# Creativity Through Cognitive Fit: Theory and Preliminary Evidence in a Business Model Idea Generation Context

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**Abstract.** There are two major types of problems: routine problems and creative problems. Extant research has established the validity of cognitive fit theory for routine problems. However, its validity for creative problems has been left unaddressed. To advance cognitive fit theory to a (more) general theory of problem solving, we extend its original formulation to creative problems. We illustrate our extension through a contextualization to a specific creative problem, business model idea generation with the Business Model Canvas, and provide preliminary experimental evidence for our propositions. Thereby, we contribute to advancing the theory of cognitive fit, and provide a first step towards theory-guided design of modeling languages for business models.

**Keywords:** Cognitive fit theory, creativity, business model, innovation, canvas.

## 1 Introduction

Problems are a central part of human life, therefore problem solving is a permanent necessity [1]. The theory of cognitive fit is an established foundation for the design of tools for problem solving. It provides support by identifying problem representations that are efficient and effective for specific problem types [2]. The validity of cognitive fit theory (CFT) has been demonstrated for a wide range of problems, in contexts as diverse as conceptual modeling [3], multiattribute decision making [4], network analysis [5], and website design [6]. Consequently, the theory of cognitive fit has been claimed to be *"one aspect of a general theory of problem solving"* [7].

However, abstracting from specific contexts, it becomes clear that previous research, without exception, has focused on a specific type of problems: *routine* problems (problems which can be solved through existing knowledge [8]). For this problem type, a firm foundation for the validity of CFT has been established. There is, though, another problem type with substantial importance. This type comprises the problems that cannot solely be solved through existing knowledge, but rather require new ideas to be generated: *creative* problems [8]. The importance of creative problems is reflected in that creativity is considered a key enabler to organizational prob-

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lem solving [9], and a driver of the performance and competitiveness of firms [10]. In a global study by IBM [11], creativity ranks first among a number of organizational capabilities, with 60% of the surveyed chief executives giving it top priority.

The apparent importance of creativity suggests that for developing CFT towards a truly *general* theory of problem solving, research is needed to determine whether cognitive fit can enhance performance not only in *routine*, but also in *creative* problem solving. We seek to contribute a first step into this direction. Thereby, we reconcile two conflicting notions which lie at the heart of applying CFT to creative problems: while CFT predicts *fit* to promote problem solving performance [2], creativity research apparently suggests the contrary, namely that *contradictions* (e.g., between creative stimuli) promote creativity [12].

To scope our work, we focus on one specific creative problem: business model innovation. We chose this problem for two reasons: First, the business model concept has become a major research topic in information systems (IS) research. This is evidenced, for example, by recent articles [13–18] in each journal in the Senior Scholars' Basket of Six, as defined by the Association for IS [19]. Moreover, also scholars beyond our discipline have attributed to IS a major role in advancing the business model concept [20]. Second, the importance of business model innovation is not only emphasized by researchers, but also by practitioners in virtually any industry [21].

Business model innovation refers to innovating the foundational logic of how an organization creates, captures and delivers value [22]. For developing business model innovation ideas, a number of modeling languages have been proposed. Among these, the *Business Model Canvas* is by far the most popular approach, being widely used in research (e.g., [23–25]) as well as corporate practice [26]. However, despite the popularity of the canvas, the theoretical mechanisms which contribute to its popularity and its potential utility are largely unknown. Consequently, no theoretical foundation is available for advancing the canvas or other modeling approaches intended to support business model idea generation. Moreover, to the best of our knowledge, only one controlled experiment has so far been conducted for evaluating the utility of the canvas in creativity tasks. However, that experiment [23] has yielded rather contradictory results, thereby even questioning the utility of the canvas in its current form.

For developing our theoretical arguments, we follow Hong et al.'s guidelines for context-specific theorizing in IS [27]. Thereafter, we present the results of an exploratory study that we conducted as a first step towards testing our theory. Thereby we make contributions at two levels: At the first level, we extend the theory of cognitive fit to creative problem solving. Thereby we extend the boundaries of CFT to include a whole new class of problems with substantial relevance, and contribute to advancing CFT to a (more) general theory of problem solving. At the second level, we contextualize our extended CFT to the task of business model idea generation. We hope that this contextualization, being based on research in business model innovation, creativity and visual perception, constitutes a first step towards theory-guided design of modeling languages for business model idea generation. We thereby contribute to an emerging research area in IS [15, 28], which has been termed a *"unique opportunity"* to strengthen the impact of IS also beyond its boundaries [15].

