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Leading in the Unknown with Imperfect Knowledge: Situational Creative Leadership Strategies for Ideation Management

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ABSTRACT

In a fast-changing world, constantly innovating remains one of the principal challenges most organizations are facing nowadays. Survival of organizations became principally linked to the creative generation capacity of their staffs. Nonetheless, fixation imposes a key constraint to the aptitude of individuals to constantly come up with innovative ideas. Numerous studies have highlighted the significant role that could be played by leadership in this regard. Nevertheless, most of these works studied leadership's role from a social perspective, reducing the function of creative leaders as facilitators. From a more cognitive perspective, very few works have shed the light on the role of creative leaders during ideation processes. However, very recent studies showed that leaders could efficiently play the role of de-fixators, by preparing carefully their interventions (instructions, feedbacks, etc.) within the ideation process, according to their capacity to recognize the frontier between fixation and de-fixation of a project. In the present paper, we have furthered these findings, by exploring the effect of feedbacks, in specific cases in which leaders lead their teams in the unknown with imperfect knowledge. Based on varying levels of knowledge (leaders' ability to recognize if a particular idea generated by his team is inside or outside fixation), we implemented a theoretical model for ideation management using design and probability theories. Using a theory-driven experimental procedure, we showed in this paper that leadership strategies for ideation management should adopt less generic and universal tactics (such as brainstorming rules for example), but rather more situational approaches depending on followers' capacity to think out of the dominant design.

INTRODUCTION

Research context: innovation economy

Creativity has become a fundamental constituent of the so-called “Innovation Economy”. Innovation economy, also called creative economy has come to replace knowledge-dependent economy. In fact, the more innovations generated in markets, the more job opportunities created in societies. Therefore, creativity and innovations stand today with no doubt as one of the principal motors that drive the world economy. To illustrate this new phenomena, the world’s best selling magazine Business Week has published a special issue entitled “innovation economy” in honor of its 75th birthday, highlighting in it the achievements of great innovators such as Apple late CEO Steve Jobs or the World Wide Web inventor Tim Berners-Lee, and presenting in its edition a variety of inspiring strategic innovation articles such as “Building an Idea Factory”.

Within this new economy, it is worth mentioning that innovation is seen as a fundamental philosophy and culture that should be encouraged by governments. Indeed, this new innovation economy came to shift the focus of governments and societies to encourage creativity, to develop novel and useful business models, as well as innovative products and services.

Innovation is a long process comprising several stages, such as idea generation, evaluation, development and implementation (as illustrated in the figure 1 below). According to Oxford dictionary, innovation means the introduction of something new, such as a new product, service or process into the market place.

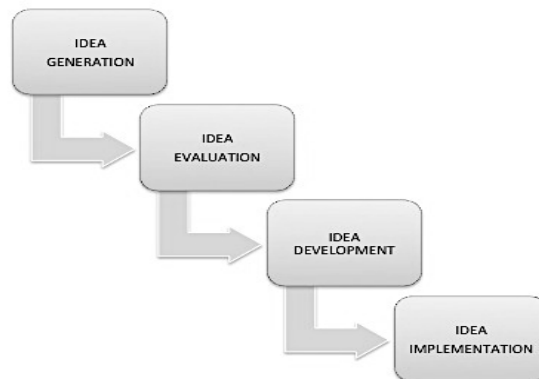


Fig. 1: Identifying Fixation/Expansion in the Egg’s Task (Agogu   et al., 2014)

The very early stage of innovation is usually considered to be ideation. Ideation or idea generation is the process of coming up or generating ideas, while creative ideation consists of coming up with creative ideas, i.e. ideas that are both novel and useful (Amabile, 1983). In the problem-solving literature, ideation is the initial stage in which individuals are required to come up with as many possible alternatives to a particular problem.

The most famous ideation method is considered brainstorming. Brainstorming is a group creativity technique popularized by Alex Faickney Osborn in his book *Applied Imagination* (Osborn, 1953). It consists of holding a group discussion to produce ideas and solutions to problems. According to the rules of Osborn (Osborn, 1957), individuals performing brainstorming sessions should: generate as many ideas as possible, withhold criticism of ideas, freewheeling (welcome wild ideas), and combine on ideas of others.

Research problematic: fixation, a major cognitive bias against creativity

However, the process of idea generation is not an easy task at all. In fact, despite the favourable conditions and necessary resources available in organizations to innovate, most firms have been facing serious difficulties precisely in the early innovation process, when their employees are required to ideate, and more specifically to generate creative ideas and solutions to problems.

One of the origins of these blocs against innovation is well known in the domain of cognitive psychology. Indeed, numerous studies have highlighted the negative role of cognitive biases against creativity, which occurs during the early stages of the innovation process, namely ideation. One of the most common and major obstacle against creative ideation is recognized as the fixation effect, also called functional fixedness (Jansson & Smith, 1991).

Fixation has always been a central topic of study in specific domains, such as design sciences or psychology (Jansson & Smith, 1991). Fixation's definition differs lightly according to different domains' perspectives. From a psychological point of view, it is a "mental block against using an object in a new way that is required to solve a problem" (Duncker & Lees, 1945). In creativity, it is frequently described as the fact that

some existing knowledge and obvious solutions are spontaneously activated in individuals' mind during a creativity context, consequently constraining their ability to generate more creative ideas and solutions (Agogu   et al., 2014; Cassotti, Camarda, Poirel, Houd  , & Agogu  , 2016).

One of the first tasks (but not the most famous one) that illustrated fixation is called the "two cord problem" (Maier, 1931). Participants were given two cords tied to the ceiling, as well as a pair of pliers. Individuals were asked to tie together the free ends of these two cords, knowing that the cords are short and cannot be held in the hands at the same time so that one can easily tie them together (see figure 2). One solution of this problem was simply to tie the pliers to one of the cord to form a pendulum that will swing to reach the second one. In this "two cord problem" experiment, most participants were "fixated" to their existing knowledge of pliers and their conventional uses in their mind, and were unable to look at it alternatively as a pendulum to solve the problem.

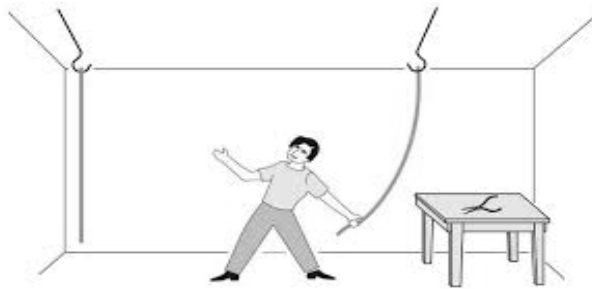


Fig. 2: Two Cord Problem (Maier, 1931)

Due to its growing importance, overcoming fixation became a key topic of study for several researchers from different disciplines such as design, engineering, cognitive science, and management. Among all these above-mentioned disciplines, it is worth mentioning that leadership has a central role to play. In fact, in all these different disciplines, a leader is implicitly or explicitly present in the ideation process, and plays a direct or indirect role to help individuals (designers, engineers, experts, etc...) bypass these cognitive obstacles against creativity. For these reasons, overcoming fixation (also called the process of defixation) becomes with no doubt a principal challenge for the field of leadership.

LITERATURE REVIEW: LEADING FOR DEFIXATION

What is Creative Leadership?

