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**Leading to overcome heterogeneous fixations: designing to limit the impact of the rejection of creative ideas**

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## **Leading to overcome heterogeneous fixations: designing to limit the impact of the rejection of creative ideas**

Fixation is a cognitive bias hindering creativity through the activation of previous knowledge. This phenomenon is well-known in the literature, as demonstrated by the many studies on actions to help individuals overcome fixation effects.

However, these studies have often focused on individuals as ideators overcoming their own fixations and not on the ability of leaders to help ideators overcome their fixations. This study tested different factors, such as fixation heterogeneity (difference in fixations between ideators and leaders), design (having leaders design on the creative problem), and reading ideas of ideators, to understand their effects on the ability of leaders to direct ideators toward creativity using directive feedback. We set up an experimental protocol simulating an interaction between a participant, in the leader role, and a (computer-simulated) ideator, where the participant had to help the ideator to be more creative by providing directive feedback. An analysis of the results highlighted a phenomenon of rejection of certain ideas that were inconceivable for the participants, which led to better creative results for leaders not having the same fixations as ideators. This rejection phenomenon was significantly less important when participants were allowed to design without a reading phase before giving feedback.

Keywords: fixation; heterogeneity; design; experimental approach; leadership

### **Introduction**

Leaders, faced with a constant need for innovation in industry (Jagersma, 2003), find themselves in charge of managing the creativity of their teams, which is defined as the ability to generate new and appropriate ideas (Sternberg & Lubart, 1991, 1996). In this paper, we consider a leader to be an individual who influences others to achieve a common goal (Chemers, 2014; Vroom & Jago, 2007), in our case creativity. The leader becomes a leader for creativity, or creative leader, whose goal is the achievement of creative results (Mainemelis et al., 2015). The leader's task is then to encourage the generation of creative ideas (new and appropriate ideas) within his or her teams. It is therefore unsurprising to find that the generation of creative ideas is a common object of

study in the literature on psychology and management. Indeed, creativity and its biases have been widely studied in recent decades. Among these biases, fixation effects have been studied extensively in different contexts. Youmans and Arciszewski (2014) showed that fixation can take various forms. In this paper, we follow the definition of fixation as an unconscious adherence that relates to the individual's previous knowledge, which can mean, for example, copying features of examples already known to the individual (Jansson & Smith, 1991; Youmans & Arciszewski, 2014). As this phenomenon of unconscious adherence is difficult to measure, we will follow the same approach as other studies in the literature for the experimental part, basing ourselves on C-K theory (Hatchuel & Weil, 2003, 2009) to measure these fixation effects (see for example Agogu e et al., 2014; Cassotti et al., 2016; Ezzat et al., 2017).

The fixation effect, caused by the propensity of individuals to activate previous examples or knowledge (Purcell & Gero, 1996), has been recognized as a major bias impeding creativity (Jansson & Smith, 1991; Smith et al., 1993). Researchers have thus focused on how these fixation biases can be overcome to generate more creative ideas or, in other words, how to promote the defixation of individuals (Ezzat, 2017). Studies have tested the ability of different tools, such as TRIZ, to overcome conscious blocking (Youmans & Arciszewski, 2014) or the effect of expertise on creativity (Belski & Belski, 2015); brainstorming with people from different backgrounds to gain different perspectives or also using breaks to encourage incubation (Paulus & Nijstad, 2003).

Recent advances in design theories, and in particular C-K theory—a design theory that explains design reasoning through an interaction between the knowledge space and concept space (Hatchuel & Weil, 2003, 2009), where knowledge enables individuals to generate concepts (ideas)—, have led to a better understanding of fixating mechanisms. Indeed, when solving a creative problem, C-K theory allows us to distinguish between

two types of knowledge for an individual: restrictive knowledge and expansive knowledge. Restrictive knowledge corresponds to knowledge that the individual can easily mobilize, which does not redefine the definition or attributes of the object of the creative problem (Hatchuel et al., 2011; Hatchuel & Weil, 2009); expansive knowledge, on the other hand, corresponds to knowledge that is difficult for the individual to mobilize, and which redefines the object's properties in relation to the creative problem (Agogu e & Cassotti, 2013). Fixation, or more precisely concepts in fixation, correspond to ideas that are generated from restrictive knowledge (Agogu e & Cassotti, 2013) and is therefore directly dependent on individuals' knowledge of the problem they are solving.

In the case of fixation effects due to unconscious adherence to previous knowledge, and particularly the spontaneous mobilization of restrictive knowledge about the creative problem, the effect of examples has been studied with an emphasis on the defixating effect of uncommon examples, that are not in fixation for the individuals (Agogu e et al., 2014; Sio et al., 2015). Similarly, visual stimuli (Borgianni et al., 2020), partial photographs (Cheng et al., 2014), drawings (Brun et al., 2019) and physical prototypes (Kershaw et al., 2011; Youmans, 2011) have been shown to be effective in overcoming fixation effects. Furthermore, using computer tools to assist in idea generation (Han et al., 2018; Yilmaz et al., 2014) or giving ideators instructions to avoid problematic elements of a pictorial example (Chrysikou & Weisberg, 2005) or not to generate ideas in certain solution categories (Ezzat et al., 2020) is possible. Reflecting on past episodes of fixation can be a way to avoid fixation (Crilly, 2015). Feedback can also help individuals be more creative because it allows them to refine their ideas (Stobbeleir et al., 2011) and gives them a reference against which to compare their own level of creativity (Zhou, 2008). Feedback has been studied in the case of facilitation during brainstorming, where an individual is in charge of providing feedback to the team to

encourage the generation of creative ideas. In such studies, feedback has been used to encourage persistence, avoid irrelevant discussions, and promote participation by all group members (Paulus & Kenworthy, 2019). More recently, Ezzat and colleagues focused on a particular feedback with the specific goal of directing an ideator (i.e., an idea generator) to generate ideas outside the ideator's fixation (Ezzat et al., 2017). To do this, they used a creativity problem well known in the literature, namely the egg task (Agogué et al., 2014, 2015; Cassotti et al., 2016), whose fixations have been referenced for certain populations relying on the C-K theory, and are known in advance by the experimenter. Therefore, for each idea generated by the ideator, the experimenter, who took the role of the leader, knew whether the idea was in fixation or not for the ideator. The experimenter could thus give appropriate feedback on the ideator's fixation to push the ideator to generate ideas outside his or her fixation zone. Feedback appropriate to the fixation, which can be called correct feedback, corresponded to the experimenter telling the ideator to “continue on this path” when the ideator generated a creative idea (not in fixation) and telling the ideator to “search for another path” when the ideator generated an idea in fixation. The results showed that by giving correct directive feedback to the ideator’s fixation after each generated idea, the ideator generated more creative ideas according to his or her own fixation.

In organizations, leaders for creativity can use the above types of tool. However, studies on reducing the fixation effect have focused on the effects of these actions on the ideators (for a literature review, see Alipour et al., 2018), without studying the leader's ability to implement and use them properly. Notably in the study conducted by Ezzat and his colleagues, the sine qua non condition for increasing the creativity of the ideators was that the leader gave correct feedback to the ideator in relation to the ideator's fixation (Ezzat et al., 2017). That is to say, the leader must recognize the ideas

in fixation for the ideator and the creative ideas for the ideator to give feedback that will allow the ideator to generate the most creative ideas. With the literature pointing to biases in idea selection and the inability to recognize creative ideas (Licuanan et al., 2007; Mueller et al., 2012, 2014), it seems reasonable to doubt the abilities of leaders to choose the correct feedback according to the fixation of ideators to guide the ideators during idea generation and help them generate more creative ideas.