## 2 Extending Cognitive Fit Theory to Creative Problems

### 2.1 Cognitive Fit Theory

The theory of cognitive fit has its origin in the debate on whether information is better represented in a graph or a table. Before the inception of CFT, a large number of studies had investigated which of these presentation formats leads to better problem solving performance, however, with inconsistent results. The theory of cognitive fit [2] resolved this issue through the finding that a given problem representation is not by its very nature superior to another. Rather, it is the interplay between a *problem representation* and a given *problem solving task* that determines the resulting *problem solving performance* (see fig. 1, note that we use *italics* to highlight references to specific constructs in our models).

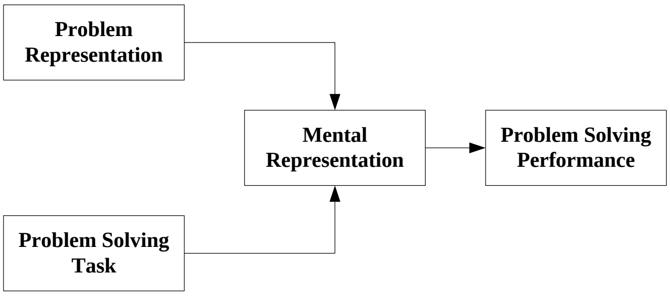


**Fig. 1.** General problem solving model [2]

The cognitive rationale underlying CFT is that when seeking to solve a problem, humans form a *mental representation* of that problem in working memory. This mental representation integrates characteristics of the *problem representation* (i.e., the information used to represent the problem being worked on) and the *task* (i.e., what specific type of question is being worked on). CFT argues that mental processes have to be invoked for processing representational as well as task characteristics. A match between characteristics of the *task* and the *problem representation* allows using similar mental processes for acting on the representation and solving the task, leading to an increase in *problem solving performance* in terms of effectiveness and efficiency.

A considerable body of work has been accumulated on the utility of CFT in a variety of contexts. Reviewing the empirical literature on CFT, Vessey [7] concludes that its propositions have generally received support. In that review, existing research has also been classified according the problem type being addressed, with no study being identified that addresses creative problems [7]. To find out whether creative problems have been addressed more recently, we performed a keyword search in the ISI Web of Science. Until the end of 2013, a total of 255 publications had cited the foundational paper of the CFT [2]. A search for *creativity OR creative OR ideation OR "idea generation"* within those 255 articles yielded six articles. However, these articles treat CFT and/or creativity only marginally.

### 2.2 Creative Problems

Creativity comprises two essential elements: First, the generation of an idea that is both novel and useful; and second, the task being rather heuristic than algorithmic [10]. From a cognitive perspective, creative tasks are a special case of problem solving tasks: Solutions are sought for specific problems, with the distinctive feature that a solution cannot be found within existing knowledge. Therefore, creative, or novel ideas are needed [29]. Comparable to routine problem solving, creative work is cognitively demanding, requiring substantial resources in working memory [30]. A difference, however, concerns the thinking processes involved. Routine problem solving mainly involves convergent thinking, which emphasizes the quest for a single correct solution. Creative problem solving relies on divergent thinking, which involves generating and exploring a large number of new solutions [31].

A challenge in the creative process is that storing a large number of intermediate and alternative solutions imposes heavy load on working memory, which constrains creative performance. For alleviating this issue, possible solutions can be represented externally, that is, creating an *"external memory"* which decreases the load on working memory and thereby enhances creative performance. The corresponding mechanisms have been explored in the literature on sketching and idea generation [32]. In that context, sketching refers to externalizing (intermediate) ideas. Idea sketching is performed freely on a blank slate, and unconstrained by specific representational rules. It involves a cyclic process in which the mental representation and the external representation of ideas interact, meaning that mental processes can give rise to changes in the external representation of ideas, which in turn may initiate changes to the ideas stored in the mental representation [32].

### 2.3 Creative Cognitive Fit Theory

The theory of cognitive fit conceptualizes a *problem representation* as an entity which contains the information necessary for solving a given task. While CFT has been applied in contexts that involve manipulations of that representation (e.g., [5]), the information being contained is *permanent* in the sense that it is not changed (as it is considered sufficient for solving the task at hand). The challenge according to the original model of CFT is to find structures that exhibit cognitive fit with the task so as to facilitate extracting the available information. For creative problems in contrast, the available information is not sufficient, because it is the very nature of creative problems that new information is required for them to be solved. Therefore, in creative problem solving processes, a *working* representation of ideas is needed, as suggested by the sketching literature. However, diverging from the sketching literature, we propose that this *working* representation in some instances does not need to be developed on a blank slate. Rather, following ideas of CFT, it can be supported by predefined visual structures that guide the way in which ideas are captured. This is the case especially for abstract concepts which do not have a natural format for being represented, such as the business model concept addressed in this research.