To better understand the role of creative leaders to help followers bypass the principal cognitive biases against creativity (and more specifically fixation), we must go through a brief review of what is leadership, who are creative leaders, and how do they drive their teams for innovation.

Leadership is with no doubt a very ambiguous concept that has as many definitions as who have tried to define it, according to one of the most prominent leadership scholars Richard Stodgill (Bass & Stogdill, 1981). Most people know what leadership is, and are capable to recognize the characteristics of a leader, but would be hardly able to define it. It is generally described as “a process of social influence in which an individual (the leader) is able to enlist the support of others (subordinates or followers) in the accomplishment of a common task” (Chemers, 2014). In other words, a leader is someone who can influence his/her team to achieve certain organizational goals, and at the same time has some kind of managerial authorities on them.

Studies on leadership have produced numerous theories all sorted according to a varying number of leadership study eras (Bolden, Gosling, Marturano, & Dennison, 2003; Brungardt, 1997; Daft, 2014; Van Seters & Field, 1990; Yukl, 1994). Among these multiple eras, we could today identify most important leadership study eras as: personality and traits, power and influence leadership, behavioral, situational, contingency, transactional, and transformational leadership eras.

However, in most of these leadership study eras, leadership scholars seem to have directly integrated creativity in the broader and larger concept of efficiency. But recently, being a subject of interest among scholars from different disciplines ranging from neurosciences to management, and as a direct consequence of its growing importance, leadership theorists and academics have finally began to add the variable ‘creativity’ as an imperative constituent of leadership.

Creative leadership could be considered as a certain form of mixture between creativity (defined as the ability to generate ideas that are both novel and useful according to its definition) and leadership (defined as the ability to influence others to accomplish

this generation process). In other words, we could say that a creative leader is someone who leads others toward the attainment of a creative outcome.

Creative leaders generally respond to challenges differently than traditional leaders. They typically avoid incremental improvements of products or services, and rather favor the implementation of radical and disruptive innovation. Creative leaders are frequently associated with the figures of great innovators such as Thomas Edison, Steve Jobs, Mark Zuckerberg, Elon Musk, Jeff Bezos, Larry Page, Bill Gates, etc..

What are the principal roles of creative leaders?

Literature review on creative leadership has underlined the role played by leaders for creativity (Mumford, Scott, Gaddis, & Strange, 2002). Prior works have majorly reduced and concentrated leaders' role as facilitators, mentors, or mediators to organizational creativity (Woodman, Sawyer, & Griffin, 1993). Indeed, numerous studies have examined varied factors that can either foster or hinder employees' creativity at individual, group, and organizational levels, and have then introduced the role of creative leaders in this regard. To foster followers' creativity, leaders could for instance create creativity-supportive climates for their teams, impact their extrinsic motivation (transactional leadership) (Jung, 2001; Wofford & Goodwin, 1994), or even intrinsic motivation (transformational leadership) (Bass, 1991)

Literature review on creative leadership has shown that leaders can enhance subordinates' creativity by directly or indirectly adapting appropriate contextual factors like group climate, group composition, resources, knowledge management, or even human resources issues (Hemlin, Allwood, & Martin, 2008; Shalley & Gilson, 2004; Zhou & George, 2003).

These various contextual factor could be managed and operated using certain types of leadership tools, such as: goal-settings (Carson & Carson, 1993; Locke & Latham, 1990), instructions (Ezzat, Agogu  , Le Masson, & Weil, 2017; Paulus, Kohn, & Arditti, 2011; Runco, Illies, & Eisenman, 2005; Runco, Illies, & Reiter-Ralmon, 2005; Runco & Okuda, 1991), feedbacks (De stobbeleir, Ashford, & Buyens, 2008; Ezzat, Agogu  , Cassotti, Le Masson, & Weil, 2016; Zhou, 1998, 2003; Zhou & Li, 2013), and

even unusual leadership tools like non-verbal devices (Brun, Ezzat, & Weil, 2015; Cardoso & Badke-Schaub, 2011; Chrysikou & Weisberg, 2005).

Do creative leaders play “defixator” roles for their teams?

When we look at leadership literature, we could note that numeral researches have paid attention to the role of leadership for creativity in general, without particularly paying attention to the cognitive biases against creativity. As an indication of this fact, we could easily find researches linking leadership to creativity in famous leadership journals such as the leadership quarterly (Lowe & Gardner, 2001), but no studies relating leadership to fixation.

Moreover, today's existing figures of creative leadership seem at first sight not to be appropriate enough to help their teams overcome the critical cognitive biases they face during creative ideation. In other words, current standard models of creative leadership do not play an explicit and clear role of “defixator” for their teams, most probably because the cognitive dimension behind these creative leadership styles is not well highlighted, or seems to be hidden among multiple traditional variables of the creative leadership equation (such as motivation for instance).

Nevertheless, there is clear evidence in the literature review of leadership that the existing forms of creative leadership incorporate certain cognitive dimensions that seem to play an indirect role of defixator since they are able to stimulate the creative performance of followers (the element ‘intellectual stimulation’ of transformational leadership is the perfect example). However, these underlying defixation cognitive processes are not well emphasized, and not clearly demonstrated in any study to the best of our knowledge.

What can creative leaders learn from defixation methods?

When we look at the literature review related to defixation processes, we clearly see that developing defixation tools, methods and managerial procedures has always been a priority for researchers in diverse areas. Over the past decades, various methods from diverse disciplines (ranging from psychology to design science) have been proposed to help individuals overcome fixation, in order to generate creative ideas (Agogu   et al.,

2014; Agogue, Le Masson, Dalmaso, Houdé, & Cassotti, 2015; Hatchuel & Weil, 2003; Kowaltowski, Bianchi, & De Paiva, 2010).

For instance, recent findings demonstrated that overcoming fixation could be made through expansive examples, i.e. examples of ideas and solutions that are outside the fixation effect, and consequently helps increase the creative generation capacities of individuals (Agogu  et al., 2014). Other studies showed that we could overcome fixation by reframing problems (Linsey et al., 2010; Zahner, Nickerson, Tversky, Corter, & Ma, 2010), providing analogies (Moreno, Yang, Hern andez, Linsey, & Wood, 2015; Smith & Linsey, 2011; Tseng, Moss, Cagan, & Kotovsky, 2008), given de-fixation instructions (Ezzat et al., 2017), or even enabling incubation (Smith & Blankenship, 1991).

In the field of design sciences, several researchers have identified creativity stimulation techniques to overcome cognitive biases against creativity (Kowaltowski et al., 2010). For instance innovative design methods like the Concept-Knowledge theory (Hatchuel & Weil, 2003), and KCP method (Hatchuel, Le Masson, & Weil, 2009) are well recognized to help individuals and teams not only identify, but also bypass fixation in contexts of innovative design.

At first sight, and by going through all these diverse creativity stimulation practices, we could inaccurately consider that they do not require any type of leadership, and that these “leaderless” defixation methodologies seem to be simply reduced to simple instructional processes. Moreover, this would be an excellent indication for management and creativity theorists claiming that creativity does not necessarily require “leadership” control (Amabile, 1998). In other words, it would be perfectly consistent with the idea that creativity flourishes from certain levels of freedom and autonomy.