As mentioned above, fixation depends on knowledge (Hatchuel et al., 2017)—particularly on the restrictive knowledge of individuals about the creative problem—and thus, more broadly on the studies followed by the individuals or the professional backgrounds of the individuals (Agogué et al., 2015; Purcell & Gero, 1996). Therefore, and especially in industrial contexts where teams are multidisciplinary (van Knippenberg et al., 2004), not all ideators may share the same fixations about a specific creativity problem, and more particularly a leader guiding an ideator relying on directive feedback does not necessarily share the fixations of the ideator on this creativity problem. The leader/ideator binomial is thus heterogeneous in the sense that they do not have the same background and knowledge and thus not the same fixations on this specific creativity problem. In this paper, in a situation where we focus on a leader/ideator binomial face to a specific creativity problem, we speak of “heterogeneous fixations” when the leader and ideator do not share the same fixations (referring to the term “heterogeneous” used in the literature to qualify diverse teams (Christensen & Ball, 2016; Shin & Zhou, 2007)). If a leader and ideator share exactly the same fixations (in that they have the same knowledge about a given problem), we speak of “homogeneous fixations” as shorthand for a homogeneous leader/ideator binomial sharing the same fixations on a particular creative problem.

In this context of heterogeneous fixations (i.e. with an heterogeneous leader/ideateur binomial), it is all the more relevant to ask whether a leader is able to give correct directive feedback to an ideator during idea generation; i.e., feedback corresponding to the fixation of the ideator that is not necessarily the same as that of the leader.

The purpose of this study is to question the ability of leaders to give correct feedback in relation to the fixation of ideators, and in particular to ask what actions would make leaders more aware of the diversity of ideators' fixations to which to adapt and make the leaders more effective in choosing the directive feedback to give. Our research question is the following: how can a leader learn to adapt to the fixations of an ideator?

In addressing this question, we start with a review of the literature to understand the mechanisms involved in idea selection and the consequences of certain actions such as designing and listening to the ideator. This allows us to develop four hypotheses that we test adopting an experimental protocol. We then present the results and discuss them in light of the literature before concluding the paper with a discussion on the limits and perspectives of our study.

## **Theoretical background**

The purpose of this paper is to highlight actions that leaders can set up to learn to adapt to the fixations of ideators. Indeed, in an organizational context, leaders have multidisciplinary teams (van Knippenberg et al., 2004) and thus do not necessarily share the fixations of all team members. As the members of the teams are the ideators in the process of generating ideas, leaders have to lead ideators with different fixations, insofar they do not have the same restrictive knowledge. In this study, we reduced the context to a minimal situation to control all the variables and better understand the



phenomenon at stake. We thus consider the situation that leaders (individuals in a leadership position in that they guide others) have to give directive feedback, which is feedback indicating the direction in which to go to generate the next idea (i.e., to continue on the same or another path), to ideators during idea generation. In our extremely simplified situation, leaders either have the exact same fixation as the ideators (we called that situation “homogeneous fixations”) or have a different fixation from the ideators (i.e., an idea in fixation for leaders is not in fixation for ideators and vice versa, we called that situation “heterogeneous fixations”).

As mentioned earlier, Ezzat et al. (2017) showed that to allow ideators to be more creative, the feedback must be aligned with the ideators’ fixations. This means that leaders, in giving “correct feedback”, must indicate to the ideators to continue on a path when they generate a creative idea (according to the referential of the ideators) or to search for another path when they generate a fixated idea (according to the referential of the ideators). We then wonder about the capacity of leaders to recognize creative ideas from ideas in fixation for the ideators, and this is all the more in a situation of heterogeneous fixations. Indeed, to give correct feedback, leaders must be able to distinguish the nature of the idea in relation to the ideator and not in relation to their own frame of reference. By doing so, they fulfill their role as leaders for creativity by enabling ideators to generate more creative ideas.

To our knowledge, the question of the ability of leaders to give correct feedback is not addressed directly in the literature, but many results in the literature can help in building hypotheses.

### ***Selection bias***

The literature tends to show that individuals are subject to a selection bias in ideas, which could be called the “so what” effect (Licuanan et al., 2007). Indeed, it seems that individuals, when they take on the role of leaders, tend to underestimate the originality of certain ideas (Licuanan et al., 2007). Thus, even if they desire creative ideas, they tend to reject them when choosing ideas (Blair & Mumford, 2007; Mueller et al., 2012, 2014). Similarly, individuals have difficulty selecting the most creative ideas from a set of ideas (Putman & Paulus, 2009; Rietzschel et al., 2006). A first explanation could be a fear of uncertainty and thus a desire to reduce this uncertainty by choosing only uncreative ideas (Lee et al., 2017; Mueller et al., 2014). Berlyne and Scitovsky (1960, 1992), inspired by the work of Wundt, gave another explanation that individuals subjected to different levels of novelty or originality will have a curve of pleasantness that has the shape of an inverted U, called the Wundt curve. According to this explanation, individuals will find uncreative ideas too boring and therefore unpleasant and original ideas too destabilizing and thus also unpleasant. Only ideas of intermediate originality will be considered as pleasant (Scitovsky, 1992).

To explain this effect of rejection of ideas that are too creative, which can be called the Wundt effect, one hypothesis that could be formulated is that these particular ideas call upon knowledge that the individuals do not have or that they are unable to mobilize, which leads to a rejection of the ideas. Indeed, it can be assumed that individuals may be confronted with ideas that they would not be able to generate themselves before being confronted with them because of a lack of knowledge. At the time that the individuals are confronted with these ideas, the ideas are inconceivable to the individuals, and this inconceivability may lead to the rejection of these particular ideas because access to knowledge related to the ideas is not possible for the individuals. We could then qualify these ideas as unacceptable inconceivable ideas. The

hypothesis is that the Wundt effect and the rejection of creative ideas can be explained by the fact that individuals reject inconceivable ideas that they consider unacceptable.

If we are in a situation of homogeneous fixations or in a situation of heterogeneous fixations, the potential rejection of these unacceptable inconceivable ideas does not have the same effect on the capacity of leaders to give correct feedback. Indeed, if the unacceptable inconceivable ideas for the leader are in fixation for the ideator, then the rejection of the ideas corresponds to correct feedback because the ideator must be encouraged to search for an idea on another path if he or she generates an idea in fixation. Conversely, if these ideas are creative for the ideator, then their rejection corresponds to incorrect feedback because the correct feedback is to encourage the ideator to continue on the present path. Thus, heterogeneity between the leader giving the feedback and the ideator affects the capacity of the leader to give correct feedback owing to the rejection of the unacceptable inconceivable ideas, which can be in fixation or creative for the ideator depending on the heterogeneity with the leader.