Hence we modify the original model of CFT to reflect the distinction between a *permanent problem representation* (*permanent representation*) and a *working prob-*

*lem representation* (*working representation*, see fig. 2). Our terminology is inspired by the computer science terms of working memory (for volatile information) and permanent memory (for non-volatile information). The *permanent representation* influences the *mental representation* of the problem in two ways. First, there is a direct influence as in the original CFT model, because the *permanent representation* is at the outset of the creative problem solving process and therefore influences the initial perception of the problem and thereby subsequent mental processes. Second, there is an indirect influence, because the *permanent representation* provides a prescription for how ideas are to be stored in the *working representation*. As the *working representation* and the *mental representation* engage in a cyclic interaction, the *permanent representation* also indirectly influences the *mental representation*.

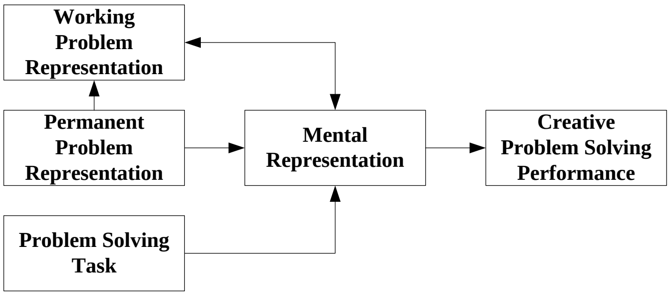


**Fig. 2.** Creative problem solving model

The cyclic process of idea exchange between *mental representation* and *working problem representation* involves repeatedly interpreting and representing developed ideas in the context of the *problem solving task*. The more efficient these activities of interpreting and representing ideas are performed, the lower the resulting working memory load, and the higher in turn the resulting *problem solving performance*. Therefore, we state the following proposition:

> *Proposition:* In a creative problem solving task, when the characteristics of the permanent problem representation and the problem solving task match (i.e., exhibit cognitive fit), creative problem solving performance increases.

This proposition is seemingly at odds with creativity research that suggests contradictions, rather than fit, to be a source of creativity. For example, it has been found that contradictory words or pictures can stimulate new ideas [12]. However, the corresponding contributions pertain to visual or semantic stimuli. These represent specific (working) content from which further ideas can be developed. In our extended model, these stimuli do not interact with the *permanent representation*, but rather reside at the level of the *working problem representation*.

## 3 Contextualizing Creative Cognitive Fit Theory to Business Model Idea Generation

### 3.1 Permanent Problem Representation

Concerning problem representations, a major distinction exists between the semantics and the syntax of a representation. Semantics refer to the content that is to be represented (i.e., what is represented?). The (visual or concrete) syntax refers to the form of the visual notation (i.e., how is content presented?) [33]. With regards to business models, the semantics concern the business model definition which the to-be-developed ideas should comply with. The syntax refers to a possible visual notation for presenting the key elements of those ideas.

So far, no unanimously accepted definition (i.e., semantics) of the business model concept has been achieved [20]. However, attributional definitions, which define a concept by enumerating its attributes or constituents [34], account for the major share of available business model definitions. These definitions operationalize the business model concept by defining a number of components which serve as a *"checklist"* for describing a business model. A recent review of such definitions identified 34 different component-based business model definitions with three to twenty components [35]. For example, according to Osterwalder and Pigneur [22], a business model can be described through the following nine components: value proposition, customer segments, channels, customer relationships, revenue streams, key resources, key activities, key partners, cost structure.

While a semantic foundation is essential for working with a concept (e.g., for defining which ideas qualify as a business model idea and which do not), a specific syntax (i.e., visual notation) does not necessarily need to be defined. In line with this, the vast majority of authors providing a business model definition remain silent regarding syntax, that is, they do not prescribe a specific visual notation to be used with their definitions. Implicitly this suggests using the business model components in a naïve, list-like manner. Consequently, a list of business model components constitutes the first problem representation available for business model innovation tasks.

Beyond the literature that defines a business model in terms of components and thereby focuses on the semantics of the business model concept, other authors have explicitly included syntax (visual notation) into their considerations. In this regard, a number of modeling languages have been proposed for the purpose of representing business models (for a review see: [36]). Specifically for the purpose of business model innovation, the modeling languages have, for example, been claimed to support finding new design options [37], conducting mental experiments [25], or collaborating in group contexts [23]. However, empirical evidence for the claimed advantages is ambiguous. While qualitative evidence has been collected in favor of some approaches through action research and case studies (e.g., [37, 38]), quantitative evaluation has yielded contradictory results. To the best of our knowledge, only one controlled experiment has been conducted for evaluating the effectiveness of a modeling language for business model idea generation. The corresponding authors, Eppler et al. [23], hypothesized that employing the Business Model Canvas [22] would increase users' creativity compared to the PowerPoint control condition, and hence lead to more innovative business model ideas. Interestingly, the authors find that *"the results are significant, but in the opposite direction of our predictions. Subjects who use the interactive template [canvas] perceive themselves as significantly less creative"* [23].

