, having a strong vision on implementing means*

PiP2decis: *decisiveness, proactive firmness in decision-making*

PiP3ProA: *anticipating future implementation complexities.*

The final model is presented in Figure 2.

*Figure 2.* ***Final model****, presenting relationships between the three effectuation principles: 1) Bird-in-hand, 2) Crazy quilt, and 3) Pilot in the plane, with Big 5 personality traits*



The model fit indices of the final model as presented in Figure 2 proved to be very satisfying: RMSEA: 0.03; CFI: 0.983/TLI: 0.978; SRMR: 0.035 (Van de Schoot *et al.*, 2012).

Table 1 presents the proportion of explained variance of the overall capacity to apply effectuation principles and the three endogenous variables.

*Table 1*. ***Final model,*** *estimated proportion explained variance, R-square of the three effectuation principles, and the overall capacity to apply effectuation principles*

| Endogenous (latent variable) | Estimated proportion explained variance R-square | Two-tailed P-value |
|---|---|---|
| Bird-in-hand principle | 92% (0.916) | 0.000 |
| Crazy quilt principle | 82% (0.820) | 0.000 |
| Pilot in the plane principle | 83% (0.828) | 0.000 |
| Overall effectuation capacities | 73% (0.728) | 0.000 |

The figures revealing the proportion of explained variance, varying from 73% to 92%, are strong. Combined with the model fit indices (RMSEA: 0.03 ; CFI: 0.983/TLI: 0.978; SRMR: 0.035) they reveal robust support for the final model. The proportion of explained variance for the overall effectuation capacities (73%), the final and overall dependent endogenous variable, seems especially convincing.

*Relationships of personality and the three effectuation principles*

Tables 2, 3 and 4 present the relationships between all three effectuation principles, the bird-in-hand, the crazy quilt and the pilot-in-the-plane principles, and the personality traits.

*Table 2. **Bird-in-hand** principle, relationships with personality and the estimated predictive strength*

| **Bird-in-hand** principle (latent variable) ON | Estimated predictive strength R-square |
|---|---|
| **Moderation** between Sensitivity to feedback X sociability X ambition | 0.19*** |
| **Moderation** between Trust X modesty | -0.15* |

* p<0.05 *** p<0.001

*Sensitivity to feedback* (*self-consciousness*) measures a sensitive alertness to feedback and social cues. Sociability measures a synergetic interaction with others. Ambition is defined as striving for higher achievement. All three of these Big Five facets are embedded in one moderating variable that is positively related to the bird-in-hand principle. A negative effect exists for the moderation effect between trust and modesty. Trust measures trusting others, modesty a lower self-attribution of success.

*Table 3. **Crazy quilt** principle, relationships with personality traits and the estimated predictive strength*

| **Crazy quilt** principle (latent variable) ON | Estimated predictive strength R-square |
|---|---|
| **Moderation** between Sensitivity to feedback X sociability X ambition | 0.16* |
| **Domain** variable Conscientiousness | -0.25* |

* p<0.05

The moderating effect between *sensitivity to feedback* X *sociability* X *ambition* is positively related to the crazy quilt principle, just as it positively impacts the bird-in-hand principle. Moreover, the *conscientiousness* domain negatively impacts the crazy quilt principle. *Conscientiousness* measures the goal-directed, efficiency-based capacity to implement business procedures.

*Table 4.* ***Pilot in the plane*** *principle, relationships with personality traits and the estimated predictive strength*

| **Pilot in the plane** principle ON | Estimated predictive strength R-square |
|---|---|
| **Domain** variable | |
| Extraversion | 0.23*** |

*** $p<0.001$

A positive impact exists for the *extraversion* domain on the pilot-in-the-plane principle. *Extraversion* measures facets like self-initiative, assertiveness, instigating a cohesive interaction, susceptibility to risk and sociability.

*Key features of the bird-in-hand principle*

- Conducting a thorough risk analysis, a measurement of the bird-in-hand principle, is related to two moderation variables: 1) the moderation (interaction) effect between *openness to new and unknown ideas* X *goal-directedness* X *ambition* (0.16*, positive effect), and 2) the moderation between *orderliness* X *self-discipline* (-0.25*, negative effect).

Another salient result is that a direct and strong relationship exists between capacities to conduct a thorough risk analysis with the overall capacity to apply the effectuation principles.

- The capacity to embed own talents in an innovative business model is a key measure of the bird-in-hand principle. It relates to the following moderation variable *openness to feelings* X g*oal-directedness* (0.16*). Openness to feelings measures an inner curiosity and reflexivity on feelings.

- Consideration of a wide range of means is negatively impacted by two facets: *trust* (-0.30*) originating from the *agreeableness* domain, and *thoughtfulness* (-0.36*) originating from the *conscientiousness* domain. *Trust* was explained earlier; *thoughtfulness* measures the capacity to design and implement effective business procedures.