The unacceptable inconceivable ideas for the leaders correspond to ideas whose knowledge cannot be mobilized. Thus, if ideators have a homogeneous fixation with these leaders, the knowledge linked to the idea is also difficult to mobilize and the idea is thus creative for the ideators. Conversely, if the fixation between leaders and the ideators is heterogeneous, then the idea is related knowledge that is easily mobilizable for ideators and it is thus in fixation for the ideators. We can now formulate our first hypothesis.

***Hypothesis 1:*** *The rejection of unacceptable inconceivable ideas for the leader has different effects on the ability of the leader to give correct feedback depending on whether the fixations are homogeneous or heterogeneous with the ideator, in the sense that a leader with homogeneous fixations with the ideator gives less correct feedback*

*than a leader with heterogeneous fixations with the ideator. In other words, the rejection of unacceptable inconceivable ideas mediates the relationship between the heterogeneity of the fixations (homogeneous or heterogeneous) between the leader and the ideator and the capacity of the leader to give correct feedback.*

### ***Listening to become aware of the other's fixations***

Our assumption is that the Wundt effect involving a rejection of unacceptable inconceivable ideas for leaders tends to favor situations that leaders have heterogeneous fixations with the ideators, insofar as the leaders rejecting these ideas give correct feedback to the ideators having fixations that are heterogeneous with their fixations. Therefore, to moderate this effect, we can search for certain actions that can be set up to help leaders become aware of the difference in the fixations between them and the ideators and thus better recognize fixations during the generation of ideas. Various studies on team diversity and their associated creative performance have shown that diversity can be positive for creativity if individuals consider the different perspectives of the group (Egan, 2005; Hoever et al., 2012). In a similar vein, being listened to by supervisors has been shown to increase employee creativity (Castro et al., 2018). In addition, various studies, especially those on brainstorming, have shown the importance of listening to others' ideas in terms of building on the ideas and generating more creative ideas, especially when building on novel ideas (Brown et al., 1998; Dugosh et al., 2000; Dugosh & Paulus, 2005; Gillier & Bayus, 2022). We can thus assume that if leaders listen to some of the ideators' ideas before giving feedback, they will then be better able to recognize a fixation different from their own and take this difference into account in giving more correct feedback. This leads us to formulate our second hypothesis.

***Hypothesis 2:*** *A phase of listening by the leaders giving feedback moderates the relationship between fixation heterogeneity (homogeneous or heterogeneous fixations) and the ability to give correct feedback, so that leaders adopting a listening phase have more facility to adapt themselves to the fixation of the ideators and give more correct feedback than leaders not adopting a listening phase.*

### ***Designing for the self-awareness of fixations***

Our second hypothesis is that a listening phase allows leaders to better know the fixation of ideators and that this increases the overall ability of leaders to give more correct feedback. However, individuals may not realize that they are themselves subject to fixation effects (Linsey et al., 2010). Therefore, another possibility to moderate the relationship between fixation heterogeneity and the ability to give correct feedback is to provide leaders with tools that enable them to better know their own fixation space. For example, educating individuals about fixation phenomena is possible to help them overcome such phenomena (Howard et al., 2013). Furthermore, studies on conflict detection show that when individuals generate a solution that is in conflict with an instruction, they become aware of the conflict and are able to modify the solution (De Neys & Glumicic, 2008; Johnson et al., 2016). Thus, if we transpose this to an instruction to generate creative ideas, individuals generating ideas should be able to realize that some ideas are not creative. Moreover, studies on idea evaluation have shown that individuals may need to engage in design to better evaluate ideas and realize their potential (Sukhov, 2018; Sukhov et al., 2021). It also appears that creative individuals themselves have more facility to discern creative ideas (Silvia, 2008). Thus, while leaders may not be aware of their own fixations, studies on the role of design show that this could help individuals to better evaluate ideas. This could provide a way for leaders to better identify their own fixations. We might then assume that by asking

leaders to design before giving feedback to ideators that they will have a better knowledge of their fixations and find it easier to identify ideators with homogeneous or heterogeneous fixations in relation to them and to adapt their feedback. This leads us to formulate our third hypothesis.

***Hypothesis 3:** The adoption of a design phase on the creative problem by the leaders giving feedback moderates the relationship between fixation heterogeneity (homogeneous or heterogenous fixations) and the ability to give correct feedback, so that leaders with a design phase have more facility to adapt themselves to the fixation of the ideators and give more correct feedback than leaders not adopting a design phase.*

***Designing for self-awareness of fixations and listening to become aware of the other's fixations***

We can cumulate the two previous actions to reinforce the leaders' capacities to recognize the ideators' fixations and to recognize their own fixations, and then to moderate the relation between the heterogeneity of the fixations and the capacity to give correct feedback. Thus, by letting leaders design on the creative problem and then listen to the ideators before giving feedback, we assume that the leaders will be able to compare their ideas with the ideas that they hear to have a better understanding of the heterogeneity of fixation between them and the ideators. This should improve the rate of correct feedback and decrease the differences between homogeneous and heterogeneous conditions through a complete adaptation of the leaders to the ideators' fixation. This leads us to formulate our last hypothesis.

***Hypothesis 4:** The adoption of a design phase on the creative problem paired with a listening phase moderates the relationship between fixation heterogeneity (homogeneous or heterogeneous fixations) and the ability to give correct feedback,*

*so that leaders adopting a design phase and then a listening phase have more facility to adapt themselves to the fixation of the ideators and give more correct feedback than leaders not adopting a design phase and listening phase. In other words, the combination of these two actions (design and listening) allows the leaders to adapt more easily to the ideators' fixations and thus to have a better rate of correct feedback than if one or both of the two actions were not present.*

We synthesized the hypotheses in the conceptual model presented in Figure 1.

[Insert Figure 1 near here]

## **Method**

### ***Data collection***

#### *Participants*

In answering our research question and testing our hypotheses, we adopted an experimental approach to finely control the different factors that can affect our dependent variable, namely the capacity of the participants in the role of leaders to give correct feedback to defixate ideators. That is to say, we tested, during idea generation, the capacity of the participants in the role of leaders to provide an ideator feedback to continue on the current path when the idea is creative for the ideator and to search for another path when the idea is in fixation for the ideator. We thus set up an experimental protocol in the laboratory varying the heterogeneity of the fixations between the participant in the role of the leader and the ideator (homogeneous or heterogeneous), the presence of a reading phase (present or not) and the presence of a design phase (present or not). In relation to the hypotheses that we constructed, we replaced the listening phase with a reading phase. Indeed, the listening phase as presented in the literature

corresponds in reality to a phase where the participants pay attention to the ideas of the others. As our protocol was carried out online, on a computer, it seemed more relevant to simulate this listening phase by reading the ideator's ideas rather than by actually listening.

By varying the three parameters (heterogeneity, design, reading), eight experimental conditions were thus constructed as described and named in Table 1.

[Insert Table 1 near here]

45 participants volunteered for and consented to the experiment. The participants were student engineers and students in management belonging to a junior enterprise (i.e., a non-profit association with an economic vocation whose aim is to enable students to put into practice the knowledge that they have learned in engineering or management school through projects responding to the needs of professionals). Twenty-four of the volunteers were already familiar with the creativity task used in the experiment and thus excluded from the analysis. At the time of recruitment, participants were asked to participate in an experiment on interaction and creativity, in exchange for which they would be offered a 1-hour training on leadership and creativity (conducted a few weeks after the experiment). The participants only knew that the experiment would last 20 minutes and be conducted online before agreeing to participate. The distribution of participants across the eight experimental conditions is described in Table 2.