Of the approaches that specifically consider syntax, the canvas has by far received the most attention in research (e.g., [23, 24]) and *"is nowadays widely deployed in corporate practice"* [26]. The widespread acceptance of the canvas drove our decision to define it as the second problem representation to consider in our research. The canvas builds upon the nine business model components by Osterwalder and Pigneur [22] that we introduced above. However, it prescribes a visual notation (see fig. 3) which has two main characteristics:

- *Matrix structure:* The business model components are laid out in a two-dimensional grid (in contrast to the unidimensional presentation in a list).
- *Semantic proximity:* The business model components are not laid out arbitrarily, rather the layout positions components with more interrelations closer to each other than those with fewer relations. For example, the components that define the business model characteristics which are decision-relevant for customers (the business model front-end) are positioned at the right-hand side, those not being decision-relevant for customers (the back-end) are positioned at the left-hand side [24].

**List**

| |
|---|
| Customer segments |
| Value propositions |
| Channels |
| Customer relationships |
| Revenue streams |
| Key resources |
| Key activities |
| Key partnerships |
| Cost structure |

**Canvas**

<table>
<tr><td rowspan="2">Key partners</td><td>Key activities</td><td rowspan="2" colspan="2">Value propositions</td><td>Customer relationships</td><td rowspan="2">Customer segments</td></tr>
<tr><td>Key resources</td><td>Channels</td></tr>
<tr><td colspan="3">Cost structure</td><td colspan="3">Revenue streams</td></tr>
</table>

**Fig. 3.** Permanent problem representations for business model idea generation tasks: list and canvas (canvas representation based on [22])

In summary, two *permanent problem representations* can be distilled from the literature as being especially relevant for business model idea generation tasks. The first, a list of components, is implicit in the majority of business model definitions, because the corresponding authors remain silent regarding a representation that diverges from a naïve, list-like representation. Its relevance is derived from the great number of authors who implicitly suggest this representation. The second *permanent problem representation* is the canvas, whose relevance is derived from its widespread application in research and practice.

### 3.2 Problem Solving Task

There is one overarching characteristic of the business model concept which inevitably shapes processes of business model idea generation, and therefore, allows deriving requirements which characterize the problem solving task. This overarching characteristic is the business model concept's aspiration to provide an integrated, high-level perspective on a company's economic logic. This high-level perspective is needed to abstract from specific functional perspectives to avoid neglecting important interdependencies between these perspectives. This view is manifest, for example, in statements such as *"a business model is a concise representation of [.] an interrelated set of decision variables"* [39] or *"[the business model concept] draws from and integrates a variety of academic and functional disciplines"* [40]. The importance of interdependencies between disparate functional areas, or using the terminology introduced before, business model components, has also been underlined through a literature review specifically dedicated to analyzing whether interdependencies exist between business model components [35]. From what has been said, two characteristics of the problem solving task follow:

- *(Almost) Equal importance of business model components:* The process of developing business model ideas inevitably involves giving due consideration to (nearly) all available business model components. Otherwise the strength of the business model concept, that is, its integrated, high-level perspective, will not be leveraged.
- *Importance of interrelations between business model components:* It is not enough to consider (nearly) all available business model components. Rather, it is also important to consider the effect of interrelations between these components.

### 3.3 Working Problem Representation

The *working problem representation* captures the (intermediate) ideas for potential business models, either self-created or taken from existing examples.

### 3.4 Creative Problem Solving Performance

Contextualizing *creative problem solving performance* to our research involves two steps. First, we need to delineate business model innovation from other types of innovation to ensure construct validity for subsequent empirical analyses. Second, we need to operationalize problem solving performance for our context.

No precise definition of business model innovation has yet been developed [41]. At an abstract level, a business model describes the foundational logic of how an organization creates, captures and delivers value. Consequently, business model innovation refers to an innovation of that foundational logic [22]. In a similar vein, business model innovation has been referred to as a change in a firm's value proposition, the addressed market segments, or its value chain architecture [25]. While being indicative of the wide range of phenomena referred to by researchers as business model innovation, such abstract definitions preclude a succinct delineation of a business model innovation from other types of innovation, such as product, service or market innovation. However, only if generated ideas can unanimously be classified as business model innovation ideas, our theory is testable.