- The capacity to introduce authentic and surprising perspectives when interacting with significant people is positively related to with the personality trait *excitement seeking* (0.13**), measuring attitude towards adventure and susceptibility to risk.

*Pilot-in-the-plane*

The third effectuation principle, the pilot-in-the-plane, is positively impacted by the *extraversion* domain, revealing a comprehensive relevancy of all underlying features like self-initiative, cordiality, assertiveness, sociability and risk-seeking during social interaction.

**Discussion**

This study was conducted with the aim of enhancing the theoretical understanding of the underlying dynamics and mechanisms of effectuation principles. The model reveals strong support that the bird-in-hand principle, the crazy quilt principle (inspirational networking) and the pilot-in-the-plane principle can be identified as quite relevant effectual behaviours in the entrepreneurial strategic decision-making process in the prelaunch phase. Moreover, the measurements or rating criteria of the three core dimensions of effectual behaviours,

displayed in the results section, seem to offer useful key performance indicators to entrepreneurs aiming to mobilise such effectual behaviours.

*The confirmatory factor analysis*

Another salient result of the confirmatory factor analysis is that the following three effectuation principles have proven to be valid and comprehensive measures of overall capacities in executing effectual behaviour in a pre-launch phase: 1) *the bird-in-hand principle,* 2) *the crazy quilt principle*, and 3) *the pilot-in-the-plane principle.* Although this result is somewhat surprising, the categorisation of effectual behaviour into three major dimensions corroborates the work psychology and human performance literature (Arnold *et al.,* 2005). As explained earlier, research from the work psychology and human performance fields explains that cognitive analytic skills, social interaction skills and goal-directed professional qualities have proven to be comprehensive but quite distinct social constructs with good social construct indices.

The lemonade principle was not found to be a major dimension in this study. From a theoretical point of view, one may argue that the lemonade principle is more relevant to the post-launch or implementation phase (Sirén *et al.*, 2018; Chandler *et al.*, 2011). Furthermore, the model supports a non-orthogonal view on the entrepreneurial qualities of susceptibility to risk and self-initiative/ being self-directed. This implies that susceptibility to risk and effectively conducting a solid risk analysis should be conceptualised as independent dimensions. Theoretically conceptualising a strong level of independence between these two entrepreneurial qualities supports scientific doubts on a hampering effect of a solid risk analysis on risk proneness and self-initiative. Furthermore, the confirmatory factor analysis

revealed that disruptive capacities should be considered a relevant effectual behaviour for the bird-in-hand principle. In the theoretical conceptualisation of this principle, little attention is given to entrepreneurial capacity to design disruptive business models (Reuber *et al.,* 2016).

*Relationship between the three effectuation principles and personality*

The final model on the relationship between personality and effectuation principles strongly supports the relevance of personality traits for applying effectuation principles. It has been claimed by one of the major developers of the effectuation framework, Saras Sarasvathy, that a trait approach cannot be considered useful in understanding the application of the effectuation principles (Sarasvathy & Dew, 2008). According to Sarasvathy, effectuation is a manifestation of entrepreneurial experience and expertise. The results of this study seem to cast serious doubt on this claim, based on the model revealing a strong and significant relationship between effectuation principles and personality. Entrepreneurs with a specific personality profile are more inclined to behave effectually. This is in line with research on the PEF framework, showing that the role of personality traits as dispositional variables cannot be neglected when a human performance in any work context is studied (see for an overview in Furnham, 2008, pp 35-40; Barrick, 2005).

*Extraversion and conscientiousness domains*

The crazy quilt principle is negatively related to the *conscientiousness* domain, while the pilot-in-the-plane principle relates positively to the domain *extraversion*. None of the separate facets originating from these domains proved to be related to these two

effectuation principles, accentuating the importance of a complete and comprehensive pattern of all facets (sub-scales) belonging to one domain.

*Patterns of personality traits, as opposed to levels*

Another salient result of this study is that specific patterns or combinations of personality traits matter, as opposed to levels, an insight corroborated by recent research results (Zhou *et al*., 2018). A key item in designing the moderation variables was research on the PEF framework and theoretical considerations on entrepreneurial personality (Schneider, 2007; Baum *et al*., 2014). An interaction/moderation effect means that personality traits falling within one pattern (within one moderation variable) mutually reinforce each other. This implies that combining multiple entrepreneurial qualities related to Big Five personality traits has a strong impact when compared to the impact of higher or lower levels of one specific personality trait. As explained earlier, this also applies to significant relationships within a complete domain, including all the six personal facets belonging to one domain.