[Insert Table 2 near here]

As mentioned above, the experiment was conducted online for 20 minutes and all participants received 1 hour of training on leadership and creativity after completing



the experimental protocol. The participants fully understood the objectives of the experiment from information presented in the training.

### *Materials*

As a creative task, we selected the egg task (Agogu e et al., 2014; Agogu e & Parguel, 2020; Cassotti et al., 2016; Ezzat et al., 2017, 2020), whose instruction is to *design as many original solutions as possible so that a hen's egg dropped from a height of 10 meters does not break*. We chose this task because it has been used in many studies on fixation phenomena, highlighting the predictive character of individuals' fixations. As mentioned earlier, as the unconscious adherence is difficult to measure, we're going to build on the previous studies and use in a same way a method to measure fixation, based on C-K theory. Indeed, on the basis of C-K theory, a reference frame including all the solutions of the egg-task has been realized (Agogu e, 2012; Agogu e et al., 2014). Studies have shown that most individuals are fixated on three particular categories of solutions: damping the shock, protecting the egg and slowing the fall (Agogu e, 2012; Agogu e et al., 2014). These three categories correspond to solutions that are generated from knowledge about the fall of fragile objects. In the studies carried out, individuals gave 80% of solutions to the egg task in these three categories, confirming that the knowledge relative to these solutions is restrictive for the populations tested. This is notably the case for a population of engineering students (Agogu e & Cassotti, 2013). Thus, owing to the very homogeneous nature of the fixations on the egg task, based on previous studies involving the same populations as our study, we can predict the fixations of the participants in the role of leaders in our experiment and artificially create an ideator with controlled fixations. It is to be noted that we were able to control for this prediction with our sample, since half the participants generated ideas on the egg task.

In our experiment, participants take the role of leaders who have to give feedback to an ideator after each generated idea. We chose to automate the ideator (i.e., to simulate the ideator using a computer) to control both its fixations (which were the same throughout the experiment) and its reaction to the participants' feedback. The interaction between the participant in the role of leader and the ideator can be diagrammed as in Figure 2.

[Insert Figure 2 near here]

A more detailed explanation of the interaction is given in the procedure section. We built two ideators: one whose fixations are the same to those of the participants as presented in the literature (Agogu e, 2012; Agogu e et al., 2014), we speak of homogeneous fixations and one whose fixations are different, we speak of heterogeneous fixations. To create the heterogeneous ideator (the one with heterogeneous fixations), we imagined the profile of a person who would be fixated on unexpected moments of action (ideas belonging to the category of acting after the fall), on how they can use the environment (ideas belonging to the category of using properties of the environment), and on bending the rules of the game (ideas belonging to the category of interrupting the fall). The set of solution categories for the egg task and the creation of the profiles of the two ideators are presented in Table 3. An example of an idea used in each category is also included.

[Insert Table 3 near here]

For each of the two constructed ideators, three solution categories are in fixation and seven are in expansion (i.e., not in fixation, creative). We filled in each of the categories using solutions generated by participants in previous studies. We ensured that there was only one solution per idea (as sometimes participants accumulated several

different solutions in the same idea) and that the category label was not present in the idea (e.g., there was to be no wording such as “an object to slow the fall”). Each idea was identified as either in fixation or in expansion for the ideator according to the heterogeneity of the ideator (homogeneous or heterogenous with the participant in terms of fixations).

The construction of the protocol described in the next section called for the presentation of 10 ideas to the participants, such that the participants saw a maximum of 10 ideas in fixation and a maximum of 10 ideas in expansion. We therefore selected five ideas in each category of fixation and two ideas in each category of expansion. Thus, if the ideator were to present a fixated idea to the participant, it would randomly draw from the 15 fixated ideas and if the idea were to be in expansion, it would randomly draw from the 14 ideas in expansion. No idea was presented twice to the same participant. In addition to this, half of the participants were under an experimental condition with a reading phase of the designer's ideas before the feedback phase. For this reading phase, participants could read eight ideas: two ideas in each of the three fixation categories for the ideator and two ideas in an expansion category for the ideator. This followed the typical proportions of ideas in fixation and ideas in expansion present in the literature (Agogu e, 2012; Agogu e et al., 2014). The participants under homogeneous conditions thus read six ideas also in fixation for them and two ideas in expansion for them whereas the participants under heterogeneous conditions read two ideas in fixation for them and six ideas in expansion for them. The ideas read were different from those used in the generation phase afterwards in the feedback section.

### *Procedure*

We set up an experimental protocol simulating an interaction between the participant, in the role of a leader, and an ideator, simulated by a computer. The main steps of the protocol, according to the experimental conditions, are presented in Figure 3.

[Insert Figure 3 near here]

Following a false draw to make the participants believe that their role was not determined in advance, they learned that they had the role of the leader and were informed of the various instructions of the experiment. Under the conditions with a design phase, the participants were told that they had to position themselves for 5 minutes in the role of an ideator and generate as many creative ideas as possible to answer the egg task. Once the 5 minutes were up, they moved on to the next step. Under the conditions with a reading phase, it was then indicated that the ideator was generating ideas himself and that they would be able to read those ideas. The participants then received eight ideas whose nature was different according to the experimental condition (homogeneous or heterogeneous). After reading the ideas, they could move on to the next part. All participants, regardless of their experimental condition, then entered the main part of the protocol, namely the direction of the ideator by the participants with the help of feedback. The participants were instructed to make the ideator more creative by using the feedback at their disposal. For each idea they received, the participants were first asked to rate the creativity of the idea from their own perspective on a scale of 1 to 7 (with a value of 1 meaning the idea was uncreative and a value of 7 meaning the idea was creative). They then had to choose between two feedback options: whether they thought that pushing the ideator to continue would make it more creative, in which case they had to provide the feedback “continue on this path”, or they thought that the ideator had to change track to be more creative, in which case they had to provide the

feedback “search for another path”. Ten ideas were proposed, with increasing intervals between each proposed idea to give the impression that a real ideator was generating the ideas, following the timing observed by Beaty and Silvia (2012). The ideator was built to react perfectly to the feedback chosen by the participants. Thus, if the participant asked the ideator to “continue on this path”, the ideator generated an idea of the same nature as the previous idea (in fixation for the ideator if the previous idea was in fixation for the ideator and in expansion otherwise). Conversely, if the participant asked the ideator to “search for another path”, the ideator generated an idea of a different nature compared with the previous idea (in expansion for the ideator if the previous idea was in fixation for ideator and in fixation for the ideator if the previous idea was in expansion for the ideator).

At the end of the experimental protocol, through an online form, we collected data on the participants (age, gender, background) and asked them some questions to ensure they understood correctly the instructions of the experiment.

### ***Data analysis***

We established two variables to analyze the data and test our hypotheses: the rate of correct feedback and the unacceptable inconceivable ideas. The following paragraphs describe these variables. It may be noted that the analyst of the data was not blind to the hypotheses and experimental condition, but analysis criteria were objective and fixed in advance to ensure the neutralization of biases (which variables to test and how).