Emphasizing the distinction between the business model concept and the concept of product market strategy, a more precise definition of a business model innovation can be derived. The product market strategy of a company defines which customers to serve and which products to sell. It is a means for generating a competitive advantage that is distinct from the business model, and therefore is defined separately (typically before the business model) [42]. Consequently, we assume that business model idea generation takes place when the product(s)/service(s) to be offered within one's value proposition have already been defined. The same applies to the customer segment(s) to be addressed. Therefore, in the context of the aforementioned *permanent problem representations*, we define a business model innovation as follows: A business model innovation is a change in any of the nine business model components as long as the customers and product(s)/service(s) of the original business model also appear in the new business model (i.e., the product market strategy is retained).

CFT defines problem solving performance in terms of *effectiveness* and *efficiency*. For measuring problem solving performance according to our definition, effectiveness and efficiency have to be translated into the business model innovation context. The first performance dimension, effectiveness, we define to denote the quality of generated ideas, as idea quality is superior to other quality measures such as the number of ideas generated [9]. The second performance dimension, efficiency, in previous research efforts on CFT has been operationalized as the time needed for fulfilling a given task. This operationalization, however, has turned out as a potential confound, since it is not always clear how experimental participants trade off the effectiveness measure *quality* with the efficiency measure *time* [7]. Therefore, in line with previous research in conceptual modeling [43] we operationalize problem solving *efficiency* through the *perceived ease of use* as experienced by users.

### 3.5 Contextualized Creative Cognitive Fit Theory

Figure 4 summarizes how we contextualized our extended theory of cognitive fit to the business model idea generation tasks using the Business Model Canvas. Our extended theory of cognitive fit suggests that the *permanent problem representation* and the *problem solving task* jointly determine *problem solving performance*. Cognitive fit between the *permanent problem representation* and the *problem solving task* should result in an increase in the *effectiveness* and *efficiency* of the problem solving process. The *problem solving task* being analyzed in our context is that of *business model idea generation*. We have characterized the problem solving task through the *(almost) equal importance of business model components* (hence referred to as *equal importance characteristic*) and the *importance of interrelations between business model components* (hence referred to as *interrelations characteristic*). Further, we have characterized the Business Model Canvas through its adherence to a *matrix structure* and to *semantic proximity*.

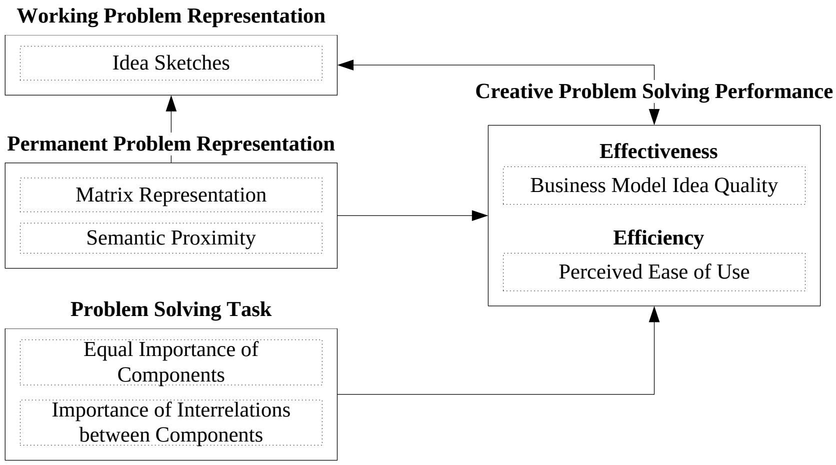


**Fig. 4.** Creative cognitive fit theory contextualized to business model idea generation

# 4 Towards Testing the Contextualized Creative Cognitive Fit Theory

## 4.1 Hypotheses

So far unaddressed is the question whether the canvas or the list problem representation yield a higher level of cognitive fit in a business model idea generation task, which in turn would increase *creative problem solving performance*. First, we clarify how the *matrix structure* characteristic of the canvas affects cognitive fit in our context. Then we turn to the *semantic proximity* characteristic.