However, by looking much deeper into these defixation procedures; we could model a very particular type of leader (with very specific managerial actions and competences) hidden behind these instructional means. For instance, if we consider the role of expansive examples as a defixation methodology (Agogu  et al., 2014), we could model figures of leader that have the competence not only to identify fixation, but also to provide their teams with examples of solutions outside fixation, as well as a certain level of legitimacy to impose the given expansive example on their teams. Therefore, it is worth mentioning that although most defixation methodologies seem at first glance to be

leaderless, they implicitly hide an important and inevitable role of leadership with specific means of actions, competences and strategies.

HOW CAN CREATIVE LEADERS DEFIXATE FOLLOWERS?

Research question: leadership versus fixation

Therefore, the research question becomes more precise and well defined now: How can leadership play an explicit role of “defixator” for their teams? In other words, how can creative leaders lead their teams towards overcoming fixation effects occurring during creative ideation contexts? The research question could be illustrated as shown in the figure 3 below.

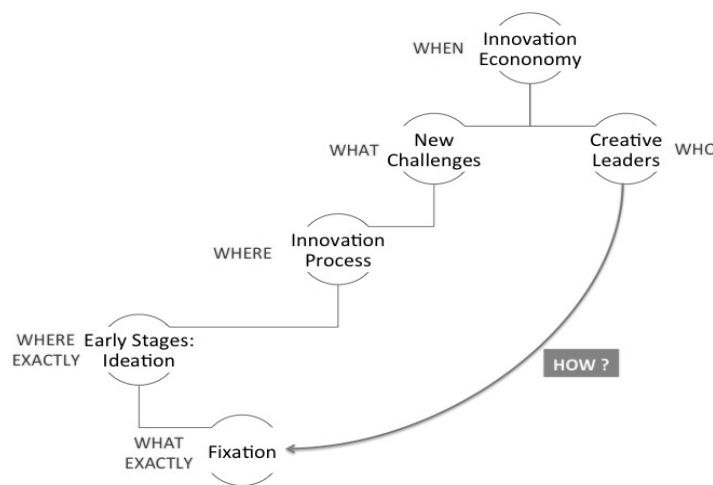


Fig. 3: An Illustration of the Research Context, Problematic and Question

Research method: A theory-driven experimental procedure

To answer this research question, we adopted an atypical research method in management science called theory-driven experiments, which consists of building a theoretical model, simulating it, and then test it using laboratory experiments (see figure 4 below). This method is usually applied to design experimental procedures in cognitive psychology. Theory-driven experiments’ methodology relies on random assignment and laboratory control to ensure the most valid and reliable results.

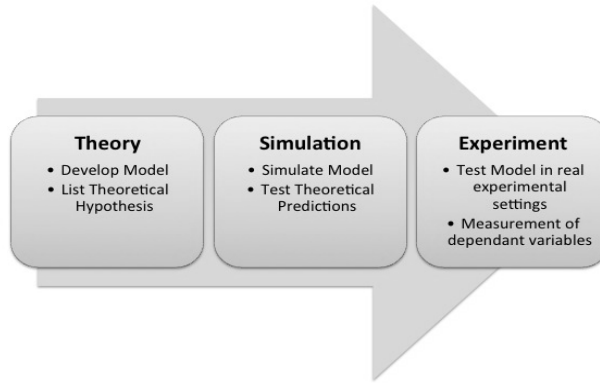


Fig. 4: Theory-driven Experiments Research Method

We chose this particular research method among others because answering research questions required having highly controlled settings, in order to neutralize most of the typical variables of creative leadership literature that could interfere with the defixation process (such as leaders motivating followers or creating creativity-supportive environment, leaders giving creative ideas to followers, leaders providing creativity-relevant resources to followers, leaders recruiting creative members, etc..). Moreover, it enables having accurate results given the fact that studying creative ideation requires some theoretical framework to measure creativity.

Given the above, we first built a theoretical model of “leadership-driven ideation”, based on both design and probability theories. We then implemented an experimental protocol, listed the theoretical predictions of our model before testing it experimentally. Finally, we used some case-control study of historical cases to illustrate the managerial implications of our experimental results.

A LEADERSHIP-DRIVEN IDEATION MODEL

Modeling ideation using Concept-Knowledge theory: fixation versus expansion

Modeling the process of ideation is important to facilitate the understanding of the cognitive processes behind creativity. Moreover, modeling ideation is highly useful for leadership to better understand how defixator leaders could manage these cognitive processes, and more precisely how they could help followers to overcome cognitive traps occurring during these processes (such as fixation).

To model ideation, we chose to use the C-K theory (Hatchuel & Weil, 2003), because it enables both the precise identification of fixation within creative design processes, as well as the managerial operations and mechanisms that could enable defixator leaders to overcome it. C-K theory is well renowned as a tool to distinguish between a fixation path that is based on the spontaneous activation of existing knowledge (inside fixation), and an expansive path that is based on the activation of less accessible knowledge (outside fixation).

Using C-K theory, we first modeled the generation of an idea as a two-stage cognitive process involving two operations: $C \rightarrow K$ and $K \rightarrow C$:

- Stage 1: Conjunction ($C \rightarrow K$)

Beginning from an initial concept C_0 in C-Space, the ideator activates in his K-Space a specific knowledge basis.

- Stage 2: Disjunction ($K \rightarrow C$)

The ideator then generates an idea (lowest branch of the concept tree), associated with the activated knowledge in stage 1.

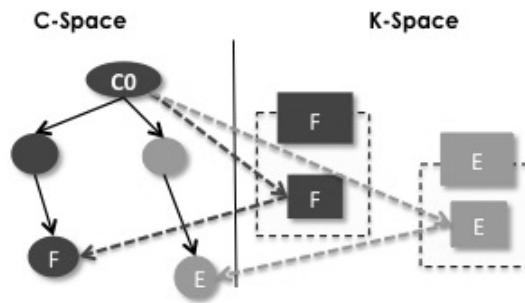


Fig. 5: Idea Generation in Fixation/Expansion using Concept-Knowledge Theory

From a creative ideation perspective, fixation is described as the fact that some existing knowledge and obvious solution are spontaneously activated in individuals' mind (inside the fixation path), constraining individuals to generate creative ideas (outside fixation, i.e. inside the expansion path). As illustrated in the figure 5 above, we could then say that an idea in fixation is generated using spontaneously activated knowledge (knowledge basis inside the fixation path). This knowledge basis (F for fixation) is easier to retrieve from memory, and is effortless. On the contrary, an idea in

expansion is generated using non-spontaneously activated knowledge basis (knowledge basis in expansion). This knowledge basis (E for expansion) is harder to retrieve from memory, and demands much more efforts from individuals.

Modeling “sequential” ideation using Bayesian theories: a Markov model

However, simply modeling ideation as a two-stage cognitive process wouldn't be accurate enough, since it doesn't take into consideration the dependency between the current idea and the later idea. In fact, ideation could be considered a stochastic process if we assume that the generation of an idea could be influenced in certain ways by the previous generated idea.

To better understand this fact, Wang gave the problem-solving example of: “how to improve university parking” (Wang, 2008). The author explains that when individuals generate ideas to this creative ideation task, the idea of “encouraging students to walk” is more likely to occur with the idea of “riding bicycles” than the idea of “increasing the parking fee”.