#### ***Rate of correct feedback***

The aim of our protocol was to study the various factors that affect the capacity of leaders to defixate an ideator. The defixation corresponds to the expansivity of the ideator (Agogu e et al., 2015), which is the number of ideas in expansion that it was able

to generate during the experiment. In this protocol, because the ideator reacts perfectly to the participant's feedback as explained in the procedure section, the number of ideas in expansion that it generates depends on the participants' ability to give correct feedback on each idea. Indeed, to make the ideator creative, the participant must choose the feedback “continue on this path” each time the proposed idea is in expansion for the ideator and the feedback “search for another path” each time the proposed idea is in fixation for the ideator. We then calculate the rate of correct feedback, which is the percentage of times that the participant gave the correct feedback on an idea to make the ideator more creative (from the ideator's point of view).

#### *Unacceptable inconceivable ideas*

Half of the participants were given the opportunity to design on the egg task, and we were thus able to code the ideas generated by the participants and look at the frequencies of occurrences of these ideas. Ideas were coded independently by two researchers, and any differences in coding were then discussed to reach a consensus. We considered an inconceivable idea to be any idea present in the construction of our ideators (i.e., any idea in the pool of ideas available during the idea generation phase for the ideator) and present at most once among all the ideas generated by the participants. It should be noted that these ideas are "inconceivable" only in relation to our sample, since out of the thousand ideas generated, they do not appear (frequency of appearance less than 0.2%), but could be conceivable for another sample.

For these ideas, we then look at the feedback given on average by the participants during the feedback phase. If the majority of feedback is “search for another path”, then we considered that the idea was an unacceptable inconceivable idea because the participants were unable to generate this idea themselves and they rejected it when it

was presented to them. The paper refers to the rejection of unacceptable inconceivable ideas, even if this is a redundancy of language between "rejection" and "unacceptable".

### *Statistical tests*

In the case of our first hypothesis, the rejection of unacceptable inconceivable ideas was considered as a mediating variable between the level of heterogeneity (homogeneous or heterogeneous fixations) and the capacity of the participants to give correct feedback. This means that we assumed that this variable explains the difference in the capacity of the participants to give correct feedback in relation with their heterogeneity with the ideators (homogeneous or heterogeneous in terms of fixations). To test the mediating role of the rejection of unacceptable inconceivable ideas in the relationship between fixation heterogeneity and the ability of the participants to give correct feedback on all ideas, we performed several tests for each condition. To compensate for the effect of the frequency of unacceptable inconceivable ideas, which are more numerous for the heterogeneous conditions (because these ideas are in fixation for the ideators), we decided to compare the capacity of the leaders to give the correct feedback according to the heterogeneity, first on all the ideas and then by filtering on the unacceptable inconceivable ideas for the leaders (by selecting only these ideas or by excluding them from the analysis). The aim was to show a significant effect of fixation heterogeneity on the ability to give correct feedback both on all ideas and on unacceptable inconceivable ideas, and then to show an absence of a significant effect of fixation heterogeneity on the ability to give correct feedback when unacceptable inconceivable ideas are neutralized.

In the cases of the second, third and fourth hypotheses, we considered design and listening (reading in our experiment) as moderating variables, meaning that we assumed that these variables limited or neutralized the effect of the heterogeneity on

the capacity of the participants to give correct feedback. To test the moderating role of the different actions that participants could perform before the feedback phase, we performed tests to compare participants' performance under these conditions against the control conditions.

## **Results**

The purpose of this study is to investigate which actions allow a leader to better realize the diversity of the ideator's fixations and thus adapt to the fixations and give more correct feedback; i.e. more appropriate feedback on the ideator's fixations. To test our hypotheses, we performed one-tailed independent t-tests between the different conditions according to the hypothesis tested. We performed Student's t tests when the assumptions of normality and homogeneity of variances were met and Mann–Whitney tests when this was not the case.

### ***Rejection of unacceptable inconceivable ideas***

We performed several analyses to test our first hypothesis on the way that the rejection of unacceptable inconceivable ideas mediates the relationship between heterogeneity and the rate of correct feedback. As presented in Figure 4A, participants under the heterogeneous condition had a better rate of correct feedback ( $M = 56.6, SD = 15.4$ ) than participants under the homogeneous condition ( $M = 47.1, SD = 19.4$ ). We performed a Student's t test and found a significant difference between homogeneous and heterogeneous conditions ( $t(55) = -2.03, p = .024$ ). Thus, under the control condition, heterogeneous fixations led to a rate of correct feedback significantly better than homogeneous fixations.

To verify that the rejection of unacceptable inconceivable ideas mediates the relationship between the heterogeneity of fixation and the rate of correct feedback, we



isolated the unacceptable inconceivable ideas to calculate the rate of correct feedback on these ideas and performed a Mann–Whitney test between the two control conditions. As presented in Figure 4B, participants under the heterogeneous condition had a significantly better rate of correct feedback on unacceptable inconceivable ideas than participants under the homogeneous condition ( $U = 149, p < .001$ ). Moreover, as presented in Figure 4C, after removing the unacceptable inconceivable ideas from the analysis, there was no significant difference in the rate of correct feedback between homogeneous and heterogeneous conditions ( $t(55) = -0.476, p = .318$ ). Thus, hypothesis 1—the rejection of unacceptable inconceivable ideas mediates the relationship between the heterogeneity of fixation and the rate of correct feedback—is supported.

[Insert Figure 4 near here]

### ***Reading***

To test hypothesis 2 on how a reading phase for the participants giving feedback moderates the relationship between fixation heterogeneity and the ability to give correct feedback, we analyzed the differences between the reading conditions and control conditions, the effect of heterogeneity for the reading conditions, the rate of correct feedback on unacceptable inconceivable ideas alone and the rate of correct feedback without these ideas. The results are graphically presented in Figure 5.

As presented in Figure 5A, under the reading conditions, the participants gave more correct feedback for the heterogeneous condition ( $M = 59.6, SD = 16.8$ ) than for the homogeneous condition ( $M = 50.7, SD = 19.2$ ). We performed a one-tailed independent Student's t-test and found that this difference was significant ( $t(51) = -1.79, p = .040$ ). However, we did not find a significant difference when comparing the

homogeneous conditions (control and reading) with each other and then the heterogeneous conditions (control and reading) with each other. The results of the Student's t tests are presented in Appendix A.

Figure 5B presents the rate of correct feedback on unacceptable inconceivable ideas. We can see that the heterogeneous conditions had a better rate of correct feedback on these ideas. We performed a one-tailed independent Mann–Whitney t-test and found that this difference was significant ( $U = 155, p = .003$ ). Moreover, when removing the unacceptable inconceivable ideas from the analysis (Figure 5C), there was no significant difference between the two reading conditions (homogeneous versus heterogeneous,  $t(51) = -0.613, p = .271$ ). Therefore, hypothesis 2 is not supported; i.e., a reading phase does not moderate the relationship between fixation heterogeneity and the ability to give correct feedback.

[Insert Figure 5 near here]

### ***Design***

To test hypothesis 3 on how a design phase for the participants giving feedback moderates the relationship between fixation heterogeneity and the ability to give correct feedback, we analyzed the differences between the design conditions and the control conditions, the effect of heterogeneity for the design conditions, the rate of correct feedback on unacceptable inconceivable ideas alone and then the rate of correct feedback without these ideas. The results are graphically presented in Figure 6.