Concerning the *matrix structure* characteristic, *competition for attention theory* (CAT) [6, 44] describes two mechanisms. One is the level of equality of the competition for attention in the visual field, the second is the aggregate competition for attention. A matrix structure is predicted to lead to a more equally distributed attention throughout the visual field [6]. With regards to the *equal importance* characteristic of the business model idea generation task this suggests the *matrix* to lead to a higher level of cognitive fit compared to the list. Moreover, the aggregate level of competition for attention determines the visual search processes employed, which in turn affects the distribution of attention to the business model components. CAT suggests that a low competition for attention environment such as a *matrix structure* favors goal-directed over exploratory search [6]. Goal-directed search, in turn, is needed in business model idea generation because there is a recurring need to deliberately shift attention from one business model component to another. Consequently, concerning the *equal importance characteristic*, also the indirect effect of the *matrix* representation, through promoting goal-directed search, suggests the *matrix* representation to exhibit a higher level of cognitive fit compared to the *list* representation. Moreover, the goal-directed search favored by the *matrix* representation also facilitates considering interrelations, because processing such interrelations again benefits from the possibility for deliberate attention shifts. Therefore, the *matrix* representation also leads to a higher level of cognitive fit with regards to the *interrelations* characteristic.

Next, we clarify how *semantic proximity* affects cognitive fit in our context. The *proximity compatibility principle* [45] suggests that how the business model components are laid out in the canvas may mediate the relationship between *matrix* structure and cognitive fit. As semantically similar business model components in the Business Model Canvas are positioned in spatial proximity, the mechanisms of the proximity compatibility principle should reinforce the cognitive fit which the *matrix* structure creates. Consequently, we expect the canvas to create more cognitive fit in business model idea generation tasks than the list, which leads to our hypotheses:

*Hypothesis 1:* In a business model idea generation task, idea quality is higher when employing the Business Model Canvas than when employing a list.
*Hypothesis 2:* In a business model idea generation task, perceived ease of use is higher when employing the Business Model Canvas than when employing a list.

### 4.2 Exploratory Study

As a first step towards the empirical validation of our theoretical propositions, we conducted an exploratory study which we briefly describe in the following.

**Sample, Design, and Procedures.** We conducted an experiment with 54 students (18 female, 36 male) of an undergraduate e-business course. The students mainly major in business administration, with a minority share of related majors (e.g., information systems, international business studies). Being in the final year of their undergraduate studies, the participants had received basic education in business strategy and thus resemble potential users in practice, first, in the sense of novice users engaging as entrepreneurs and, second, as representatives of later expert users in industry who are likely to have a business background. During their degree program, participants had not received specific training in business model development, thereby ruling out prior methodological preferences. Participation in the experiment was incentivized through additional course credit. Participants were further informed that through participating in the experiment they would have the chance to take advantage of a deeper understanding of the overall course contents.

We employed a randomized one treatment one control between-subject design. All participants received the same materials with only the visualizations of the business model components being different: a canvas for the treatment group and a list for the control group. The experiment was divided into two parts: (1) training (25 minutes) and (2) idea generation (25 minutes). The *training* materials contained unaltered text excerpts from [22] that introduced the nine business model components, complementary examples, an introduction to the sample product for which ideas were to be generated (smart glasses) and a brief questionnaire which collected information on prior experience and current (after training) understanding regarding business models and the sample product. The *idea generation* materials contained a brief explanation of the task that explicitly asked for creative and unconventional business model ideas and a sheet to be used by participants for recording their most innovative business model idea. Further, they were provided with a stapled set of scratch paper for recording intermediate ideas which had either a canvas or a list printed on it. The idea generation materials were concluded with a questionnaire asking for additional information on participants' background and perception of the experiment.

**Measures.** We measured perceived ease of use as our dependent variable using the scale of [46] in the German translation of [47]. We dropped item #4 because it explicitly refers to interactive systems and therefore was inapplicable to our context. To ensure that our manipulations were effective, in the final questionnaire we asked participants to what extent they had *treated all business model components as equally important* during the idea generation, to what extent they had *considered interrelations*, and combining these task characteristics, to what extent they had *adopted an integrated and comprehensive perspective* on the components.

**Results.** The reliability of the perceived ease of use scale was very good ($\alpha = .85$). Perceived ease of use was significantly higher for the canvas group than for the list group ($F[1, 51] = 4.85$, $p = .02$). Concerning manipulation effectiveness, participants for the canvas group were significantly better at adopting an *integrated and comprehensive perspective* ($F[1,50] = 7.02$, $p = .01$). However, the individual manipulation checks were in favor of our predictions, but not significant (for *equal importance*: $F[1, 52] = 1.1$, $p = .3$, for *interrelations*: $F[1, 51] = 1.1$, $p = .3$). The degrees of freedom vary because our data had missing values for some participants.

**Discussion.** Overall, the results are in line with our theoretical propositions. In support of hypothesis 2, perceived ease of use is significantly higher for the canvas group. Moreover, participants using the canvas were adopting an integrated and comprehensive perspective on the business model components, which is an important antecedent for the better quality business model ideas that hypothesis 1 predicts for this group. However, adherence with the individual task characteristics was not as strong as expected. This may be attributable to the small sample size. In addition, at least for the *interrelations* characteristic there may have been a problem with the question wording, as we asked for *interdependencies* instead of *interrelations*, which carries a stronger connotation concerning the strength of the relations, and thereby may have misled our participants.