For these reasons, modeling the process of sequential ideation (sequence or chain of ideas) would be much more precise since it would clarify the dependency and link between successive ideas. Moreover, by modeling sequential ideation, we could enable defixator leaders to intervene during the creative ideation process itself, to stimulate followers and deviate their ideation paths towards certain directions (either in the fixation path, or in the expansion path) depending on followers' performance.

To do that, we modeled sequence of ideas as a two-state Markov chain. Markov chains are stochastic processes (named after its founder Andrey Markov) that satisfy the Markov property (Markov, 1971). Frequently described as memory-less systems, a process satisfies the Markov property if predictions of the future states depend uniquely on its present state. In other words, in a Markov process, what happens next depends only on the current state of the system.

Consider the example of figure 6. An ideator generates a sequence of five ideas during an ideation task. Each generated idea is either in fixation (F) or in expansion (E). The sequence of ideas the ideator generated is: FFEEF. The Markov chain presents two states: fixation (F) and expansion (E), with four transitional probabilities:

- The probability of maintaining the state of fixation (α): it refers to the probability that ideators generate an idea in fixation after having generated an idea in fixation. This probability refers to the incapacity of ideators to defixate. In figure 6, it is illustrated by the transition (in red) from the first idea to the second one.
- The probability of de-fixation ($1-\alpha$): it refers to the probability that ideators generate an idea in expansion after having generated an idea in fixation. In other words, it is the probability that ideators defixate. In the figure below, it is illustrated by the transition (in green) from the second idea to the third one.
- The probability of maintaining the state expansion (β): it refers to the probability that ideators generate an idea in expansion after having generated an idea in expansion. It is the probability that ideators maintain the flow of creative ideas. In the figure below, it is illustrated by the transition (in orange) from the third idea to the fourth one.
- The probability of re-fixation ($1-\beta$): it refers to the probability that ideators generate an idea in fixation after having generated an idea in expansion. In other words, it is the probability that ideators become re-fixated again. In the figure below, it is illustrated by the transition (in purple) from the fourth idea to the last one.

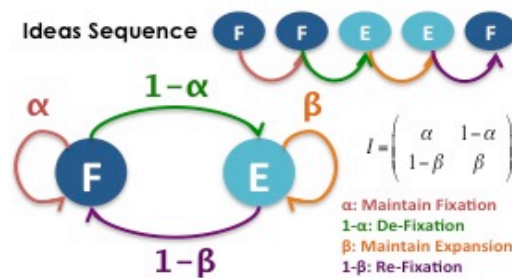


Fig. 6: Markov chains of Sequential Ideation

Using the sequence of ideas, we could then estimate a transition matrix (I), which gives us a good indication of the creative performance of an ideator. A creative ideator should have a low probability of maintaining fixation (α) and a high probability of maintaining expansion (β). However, this transition matrix (I) parameters' estimation is

significant only if the ideator exhibits a high ideational fluency (which means come up with many ideas). It is worth mentioning that if the ideator generates few ideas, the Markov model could be inaccurate to determine his/her creative performance.

The four types of Ideators

Based on the Markov model presented above, we could say that the vector composed of the fixation rate (F) and the expansion rate (E) at sequence t+1 (of the later state), corresponds to the multiplication of the transition matrix (I) by the vector composed of the fixation rate (F) and the expansion rate (E) at sequence t (of the current state)

$$\begin{pmatrix} F_{t+1} & E_{t+1} \end{pmatrix} = I \times \begin{pmatrix} F_t & E_t \end{pmatrix}$$

$$\begin{pmatrix} F_{t+1} & E_{t+1} \end{pmatrix} = \begin{pmatrix} \alpha & 1-\alpha \\ 1-\beta & \beta \end{pmatrix} \times \begin{pmatrix} F_t & E_t \end{pmatrix}$$

Based on the above, we then obtain the following equations:

$$\begin{aligned} F_{t+1} &= \alpha \times F_t + (1-\beta) \times E_t \\ E_{t+1} &= (1-\alpha) \times F_t + \beta \times E_t \\ F_{t+1} + E_{t+1} &= 1 \end{aligned}$$

At steady state, we could then deduce this interesting relationship between re-fixation (1-β) and defixation (1-α) as follows:

$$(1-\beta) = \frac{1-E}{E}(1-\alpha)$$

This formula leads us to plot the relationship between re-fixation (1-β) and defixation (1-α) as shown in the figure 7 below:

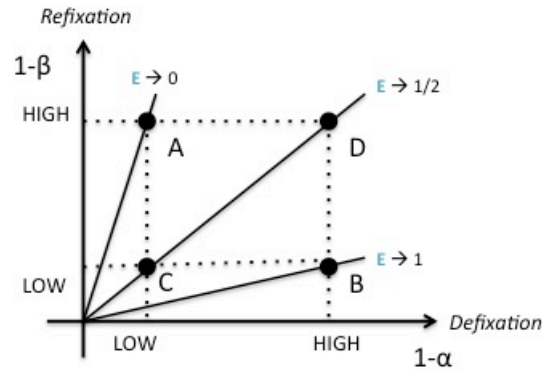


Fig. 7: Markov chains of Sequential Ideation

From the figure above, we could notice the following:

- Good ideator creative performance means having high score of E (high expansion rate), and means moving clockwise.
- Different couples of α and β could give the same creative performance. However, depending on ideator's fluency, we could have fast (large sequence of ideas) or slow (short sequence of ideas) ideation performance.
- There are four different types of ideators' creative performance
 - Ideator type A: this ideator is low at defixation, and high at re-fixation.
 - Ideator type B: this ideator is high at defixation, and low at re-fixation.
 - Ideator type C: this ideator is low at defixation, and low at re-fixation.
 - Ideator type D: this ideator is high at defixation, and high at re-fixation.

Integrating leadership in the ideation process

Now, the intuition behind our model is that an external factor (the leader “L”) could play a pivotal role in “triggering” some of followers’ (ideator “I”) generated ideas at certain instants (see figure 8). This could then force followers’ ideation paths to take unexpected tracks they wouldn’t have take if they weren’t confronted to this external factor. A “defixator” leader should help followers to decrease the probability of maintaining fixation (α), i.e. help to defixate his/her followers, and to increase the probability of maintaining expansion (β), i.e. help his/her team to persist in generating creative ideas.