As presented in Figure 6A, under the design conditions, the participants gave more correct feedback for the heterogeneous condition ( $M = 60, SD = 16.4$ ) than for the homogeneous condition ( $M = 52.5, SD = 19.7$ ). We performed a one-tailed independent Student's t-test and found that this difference was not significant ( $t(56) = -1.58, p =$

.060). In the same way, when comparing the homogeneous conditions (control and design) with each other and then the heterogeneous conditions with each other (control and design), we did not find a significant difference. The results of the Student's t tests are presented in Appendix A.

Figure 6B presents the rate of correct feedback on unacceptable inconceivable ideas. We can see that heterogeneous conditions had a better rate of correct feedback on these ideas but the difference was not significant (i.e., a one-tailed independent Mann–Whitney t-test gave  $U = 254, p = .113$ ). Moreover, when removing the unacceptable inconceivable ideas from the analysis (Figure 6C), there was no significant difference between the two design conditions (homogeneous versus heterogeneous,  $t(56) = -1.01, p = .159$ ). Therefore, hypothesis 3—a design phase moderates the relationship between fixation heterogeneity and the ability to give correct feedback—is supported, because the difference between homogeneous and heterogeneous conditions is neutralized for both the rate of correct feedback and the rate of correct feedback on unacceptable inconceivable ideas.

[Insert Figure 6 near here]

### ***Design and reading***

To test hypothesis 4 on how a design and reading phase for the participants giving feedback moderates the relationship between fixation heterogeneity and the ability to give correct feedback, we analyzed the differences between the design and reading conditions and the design conditions and reading conditions, respectively. We then analyzed the effect of heterogeneity for the design and reading conditions, the rate of correct feedback on unacceptable inconceivable ideas alone and then the rate of correct feedback without these ideas. The results are graphically presented in Figure 7.

As presented in Figure 7A, under the design and reading conditions, the participants under the heterogeneous condition gave more correct feedback ( $M = 60.4$ ,  $SD = 16.3$ ) than the participants under the homogeneous condition ( $M = 50.7$ ,  $SD = 17.3$ ). We performed a one-tailed independent Student's t-test and found that this difference was significant ( $t(51) = -2.09$ ,  $p = .021$ ). However, when comparing the homogeneous conditions (reading with design and reading, design with design and reading) with each other and then the heterogeneous conditions (reading with design and reading, design with design and reading) with each other, we did not find a significant difference. The results of the Student's t tests are presented in Appendix A.

Figure 7B presents the rate of correct feedback on unacceptable inconceivable ideas. We can see that the heterogeneous conditions had a better rate of correct feedback on these ideas. We performed a one-tailed independent Mann–Whitney t-test and found that this difference was significant ( $U = 101$ ,  $p < .001$ ). Moreover, when removing the unacceptable inconceivable ideas from the analysis (Figure 7C), there was no significant difference between the two design and reading conditions (homogeneous versus heterogeneous,  $t(51) = -0.320$ ,  $p = .375$ ). Therefore, hypothesis 4 is not supported; i.e., a design and reading phase does not moderate the relationship between fixation heterogeneity and the ability to give correct feedback.

[Insert Figure 7 near here]

## **Discussion**

The purpose of our study was to test actions that leaders can implement to learn about ideator fixations and to adapt their directive feedback to ideators. We were interested in the effect of the rejection of unacceptable inconceivable ideas on the leaders' ability to give correct feedback according to their heterogeneity with ideators and the role of

design and listening in helping leaders adapt to ideator fixations. Listening was replaced by reading in our experiment, as reading was the most relevant way for participants playing the role of leaders to pay attention to the ideator's ideas.

The results showed that the rejection of unacceptable inconceivable ideas by participants in the leader role had a significant effect on the ability of the participants to give correct feedback depending on their heterogeneity with the ideators. Specifically, participants under the heterogeneous conditions had more facility to give correct feedback than participants under the homogeneous conditions owing to the rejection of unacceptable inconceivable ideas. This effect was moderated when we gave participants the opportunity to design beforehand on the creative problem; i.e., under the design conditions, there was no significant difference between the participants with homogeneous fixations with ideators and the participants with heterogeneous fixations with ideators. Conversely, the significant difference between the homogeneous and heterogeneous conditions remained when participants adopted a reading phase (either alone or in addition to a design phase).

Our study allows us to put forward several results regarding the capacity of individuals in the role of leaders to give directive feedback to help ideators to be more creative. By giving as much correct feedback as possible, the individuals allow the ideators to defixate themselves as they help them to continue on the path of creative ideas and to change path when the generated idea is in fixation (according to the frame of the ideator). First, without any particular action by individuals in the role of leaders, a context of heterogeneous fixations allows individuals to be more efficient in their choice of feedback. This phenomenon occurred in our study because of the way we constructed our two artificial ideators. Indeed, as shown by the results, the significant difference was due to the rejection of unacceptable inconceivable ideas for the

participants. However, it turns out that these particular ideas were considered in fixation for the ideators who had heterogeneous fixations with the participants and in expansion (creative) for the ideators who had homogeneous fixations with the participants. Thus, the rejection of these ideas allowed for a better defixation of ideators who did not have the same fixations as the individuals in the role of leaders.

The uncovering of these unacceptable inconceivable ideas allows us to re-examine the literature on the rejection of creativity in a new light. Indeed, many studies have indicated that even if individuals seek out creative ideas, they tend to reject them (Blair & Mumford, 2007; Licuanan et al., 2007; Mueller et al., 2012). The reasons put forward relate to fear (Lee et al., 2017) and in particular fear in situations of uncertainty, with behaviors aimed at reducing this uncertainty (Mueller et al., 2012, 2014). Our study allows us to complete these results. Indeed, the ideas that were rejected by the individuals in the role of leaders correspond either to ideas that seem to circumvent the problem by responding differently or ideas that do not seem feasible because of a lack of knowledge. Therefore, actions may exist that reduce this fear of uncertainty and the rejection of ideas that are too creative. For example, making explicit the knowledge that allows the realization of an idea would improve the feasibility judgment of an idea and increase the chances of the idea being accepted.

A designing phase for the leader before the feedback phase removed the difference in the way feedback was given between the heterogeneous and homogeneous conditions, by reducing the rejection of unacceptable inconceivable ideas. This could advance research showing that in evaluating and selecting ideas, individuals need to design to complete the ideas and better appreciate the potential of the ideas (Sukhov, 2018; Sukhov et al., 2021). Meanwhile, the results do not allow us to say exactly what makes this moderation possible. Possible explanations are that the design phase allows a

better recognition of creative ideas of the ideators and that there is an attraction toward the fixation under heterogeneous conditions.