*Relationship of the bird-in-hand principle to personality*

The bird-in-hand principle relates to two (2) specific moderating variables:

1. *sensitivity to feedback and social signals X sociability X ambition*
2. *lower trust X lower modesty*

The result for sensitivity to feedback and social signals, originating from the *neuroticism* domain, is somewhat surprising. Meta-studies reveal that facets originating from the *neuroticism* domain have an overall negative impact on human performance (Barrick *et al.,* 2001; Barrick and Mount, 1991). However, instead of the expected negative effect,

sensitivity to feedback and social cues proved to have a positive impact on the bird-in-hand principle when combined with sociability and ambition. This aligns with studies showing that there seems to be a positive impact of facets originating from the *neuroticism* domain in innovative, adaptive and learning capacities (Hensel and Visser, 2018; Hensel, 2010). Managerial developmental capacities are positively impacted by higher sensitivity to feedback and social cues (Hensel, 2010). Furthermore, despondency, a trait also originating from the *neuroticism* domain, is positively related to shared, transformational leadership qualities (Hensel and Visser, 2018). This is in line with studies on brain learning, with the explanation that effective brain learning in complex and ambiguous work and learning situations demands alertness (Li *et al.,* 2015). Lower scores on sensitivity to feedback can be interpreted as a low(er) form of alertness (Heilig, 2004).

The result for the facet sociability, originating from the *extraversion* domain, is hardly surprising. *Extraversion* measures entrepreneurial core competencies, with well-known examples being self-directedness/assertiveness and self-initiative. Sociability in particular measures a synergetic way of interacting with others, with a mutually reinforcing effect. The interaction effect with sensitivity to feedback means that this synergetic way of interacting with others is important for the bird-in-hand principle but should be combined with a strong sensitivity to feedback. The third facet in this moderating variable is ambition. This implies that the interaction between sensitivity to feedback and sociability should be enhanced by greater striving for achievement. This result is highly aligned with other research results showing that ambition is relevant for entrepreneurial success (Baum *et al.*, 2014, pp. 15-18).

Moreover, a negative impact for the bird-in-hand principle was found for the moderating effect between trust and modesty, both originating from the agreeableness domain. A*greeableness* measures a warm, personal and cohesive way of interacting with others (Barrick *et al.,* 2001). However, higher *agreeableness* is related to lower intellectual autonomy, which is an important entrepreneurial quality when innovative or disruptive qualities are required (see for an overview in Baum *et al.*, 2014, pp. 15-18; Dyer *et al.,* 2008). Consequently, scores on trust and modesty can be quite useful for an entrepreneurial reflection on intellectual autonomy. The negative impact of modesty points to the relevance of higher self-confidence for 'coping with frustration'.

*Risk analysis*

The capacity to conduct a thorough and well-scrutinised risk analysis relates to two moderation effects: 1) *openness/ intellectual curiosity for new ideas X goal-directedness X ambition (positive impact);* 2) *orderliness X self-discipline (negative impact).*

In order to conduct a thorough and well-scrutinised risk analysis, intellectual curiosity for new ideas should be combined with goal-directedness and strong achievement striving (ambition). This highlights the intra-psychological character of the process of analysing prospect risks.

A salient result of this study is the negative impact of the interaction (moderation) between orderliness and self-discipline. Orderliness measures a controlled, orderly and rational way of working, self-discipline a rigorous and straightforward style of achieving goals. This result suggests that such a self-disciplined, rigorous and orderly style of working hampers the intellectual creativity and visionary goal-directedness needed for effective entrepreneurial risk analysis.

The final model reveals the existence of a strong direct impact of thorough risk analysis on the overall capacity for displaying effectual behaviour, a result highlighting the overall relevance of proactive behaviours in analysing risks.

*Reflection on own talents*

A core feature of the bird-in-hand principle is the reflection of own unique talents, with the aim of embedding unique talents and capacities into the business model. This key feature is related to the moderating effect between openness for feelings and goal-directedness. Consequently, the capacity to apply this key principle seems to require an inner curiosity for feelings combined with goal-directedness.

*Consideration of a wide range of means*

Considering a wide range of means and turning available means into new ends is a key element of the effectuation framework, especially for the bird-in-hand principle. A negative impact for two (2) of the Big Five facets was found for this cognitive effectual skill: trust and thoughtfulness. Higher trust seems to hamper intellectual autonomy, damaging the entrepreneurial ability to analyse a wide range of means to achieve a given set of goals. The relevance of intellectual autonomy conforms with other research on the entrepreneur's personality (Baum *et al.*, 2014). Thoughtfulness measures a strong orientation on designing work procedures and adapting to such procedures. It seems that higher thoughtfulness hampers the creative ability to develop a holistic view on a wide diversity of means to innovatively turn available means into new strategic goals.

*Relationships of the crazy quilt principle with personality*

The moderation effect between sensitivity to feedback, sociability and ambition also relates to the crazy quilt principle, a result that reveals a strong relevance of this moderation variable to executing two major effectuation principles: the crazy quilt and the bird-in-hand principles. All previously described considerations also apply to the crazy quilt principle.