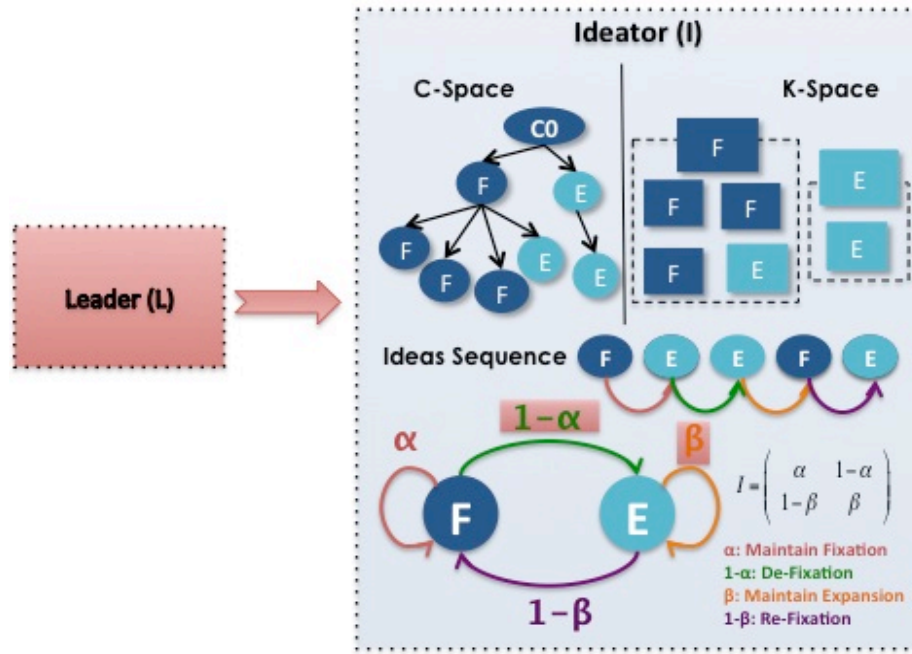


Fig. 8: Leadership-driven Ideation Model

This triggering effect made by leaders could stimulate followers to generate certain types of ideas, by searching for related (or unrelated) knowledge basis. It could help to enlarge (or restrain) the solution space and enable creativity to flourish. It is worth mentioning that in previous cognitive psychology studies, this triggering phenomenon was called attention. In the work of Janis (Janis, 1972) for instance, triggering referred to paying attention of individuals to a range of category of ideas in group ideation interactions (Brown, Tumeo, Larey, & Paulus, 1998).

It is important to note that depending on the type of ideator (type A, B, C or D), leaders could have different contingent strategies to defixate and maintain defixation. For instance if ideators are very good at defixation (thinking outside the dominant design), they would need a leader to help them maintain their creative performance (persisting in the generation of creative ideas). Otherwise, if the ideators are poor at defixation, leaders should mainly concentrate on managing the process of defixation (deviating their ideation paths outside the dominant design).

FEEDBACKS: A TOOL FOR LEADERSHIP-DRIVEN IDEATION

State of the art of the role of feedbacks for creativity

We have seen that leaders could manipulate the contextual factors for creativity through various tools, mostly based on instructional processes. In the present study, we chose leadership feedbacks as a tool to manage followers' ideation. We chose feedbacks, since it is the convenient tool to manage followers' ideation paths by paying attention to (or triggering) certain ideas during the process of ideation.

Few studies have been devoted to the relationship between feedback and creativity. Most researchers have examined feedback from a very broad perspective. These researchers have investigated the influence of evaluative information on creative performance and argued that it could have a strong influence on enhancing creative processes (De Stobbeleir, Ashford, & Buyens, 2011). Indeed, these studies have underscored the importance of being exposed to others' ideas and perspectives in the stimulation of the generation of creative ideas.

Other studies have noted that feedback could considerably help to control individuals' creative performances (Zhou & Li, 2013). Moreover, other findings have argued that delivering negative and controlling feedback to individuals can damage their creative performance, and in contrast, the delivery of constructive or developmental feedback can exert a positive influence on creativity (Carson & Carson, 1993; De Stobbeleir et al., 2008; Zhou, 1998, 2003; Zhou & Li, 2013).

Recent studies by Ezzat et al. analyzed the impact of directive feedbacks during an interactive creative ideation task, and demonstrated that leaders could drive followers' ideation paths in distinct directions according to their expertise (Ezzat et al., 2016). They showed that the process of de-fixation is in itself important but not enough, and that creative leaders must equally pay attention to strategies to de-fixate their teams, as well as to maintain their ideation in a state of de-fixation.

In this paper, we have furthered these previous findings, by exploring the effect of feedbacks, in specific cases in which leaders lead followers in the unknown with imperfect knowledge. We have implemented an experimental protocol, in which leaders had varying levels of knowledge (leaders' ability to recognize if a particular idea

generated by his team is inside or outside fixation), and interacted with their teams to de-fixate them.

Modeling three types of leaders' feedbacks

We then modeled three types of leaders' feedbacks:

- Neutral Feedback: "I confirm receipt of your idea, and await for the next one".

This feedback was considered to be neutral and to have no impact on ideators' sequence of ideas.

- Positive Feedback: "continue in this path".

This feedback was considered to encourage ideator to generate ideas that would be similar to a generated idea in expansion. According to C-K theory, this positive feedback should force ideators to activate the knowledge basis associated with the idea in expansion (see figure 9 below).

- Negative Feedback: "search for another path".

This feedback was considered to force ideator to search for ideas that would be dissimilar from a generated idea in fixation. This negative feedback should help individuals to inhibit the knowledge basis associated with the idea in fixation (as shown in the figure below).

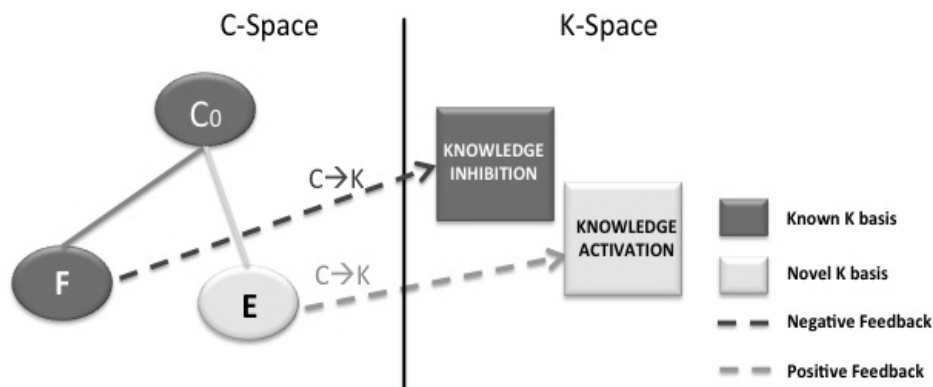


Fig. 9: The Impact of Leader's Positive versus Negative Feedback According to C-K Theory

Leaders' feedbacks in case of various level of knowledge

Leaders' knowledge is a crucial factor of the evaluation of an idea. In this paper, we considered leaders' knowledge as the capacity to recognize that followers' ideas are in fixation (uncreative) or in expansion (creative). Leaders could occasionally give their followers wrong feedbacks due to their incapacity to recognize if an idea is in fixation or outside fixation.

People usually categorize or evaluate an idea as creative if it is both useful and novel (Amabile, 1983). However, leaders could differ on the judgment of what is creative and what it is not. Prior studies proposed that domain knowledge could determine the recognition of creative ideas, arguing that ideas that could be categorized as creative if it is considered new according to one's domain knowledge (Elsbach & Kramer, 2003).

Studies have also shown that leaders could simply fail to recognize creative ideas, and consequently reject them (Mueller, Goncalo, & Kamdar, 2011). Sometimes the rejection of creative ideas could be done due to risk or uncertainty. Otherwise, number of errors and cognitive biases could also occur leading to incorrect evaluation of the creativity of an idea (Licuanan, Dailey, & Mumford, 2007).

However, in the present paper, we argue that recognizing creative ideas does not necessarily mean recognizing uncreative ideas. Leaders could be very good at recognizing the dominant design of a project, and have the strategy to deviate their teams from the dominant design. Other leaders could be excellent at identifying what is creative, and outside the dominant design, but hesitant vis-à-vis of uncreative ideas.