Finally, the reading phase did not have the expected effect. We expected that this phase would allow individuals in the role of leaders to better recognize the ideator's fixations and thus change the way that they directed them, but this was not the case. Indeed, the literature tends to show that individuals are capable of considering the perspectives of others, especially if they are explicitly asked to do so (Egan, 2005; Hoever et al., 2012). In our study, we introduced a reading phase and asked the individuals in the role of leaders to make the ideators more creative, but we did not explain further what this meant for the ideators. Therefore, the method of integrating the ideators' perspectives was perhaps not made explicit enough. Moreover, the listening (or here reading) phase seems important for ideation to build on the ideas of others and build new creative ideas in relation to the ideas proposed by others (Dugosh et al., 2000; Dugosh & Paulus, 2005; Gillier & Bayus, 2022). This phase may not have the same effect when the objective of paying attention to ideas is the recognition of fixations. Moreover, individuals have been shown to experience difficulty recognizing the creative ideas of others (Runco & Smith, 1992), which could explain why, despite this reading phase, the recognition of fixations was more complex than was expected in the present study. Moreover, the reading phase seems to cancel the moderating effect of design on the rejection of inconceivable ideas because under the reading and design conditions, there is again a significant difference between the homogeneous and heterogeneous conditions. This result is possibly due to the fact that the reading phase took place after the design phase, resulting in the suppression of the benefits of design. Future research could focus on the study of tools that would allow individuals to better recognize fixation in others and thus better manage the fixation.

Our study has managerial implications. Indeed, in organizations, leaders are in charge of creativity and must therefore adopt behaviors that make their team creative (Mainemelis et al., 2015). Thus, if they place themselves in the position of defixating leaders, involved in the idea generation process (Ezzat, 2017; Ezzat et al., 2017), then they should first question their level of heterogeneity with their team members. Indeed, if they are certain that they are in fixation heterogeneity, then they can simply capitalize on the phenomenon of rejecting unacceptable inconceivable ideas to guide their team members toward defixation and thus toward generating more creative ideas. If they are unsure of this heterogeneity, a recommendation would be to design ahead of the creativity session to limit the rejection of creative ideas. Beyond the results of our study, which are for a particular heterogeneity, this indicates to leaders that their choice of feedback that they give may be biased, especially in terms of their reaction to inconceivable ideas. One recommendation would be to be aware of their own biases so as to be more attentive to them when guiding ideators during idea generation and thus avoid rejecting ideas that could be interesting.

## **Conclusion**

The present study allows us to draw conclusions about the ability of individuals in the role of leaders to help ideators to be more creative through directive feedback. Without specific actions from individuals in the role of leaders, situations where leaders and ideators have heterogeneous fixations promote defixation through the rejection of unacceptable inconceivable ideas. With the addition of a phase of reading ideas of the ideators, the individuals in the role of leaders do not seem to be able to better recognize the fixations of the ideators. Conversely, a phase of design on the creative problem allows the individuals in the role of leaders to avoid the rejection of unacceptable inconceivable ideas and then to give as much correct feedback to homogeneous ideators



as to heterogeneous ideators.

This study has limitations. Indeed, as for any laboratory experiment, the neutralization of a certain number of variables limits the transfer of knowledge to the organizational contexts where idea generation happens with far more variables. Further research should be conducted, especially by adding an organizational context to the creative problem. In particular, we have minimized the possible interactions between the study participants and the ideators to be able to finely measure the effects of the participants' behaviors on the ideators' defixation. It would be interesting to continue this study by reintroducing social interactions between individuals. It is possible that by leaving free the nature of the feedback sent by the individual in the role of the leader, the feedback will in fact be much richer than a simple direction. Real ideators might also adapt themselves to the feedback, learn from it, and modify their fixations. Individuals in the role of leaders could, for example, choose to transmit knowledge or even ideas that could then serve as defixating examples (Agogué et al., 2014).

The present study was conducted with a student population, and it would be necessary to reproduce the results with a professional population. Indeed, several studies have shown differences between novices and experts (Bonnardel & Marmeche, 2004; Ozkan & Dogan, 2013). It would be particularly relevant to study the reaction of experts, who are experienced in evaluating ideas, when they are confronted with inconceivable ideas. To take this study a step further, it would also be useful to study an interaction between a leader/ideator pair used to working together, to confirm that reactions are indeed the same in a social context.

The egg task allowed us to have a good appraisal of which ideas would be in fixation or in expansion (creative) for the participants. In the case of a more complex creative problem, the fixations could be more difficult to perceive and not as linear as in

our study. Ideas are possibly more complex in that they could be partly in fixation and partly in expansion, making it more difficult to give precise directive feedback.

However, we would not have been able to draw our conclusions without a very restrictive context in the present study.

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### **Declaration of interest statement**

The authors declare that they have no competing interests.

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## Appendices

### Appendix A

Factor tested	Conditions	Independent t-test
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Heterogeneity	Homogeneous control – Heterogeneous control	$t(55) = -2.03, p = .024$
	Homogeneous with reading – Heterogeneous with reading	$t(51) = -1.79, p = .040$
	Homogeneous with design – Heterogeneous with design	$t(56) = -1.58, p = .060$
	Homogeneous with reading and design – Heterogeneous with reading and design	$t(51) = -2.09, p = .021$
Reading	Homogeneous control – Homogeneous with reading	$t(53) = -0.691, p = .246$
	Heterogeneous control – Heterogeneous with reading	$t(53) = -0.704, p = .242$
	Homogeneous with design – Homogeneous with reading and design	$t(55) = .36, p = .357$
	Heterogeneous with design – Heterogeneous with reading and design	$t(52) = -0.0931, p = .463$ $U = 351, p = .570$
Design	Homogeneous control – Homogeneous with design	$t(54) = -1.02, p = .155$
	Heterogeneous control – Heterogeneous with design	$t(57) = -0.831, p = .205$
	Homogeneous with reading – Homogeneous with reading and design	$t(54) = .0105, p = .504$ $U = 392, p = .503$
	Heterogeneous with reading – Heterogeneous with reading and design	$t(48) = -0.171, p = .433$

Table 1. Experimental conditions

<b>General condition</b>	<b>Condition name</b>	<b>Description</b>
<b>Control</b>	<b>Homogeneous control</b>	The participant and ideator have the same distribution of fixations; the participant does not read the ideator's ideas and does not design before giving feedback
	<b>Heterogeneous control</b>	The participant and ideator do not have the same distribution of fixations; the participant does not read the ideator's ideas and does not design before giving feedback
<b>Reading</b>	<b>Homogeneous with reading</b>	The participant and ideator have the same distribution of fixations; the participant reads the ideas of the ideator but does not design before giving feedback
	<b>Heterogeneous with reading</b>	The participant and ideator do not have the same distribution of fixations; the participant reads the ideas of the ideator but does not design before giving feedback
<b>Design</b>	<b>Homogeneous with design</b>	The participant and ideator have the same distribution of fixations; the participant does not read the ideas of the ideator but designs before giving feedback
	<b>Heterogeneous with design</b>	The participant and ideator do not have the same distribution of fixations; the participant does not read the ideas of the ideator but designs before giving feedback
<b>Design and reading</b>	<b>Homogeneous with design and reading</b>	The participant and ideator have the same distribution of fixations; the participant designs and reads the ideator's ideas before giving feedback
	<b>Heterogeneous with design and reading</b>	The participant and ideator do not have the same distribution of fixations; the participant designs and reads the ideator's ideas before giving feedback

Table 2. Distribution of the participants between the eight conditions according to age and gender