A major difference exists, however. The crazy quilt principle is closely related to lower averages for the *conscientiousness* domain. *Conscientiousness* measures an orderly, goal-directed style of working, with a strong orientation on work procedures. The surprising aspect of this research result is that entrepreneurial qualities in the crazy quilt principle are not related to higher averages for *extraversion* but to lower *conscientiousness*. The crazy quilt principle is defined as an important networking ability, embedding two key entrepreneurial qualities: 1) inspirational networking aimed at the redesign and improvement of innovative business models; 2) detecting and forming important strategic alliances. Inspirational networking, represented by the crazy quilt principle, is considered one of the key processes in the contingency leverage principle. Based on the meta-studies on the PEF, one would expect significant results for facets originating from the *extraversion* domain, because they represent entrepreneurial core-competencies like being self-directed, assertive, and full of self-initiative (Barrick *et al.,* 2001). However, only the facet sociability, originating from *extraversion*, is related to the crazy quilt principle, and only when embedded in a moderating variable, interacting with sensitivity to feedback and ambition. Therefore, it is important to highlight that higher *conscientiousness*, meaning an orderly procedure-oriented way of working, hampers the inspiring networking ability measured by the crazy quilt principle. Surprisingly, none of the facets of the *conscientiousness* domain

proved to have a significant negative impact. This means that the whole comprehensive pattern measuring *conscientiousness* seems to be relevant for a negative impact of a higher *conscientiousness* on the crazy quilt principle.

*Surprising others with authentic perspectives*

The capacity to surprise others by introducing authentic perspectives during dialogue on business ideas was positively impacted by the personality trait excitement-seeking, originating from the dimension *extraversion*. Excitement-seeking is defined as risk-taking behaviours during social interaction, especially in larger groups of individuals.

*The pilot-in-the-plane principle*

A core point of the pilot-in-the-plane principle is the business opportunity creation process, leading to the creation or co-creation of business opportunities, requiring goal-directed and proactive behaviours. These are important for proactively anticipating future complexities or implementation problems. Only the *extraversion* domain and none of its embedded facets have proven to have a significant positive impact. This means that the whole pattern is relevant for the positive impact of higher *extraversion* on the pilot-in-the-plane principle. This is hardly surprising, because *extraversion* identifies core entrepreneurial qualities like being self-directed and full of self-initiative (Barrick *et al.,* 2001). This means that the entrepreneurial qualities of communicating in a cohesive, energetic and synergetic way, being self-directed and assertive, being risk-prone during social interaction and labelling others' behaviours in a positive way all seem to have an interdependent impact on the pilot-in-the-plane principle.

*Trust*

The role of trust in the process of applying effectual logic is currently the subject of scientific debate. It is argued that trust, especially over-trust, has a mitigating effect on entrepreneurial effectiveness when effectual logic is applied (Karri and Goel, 2008). Sarasvathy and Dew (2008), on the other hand, contradict this perspective by stating that trust has no impact, neither a positive nor a negative one. However, the research results presented in this paper show a strong and significant relevance of trust. This supports the research results of Welter (2012), revealing both a bright and a dark side to trust in the context of entrepreneurial performance.

## Practical implications

The research results offer deeper insights for the mobilisation and development of complex entrepreneurial behaviours, because they point to relevant underlying mechanisms and dispositional variables. The research results offer pragmatic insights into underlying entrepreneurial qualities in applying the effectuation framework or effectual logic, and insights into dispositional antecedents of mobilising effectual behaviours.

## Limitations and suggestions for future research

The most salient limitation of this study is the exclusion of the lemonade principle from the final model, based on unacceptable fit indices. Two underlying reasons could exist for the unsatisfying measurement indices that demanded the rejection of the lemonade principle as a core dimension in this study. First, the relevance of the lemonade principle as an emotional/cognitive analytic skill in a pre-launch phase could be significantly inferior to the three major dimensions included in the final model: the bird-in-hand, crazy quilt and pilot-in-

the-plane principles. However, as previously explained, the theoretical conceptualisation of the effectuation framework in three core dimensions matches other research results (Futterer *et al.,* 2018; Fang He *et al.,* 2018). Moreover, it seems to be in line with theoretical insights that no general entrepreneurial competencies exist and that the design of all entrepreneurial competencies demands a specification of the context (Baum *et al.*, 2014). Secondly, the applied assessment methodology could be unsuitable for measuring 'coping with frustration'. Coping with frustration is a complex intrapersonal process, making it very difficult for assessors to collect valid data by analysing a 'here and now' interaction.

Future research could enhance the theoretical understanding of the lemonade principle as a core dimension in the effectuation framework, specifying its relevancy for a pre-launch, launch and post-launch phase. Another limitation of this study is its cross-sectional design.

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