To integrate this knowledge dimension in our leadership-driven ideation model, we considered two supplementary probabilities:

- Probability γ : it refers to the probability that leaders recognize that an idea is in fixation. If γ tends to one, it means that the leader could perfectly recognize if an idea is in fixation.
- Probability σ : it refers to the probability that leaders recognize that an idea is in expansion. If σ tends to one, it means that the leader could perfectly recognize if an idea is in expansion.

Based on the above, we added four new states in our Markov model as shown in figure 10 below:

- State F-: Leaders give negative feedback given the idea is in fixation. In this case, the leader has the capacity to perfectly recognize that follower's idea is in fixation (γ), and consequently gives follower a negative feedback. This negative feedback will help decreasing the probability of maintaining the state of fixation (α decreases to α').
- State F+: Leaders give positive feedback given the idea is in fixation. In this case, the leader fail to recognize that follower's idea is in fixation ($1-\gamma$), and consequently gives follower a positive feedback. This positive feedback will help increasing the probability of maintaining the state of fixation (α increases to α'').
- State E+: Leaders give positive feedback given the idea is in expansion. In this case, the leader has the capacity to perfectly recognize that follower's idea is in expansion (σ), and consequently gives follower a positive feedback. This positive feedback will help increasing the probability of maintaining the state of expansion (β increases to β'').
- State E-: Leaders give negative feedback given the idea is in expansion. In this case, the leader fail to recognize that follower's idea is in expansion ($1-\sigma$), and consequently gives follower a negative feedback. This negative feedback will help decreasing the probability of maintaining the state of expansion (β decreases to β').

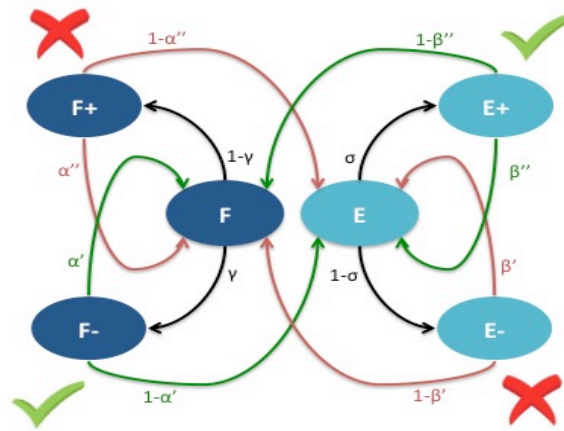


Fig. 10: Markov Model Representing the Effects of Leaders' Feedbacks depending on their Knowledge

Using this Markov model, we could first deduce the new probabilities α^* and β^* after the intervention of leaders during the ideation process through feedbacks. These new parameters now depend on leaders' capacities to recognize fixation (γ) and to recognize expansion (σ):

$$\begin{aligned}\alpha^* &= \gamma\alpha' + (1-\gamma)\alpha'' \\ \beta^* &= \sigma\beta'' + (1-\sigma)\beta'\end{aligned}$$

If leaders have a high capacity to detect fixation (high probability γ), the new α^* after the intervention of leaders tend to decrease the probability of maintaining the state of fixation (α transforms to α'). On the contrary, if leaders have a low capacity to detect fixation (low probability γ), the new α^* after the intervention of leaders tend to increase the probability of maintaining the state of fixation (α transforms to α'').

Similarly, if leaders have a high capacity to detect expansion (high probability σ), the new β^* after the intervention of leaders tend to increase the probability of maintaining the state of expansion (β transforms to β''). On the contrary, if leaders have a low capacity to detect expansion (low probability σ), the new β^* after the intervention of leaders tend to decrease the probability of maintaining the state of expansion (β transforms to β').

These transformation of parameters α to α^* , and β to β^* depending on leaders' knowledge, leads us now to an interesting relationship between the new probabilities of re-fixation ($1-\beta^*$) and defixation ($1-\alpha^*$) as follows:

$$(1-\beta^*) = \frac{1-E_+}{E_+}(1-\alpha^*)$$

Then, according to these equations we could plot the relationship between the new probabilities of re-fixation (in y-axis) and defixation (in x-axis) as shown in figure 11 below.

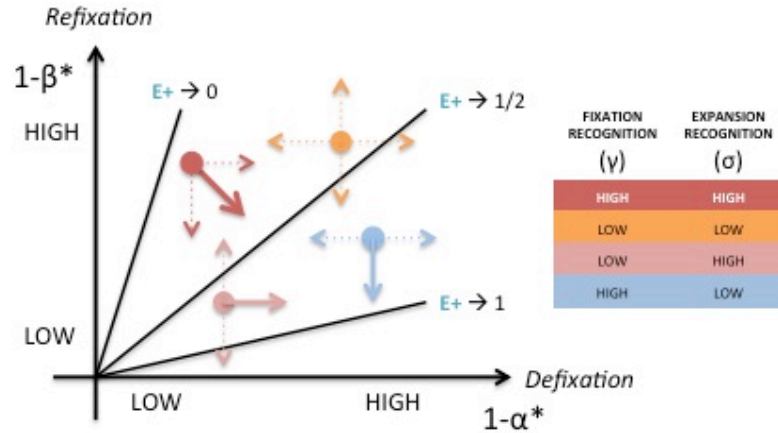


Fig. 11: Re-fixation versus Defixation Ideators' Performance after Leaders' Intervention

From the figure above, we could notice the following:

- A creative leader should manage followers to force defixation (pushing right-side) and not to re-fixation (maintain expansion by pushing downside).
- We could note interesting situational strategies to manage leadership-driven ideation:
 - If leaders have perfect knowledge (high γ , and high σ), they would be able to push followers towards defixating them and maintaining expansion (see red arrow in the figure). We named this leader “expert”.
 - If leaders have imperfect knowledge (low γ , and low σ), they won't be able to push followers towards defixating them, and they won't be able as well to maintain expansion if followers are defixated (see orange arrow in the figure). We named this leader “inexpert”.
 - If leaders have perfect knowledge of expansion (low γ , and high σ), they won't be able to push followers towards defixating them, but they would be able to maintain expansion if followers are defixated (see pink arrow in the figure). We named this leader “expert in expansion”.
 - If leaders have perfect knowledge of fixation (high γ , and low σ), they would be able to push followers towards defixating them, but won't necessarily help them to maintain expansion if followers are defixated (see blue arrow in the figure). We named this leader “expert in fixation”.

Theoretical predictions: a situational case

According to the Markov model above, we then listed three hypotheses regarding leadership-driven ideation with various levels of knowledge as follows:

- Hypothesis 1: Ideators led by “expert” leaders will have the highest expansion rate.
- Hypothesis 2: Ideators led by “inexpert” leaders will have the lowest expansion rate.
- Hypothesis 3: Ideators led by “expert in fixation” leaders will have a higher expansion rate than ideators led by “expert in expansion” leaders, if the group is more or less fixated.

To verify and test these theoretical predictions, we constructed an experimental protocol in which leaders (the experimenters) intervene during the ideation process. The experimenters directed the ideators (the participants of the experiment) through feedbacks with varying levels of knowledge (capacity to recognize fixation and expansion).