## 5 Conclusion

The theory of cognitive fit is an established theory for guiding the design of problem solving tools. Past research on CFT, however, has exclusively focused on routine problems, and neglected creative problems. Therefore, we provide a first step towards establishing the validity of CFT also for creative problems. We focus on a specific creative task which has received major attention in research as well as practice: business model innovation, or more specifically, business model idea generation. With the present research, we contribute to making CFT a truly *general* theory of problem solving by opening up to CFT a whole new type of problems previously unaddressed. Moreover, with regards to business model research, we contribute a first step towards theory-guided design of modeling languages for business models. An exploratory study has already provided some results in support of our theoretical considerations. Transferring methodological expertise from creativity research, in future research we plan to conduct a large-scale experiment which also addresses the resulting idea quality through expert raters (cf. our first hypothesis).

## References


1. Davidson, J., Sternberg, R.: Preface. In: Davidson, J.E., Sternberg, R.J. (eds.) The psychology of problem solving, pp. ix–xi. Cambridge University Press, Cambridge (2003)
2. Vessey, I.: Cognitive Fit: A Theory-based analysis of the graphs versus tables literature. Decision Sciences 22, 219–240 (1991)
3. Khatri, V., Vessey, I., Ramesh, V., Clay, P., Park, S.-J.: Understanding conceptual schemas: Exploring the role of application and IS domain knowledge. Information Systems Research 17, 81–99 (2006)
4. Umanath, N.S., Vessey, I.: Multiattribute Data Presentation and Human Judgment: A Cognitive Fit Perspective. Decision Sciences 25, 795–824 (1994)
5. Zhu, B., Watts, S.: Visualization of network concepts: The impact of working memory capacity differences. Information Systems Research 21, 327–344 (2010)
6. Hong, W., Thong, J., Tam, K.Y.: The effects of information format and shopping task on consumers' online shopping behavior: A cognitive fit perspective. Journal of Management Information Systems 21, 149–184 (2004)
7. Vessey, I.: The theory of cognitive fit: One aspect of a general theory of problem solving? In: Zhang, P., Galletta, D. (eds.) Human-computer interaction and management information systems: Foundations, pp. 141–183. M.E. Sharpe, Armonk, NY (2006)
8. Lubart, T.I., Mouchiroud, C.: Creativity: A source of difficulty in problem solving. In: Davidson, J.E., Sternberg, R.J. (eds.) The psychology of problem solving, pp. 127–148. Cambridge University Press, Cambridge (2003)
9. Reinig, B.A., Briggs, R.O., Nunamaker, J.: On the measurement of ideation quality. Journal of Management Information Systems 23, 143–161 (2007)
10. Amabile, T.M.: Creativity in context: Update to The social psychology of creativity. Westview Press, Boulder, CO (1996)
11. IBM: Capitalizing on complexity: Insights from the global chief executive officer study. Somers, NY (2010)
12. Ward, T.: Cognition, creativity, and entrepreneurship. Journal of Business Venturing 19, 173–188 (2004)