A THEORY-DRIVEN EXPERIMENT: LEADING FOR DEFIXATION USING FEEDBACKS

A creativity task: the hen’s egg task

We chose to perform our experiment using a creative ideation task called the hen’s egg task. This creativity task consist of proposing the maximum number of original solutions to ensure that a hen’s egg dropped from a distance of ten meters does not break. We chose this particular creativity task since we have an existing database of ideas and solutions of more than thousands subjects that have performed this task within the past years. This database reveals that more than 80% of participants generate ideas around three main categories of obvious “restrictive” solutions (which are damping the shock, slowing the fall, and protecting the egg). However, only 20% of participants usually generate non-obvious “expansive” solutions (for instance: before and after the fall, with a living device, using the intrinsic properties of the environment, etc..).

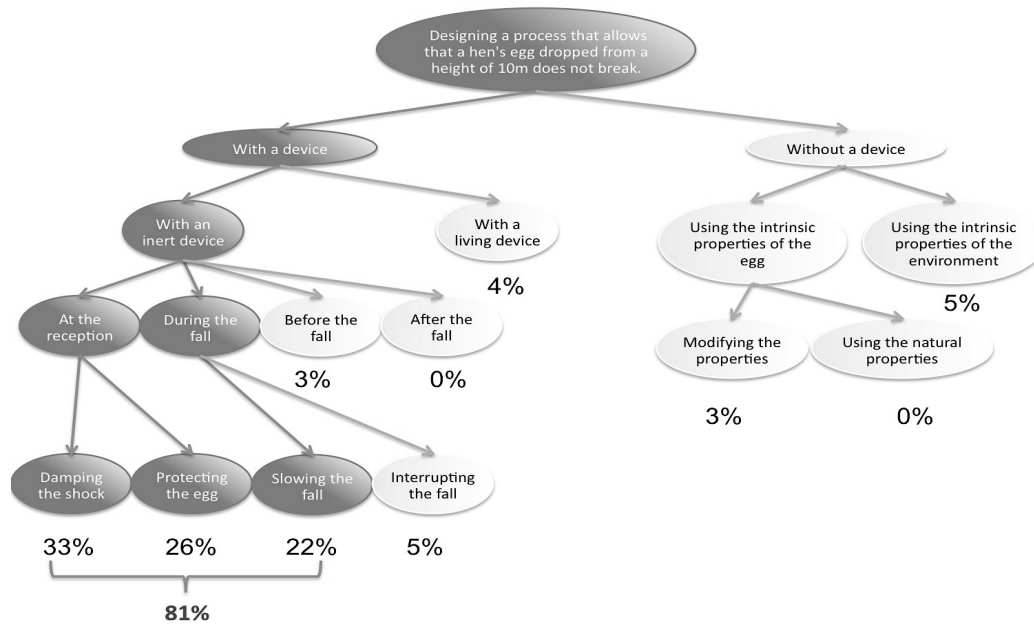


Fig. 12: Categories of Ideas in Fixation/Expansion of the Hen's Egg Task (Agogu   et al., 2014)

Using CK theory, we were able to differentiate between restrictive paths of ideas and solutions (dark partitions) and expansive ones (light partitions) as shown in figure 12 above. By doing this, two distinct sub-spaces could be identified: fixation and expansion zones (Agogu   et al., 2014).

Participants of the experiment

Participants (N=100) of the Faculty of Psychology of Paris Descartes University have participated in this study. Subjects were between 19 and 29 years old, with a mean age of 22. 68% of the participants were females. All subjects recruited to perform this task haven't previously heard about the hen's egg task.

Experimental procedure

Participants were recruited from the faculty of psychology and were asked to perform a creative task via an online text conversation with their experimenter. The participant and the experimenter were in two different rooms (see figure 13 below). We chose to perform the complete task online via a written chat conversation on Skype to avoid any type of social biases that could appear and affect our experimentation, as a

consequence of the physical presence of experimenters face to face in front of participants (Belletier et al., 2015). The task duration was set to 10 minutes for each participant.

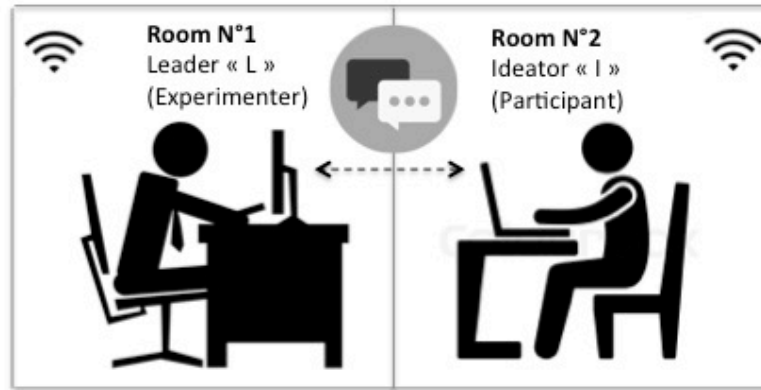


Fig. 13: Written Chat Conversation between the Experimenter (Leader) and the Participant (Ideator)

Participants were randomly divided into five groups (20 subjects per group). Each participant was assigned a different leadership behavior type depending on the group he/she was randomly assigned to, as illustrated in table 1 below.

Groups	Leaders' Feedbacks	
	If participant generates an idea in fixation	If participant generates an idea in expansion
Group 1 (Control) N=20	Leader gives neutral feedback	Leader gives neutral feedback
Group 2 (Expert) N=20	Leader gives negative feedback	Leader gives positive feedback
Group 3 (Inexpert) N=20	Leader could erroneously give positive feedback half of the time	Leader could erroneously give negative feedback half of the time
Group 4 (Expert in E) N=20	Leader could erroneously give positive feedback half of the time	Leader gives positive feedback
Group 5 (Expert in F) N=20	Leader gives negative feedback	Leader could erroneously give negative feedback half of the time

Table 1: Leaders' Feedbacks depending on Followers' ideation

The experimenter (playing the role of leader) initially instructed the participant (playing the role of follower) with the task's objective ("I am your team leader for this task, and the aim is to propose the maximum number of original solutions to ensure that a hen's egg dropped from a distance of ten meters does not break."), specifying to them to "be as creative as possible in this task". Then, at each idea generated by the participant, the experimenter was giving a feedback.

Participants of the first group were chatting with a neutral leader, which simply acknowledges reception of each ideas generated by subordinates, awaiting the next one. We considered group 1 as a control case.

Participants of the second group were chatting with an expert in the recognition of both ideas in fixation and expansion. If the idea generated by participants was in fixation, the leader would recognize it perfectly and give negative feedback ("search for another path"). Similarly, if the idea generated by participants was in expansion, the leader would also recognize it perfectly and give positive feedback ("continue in this path").

Participants of the third group were chatting with an inexperienced in the recognition of both ideas in fixation and expansion. If the idea generated by participants was in fixation, the leader would half of the time recognize it correctly and give negative feedback, while the other half the leader would fail to recognize it and give positive feedback. Similarly, if the idea generated by participants was in expansion, the leader would half of the time recognize it correctly and give positive feedback, while the other half the leader would fail to recognize it and give negative feedback.

Participants of the fourth group were chatting with an expert in the recognition of ideas in expansion. If the idea generated by participants was in fixation, the leader would half of the time recognize it correctly and give negative feedback, and the other half the leader would fail to recognize it and give positive feedback. However, if the idea generated by participants was in expansion, the leader would recognize it perfectly and give positive feedback.

Participants of the fifth group were chatting with an expert in the recognition of ideas in fixation. If the idea generated by participants was in fixation, the leader would recognize it perfectly and give negative feedback. However, if the idea generated by participants was in expansion, the leader would half of the time recognize it correctly and

give positive feedback, while the other half the leader would fail to recognize it and give negative feedback.

Experimental Results

We computed the mean expansion rate for each group. The expansion rate was calculated for each participant, by dividing the number of ideas in expansion by the total number of ideas generated (sum of the ideas in fixation and the ideas in expansion). The expansion rate gives us an excellent indication of participants' creative performance for this creativity task. We compared each group's expansion rate with the control group as shown in the figure 14 below.

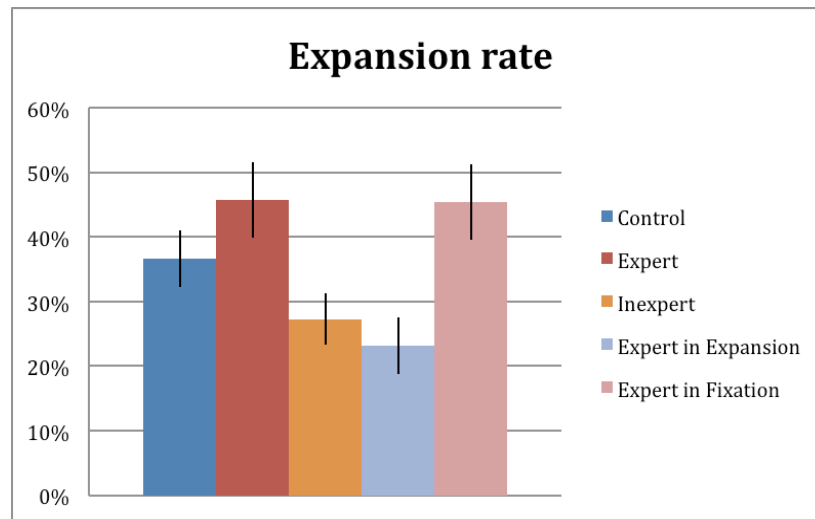


Fig. 14: Score of expansion rate for each group

First of all, by analyzing the results of the control group (in dark blue color), we could clearly note that the sample of the experiment (students of the faculty of psychology) was more or less fixated. Indeed, only 37% of the participants of the control group were defixated, while 63% were fixated.

Moreover, we can see that results confirmed the hypothesis 1. In fact, ideators confronted to “expert” leaders obtained the highest expansion rate (in red color). Expert leaders were able to identify fixation and deviate their teams from it, as well as identify expansion and maintain the creative ideation flow of their teams. They increased the expansion rate to 46%.

Nonetheless, hypothesis 2 was not fully confirmed. In fact, ideators confronted to “inexpert” leaders obtained a low expansion rate (in orange color) compared to the control group, since the expansion rate was decreased to 27%. However, they performed slightly better than the group confronted to the expert in expansion leaders. Indeed, inexpert leaders were unable to identify fixation and expansion, and consequently disturbed the ideation process of their teams.

Finally, results confirmed the hypothesis 3. Since the sample was more or less fixated, ideators leaded by “expert in fixation” leaders obtained a higher expansion rate (in pink color) than ideators leaded by “expert in expansion” leaders (in light blue color). Indeed, ideators leaded by “expert in fixation” leaders highly increased the expansion rate to 45% (which is quite similar to the expansion rate obtained for the ideators leaded by expert leaders), while ideators leaded by “expert in expansion” leaders highly decreased the expansion rate to 23% (which was the lowest expansion rate in all groups).

CONCLUSION AND MANAGERIAL IMPLICATIONS

In the present study, we demonstrated that leaders could efficiently play the role of de-fixators, by preparing carefully their interventions (through feedbacks) within the ideation process, according to their capacity to recognize the frontier between fixation and de-fixation of a project.

We have explored the effect of feedbacks, in specific cases in which leaders lead their teams in the unknown with imperfect knowledge. We designated varying levels of knowledge by leaders’ aptitude to recognize if a particular idea generated by his team is inside or outside fixation.

In this study, we implemented a theoretical model for leadership-driven ideation management using design (C-K theory) and probability theories (Markov chains). Using a theory-driven experimental procedure, in a creativity task where the aim was to propose the maximum number of original solutions to ensure that a hen’s egg dropped from a distance of ten meters does not break, we showed that leadership strategies for ideation management should adopt more situational and contingent approaches depending on followers’ capacity to think out of the dominant design.

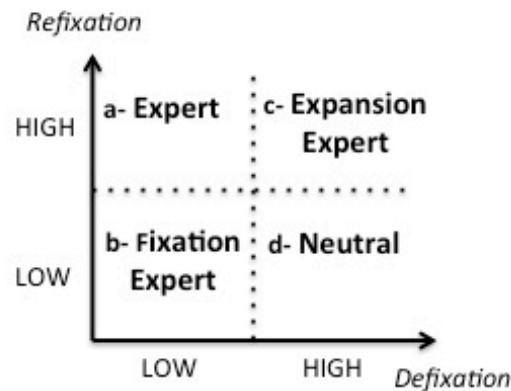


Fig. 15: A Situational Approach to Creative Leadership for Ideation Management

The major managerial implications in the present study could be summarized as follows:

- Leaders can in certain specific cases obstruct followers' creative ideation capacities if they are not capable of recognizing the frontier between fixation (the dominant design of a project) and expansion (outside the dominant design).

These findings clearly confirm the point of view in management science arguing that leaders shouldn't control followers and should rather grant them more freedom and autonomy for creativity to emerge (Amabile, 1998).

For these reasons, it is worth mentioning that leadership and creativity scholars must pay more attention to the importance of leaders' idea evaluation, specifically based on fixation recognition.

- However, leaders could as well highly improve followers' creative ideation capacities, if they are capable of recognizing the frontier nearby the dominant design of a project.

These findings show that leadership control does not always kill creativity, provided that leaders have good knowledge of the project, and a good vision of creativity.

For these reasons, it is important to note that leadership's role should be explicitly incorporated in followers' creativity process in general, and during the ideation processes more specifically. It highlights the implicit cognitive dimension behind creative leadership (such as overcoming the cognitive biases against creativity),

rather than the social perspective of creative leadership (such as motivation). It enables us to slightly redefine leadership for creativity as a process of “cognitive influence” rather than “social influence”, toward the attainment of a creative outcome.

- Moreover, the present findings demonstrated that less knowledgeable leaders (having the ability to recognize either fixation or expansion) could also highly increase followers’ creative ideation capacities, if they are confronted to appropriate teams.

In fact, our leadership-driven ideation model presents a situational approach to ideation management as shown in figure 15 above. In the present paper, we demonstrated that if teams are more or less fixated, leaders who could recognize the dominant design of the project should preferably lead them.

These findings could interestingly link to situational leadership theories (Hersey, Blanchard, & Natemeyer, 1979), and give new sights to managerial implications towards a situational approach to creative leadership.

Finally, future studies will consist of linking these experimental findings (more specifically the situational aspects of the results) with well-documented historical cases of great innovative leaders (such as Gustave Eiffel, Steve Jobs, Thomas Edison, etc..), using a case-control study method.

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