13. Al-Debei, M., Avison, D.: Developing a unified framework of the business model concept. European Journal of Information Systems 19, 359–376 (2010)
14. Rai, A., Tang, X.: Information technology-enabled business models: A conceptual framework and a coevolution perspective for future research. Information Systems Research 25, 1–14 (2013)
15. Osterwalder, A., Pigneur, Y.: Designing business models and similar strategic objects: The contribution of IS. Journal of the Association for Information Systems 14, 237–244 (2013)
16. Keen, P., Williams, R.: Value architectures for digital business: Beyond the business model. MIS Quarterly 37, 643–647 (2013)
17. Kuk, G., Janssen, M.: Assembling infrastructures and business models for service design and innovation. Information Systems Journal 23, 445–469 (2013)
18. Clemons, E.: Business models for monetizing internet applications and web sites: Experience, theory, and predictions. Journal of Management Information Systems 26, 15–41 (2009)
19. Liu, F., Myers, M.: An analysis of the AIS basket of top journals. Journal of Systems and Information Technology 13, 5–24 (2011)
20. Zott, C., Amit, R., Massa, L.: The business model: Recent developments and future research. Journal of Management 37, 1019–1042 (2011)
21. IBM: Expanding the innovation horizon: Global CEO study 2006. Somers, NY (2006)
22. Osterwalder, A., Pigneur, Y.: Business model generation: A handbook for visionaries, game changers, and challengers. Wiley, Hoboken, NJ (2010)
23. Eppler, M., Hoffmann, F., Bresciani, S.: New business models through collaborative idea generation. International Journal of Innovation Management 15, 1323–1341 (2011)
24. Günzel, F., Holm, A.: One size does not fit all: Understanding the front-end and back-end of business model innovation. International Journal of Innovation Management 17 (2013)
25. Chesbrough, H.: Business model innovation: Opportunities and barriers. Long Range Planning 43, 354–363 (2010)
26. Spieth, P., Schneckenberg, D., Ricart, J.: Business model innovation: State of the art and future challenges for the field. R&D Management 44, 237–247 (2014)
27. Hong, W., Chan, F., Thong, J., Chasalow, L., Dhillon, G.: A framework and guidelines for context-specific theorizing in information systems research. Information Systems Research 25, 111–136 (2014)
28. Veit, D., Clemons, E., Benlian, A., Buxmann, P., Hess, T., Kundisch, D., Leimeister, J.M., Loos, P., Spann, M.: Business models: An information systems research agenda. Business & Information Systems Engineering 6, 45–53 (2014)
29. Santanen, E., Briggs, R.O., Vreede, G.-J.D.: Causal relationships in creative problem solving: Comparing facilitation interventions for ideation. Journal of Management Information Systems 20, 167–197 (2004)
30. Mumford, M., Gustafson, S.: Creative thought: Cognition and problem solving in a dynamic system. In: Runco, M. (ed.) Creativity research handbook, 2, pp. 33–77. Hampton, Cresskill, NJ (2007)

31. Mumford, M., Mobley, M., Reiter-Palmon, R., Uhlman, C., Doares, L.: Process analytic models of creative capacities. Creativity Research Journal 4, 91–122 (1991)
32. Goldschmidt, G.: Modeling the role of sketching in design idea generation. In: Chakrabarti, A., Blessing, L.T.M. (eds.) An Anthology of Theories and Models of Design, pp. 433–450. Springer, London (2014)
33. Moody, D.: The “physics” of notations: Towards a scientific basis for constructing visual notations in software engineering. IEEE Transactions on Software Engineering 35, 756–778 (2009)
34. Bagozzi, R.: A prospectus for theory construction in marketing. Journal of Marketing 48, 11–29 (1984)
35. Krumeich, J., Burkhart, T., Werth, D., Loos, P.: Towards a component-based description of business models: A state-of-the-art analysis. Proceedings of the 19th Americas Conference on Information Systems (2012)
36. Kundisch, D., John, T., Honnacker, J., Meier, C.: Approaches for business model representation: An overview. Proceedings of the 7th Multikonferenz Wirtschaftsinformatik (2012)
37. Gordijn, J., Akkermans, H.: Value-based requirements engineering: Exploring innovative e-commerce ideas. Requirements Engineering 8, 114–134 (2003)
38. Lucassen, G., Brinkkemper, S., Jansen, S., Handoyo, E.: Comparison of visual business modeling techniques for software companies. Proceedings of the 3rd International Conference on Software Business (2012)
39. Morris, M., Schindehutte, M., Allen, J.: The entrepreneur's business model: Toward a unified perspective. Journal of Business Research 58, 726–735 (2005)
40. Chesbrough, H., Rosenbloom, R.: The role of the business model in capturing value from innovation: Evidence from Xerox Corporation's technology spin-off companies. Industrial and Corporate Change 11, 529–555 (2002)
41. Schneider, S., Spieth, P.: Business model innovation: Towards an integrated future research agenda. International Journal of Innovation Management 17 (2013)
42. Zott, C., Amit, R.: The fit between product market strategy and business model: implications for firm performance. Strategic Management Journal 29, 1–26 (2008)
43. Gemino, A., Wand, Y.: A framework for empirical evaluation of conceptual modeling techniques. Requirements Engineering 9, 248–260 (2004)
44. Janiszewski, C.: The influence of display characteristics on visual exploratory search behavior. Journal of Consumer Research 25, 290–301 (1998)
45. Wickens, C.D., Carswell, C.M.: The proximity compatibility principle: Its psychological foundation and relevance to display design. Human Factors: The Journal of the Human Factors and Ergonomics Society 37, 473–494 (1995)
46. Venkatesh, V., Bala, H.: Technology acceptance model 3 and a research agenda on interventions. Decision Sciences 39, 273–315 (2008)
47. Gottschalk, I., Kirn, S.: Eignet sich Cloud-Computing als Instrument zur Förderung ökologischer Ziele? Wirtschaftsinformatik 55, 299–314 (2013)