<b>Condition</b>	<b>N</b>	<b>Age</b>	<b>Gender</b>
Homogeneous control	28	$M = 21, SD = 1.66$	18 males, 10 females
Heterogeneous control	29	$M = 20.8, SD = 1.45$	17 males, 12 females
Homogeneous with reading	27	$M = 20.8, SD = 1.69$	16 males, 11 females
Heterogeneous with reading	26	$M = 21.2, SD = 2.28$	17 males, 9 females
Homogeneous with design	28	$M = 20.9, SD = 1.63$	19 males, 9 females
Heterogeneous with design	30	$M = 20.8, SD = 1.56$	20 males, 10 females
Homogeneous with design and reading	29	$M = 20.7, SD = 1.20$	20 males, 9 females
Heterogeneous with design and reading	24	$M = 21.5, SD = 1.84$	15 males, 9 females

Table 3. Categories of solutions for the egg task and construction of the two ideators

Category of solutions	Examples of ideas used by the ideator (computer)	Homogeneous ideator	Heterogeneous ideator
Damping the shock	Throwing the egg onto a mattress on the floor	Fixation	Expansion
Protecting the egg	Wrapping the egg in bubble wrap	Fixation	Expansion
Slowing the fall	Attaching a small motor to the egg so that it descends gently.	Fixation	Expansion
Interrupting the fall	Throwing the egg over a net	Expansion	Fixation
Acting before the fall	Throwing the egg from 11 metres, so that after 10 metres it won't be broken.	Expansion	Expansion
Acting after the fall	Replacing broken egg with twin egg	Expansion	Fixation
Using a living device	Asking an eagle to catch the egg in flight	Expansion	Expansion
Modifying the properties of the egg	Cooking the egg to harden it before throwing it	Expansion	Expansion
Using the natural properties of the egg	Throwing the egg so that it falls exactly on its oval axis (this axis is unbreakable).	Expansion	Expansion

Using the properties of the environment	Releasing the egg in weightlessness	Expansion	Fixation
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Figure 1.

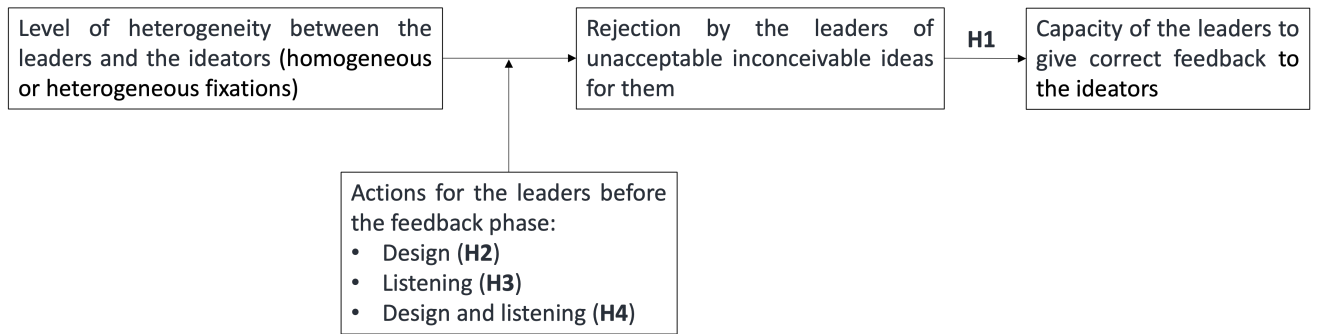


Figure 2.

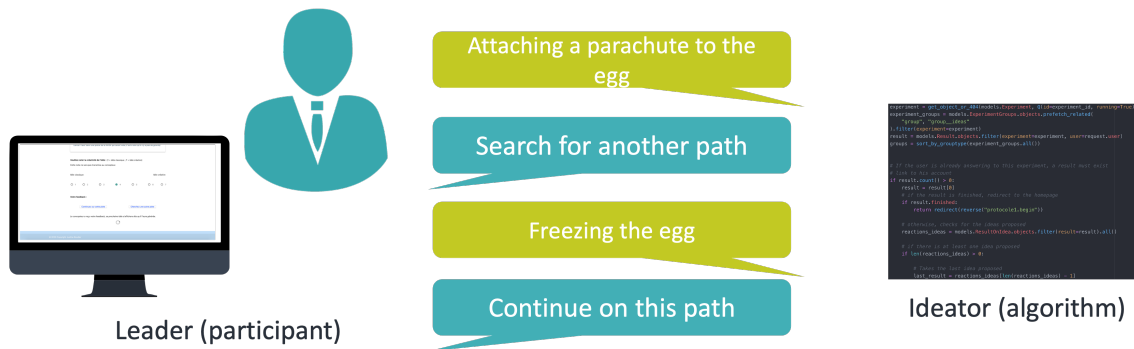


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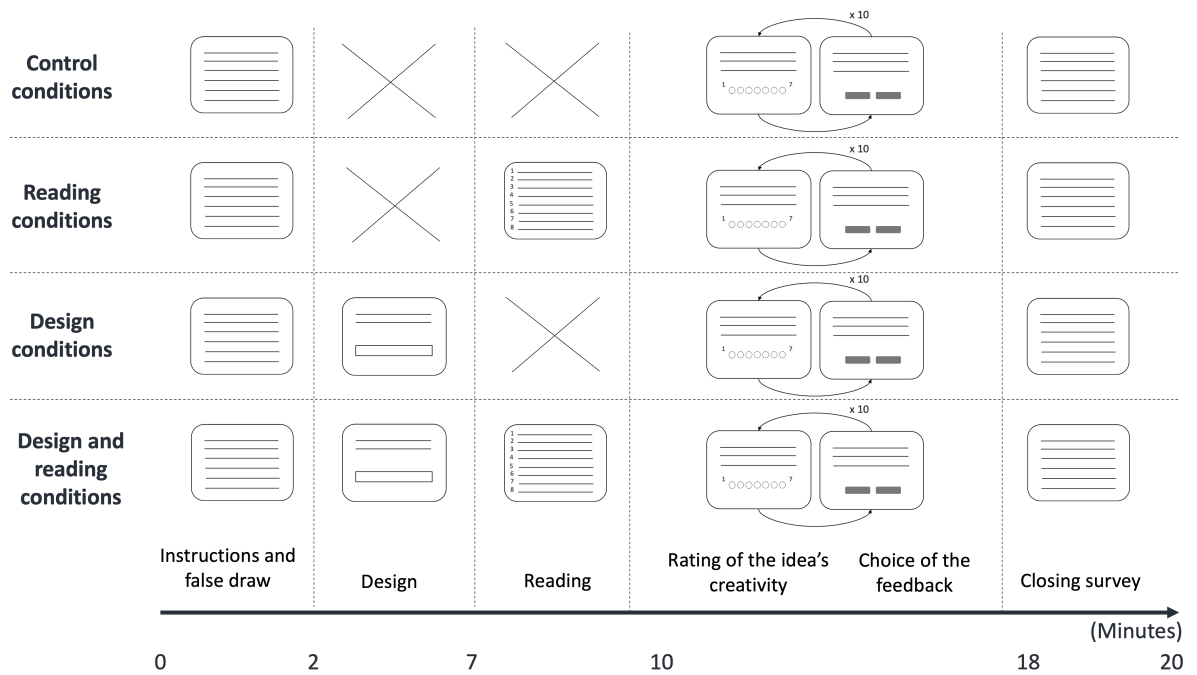




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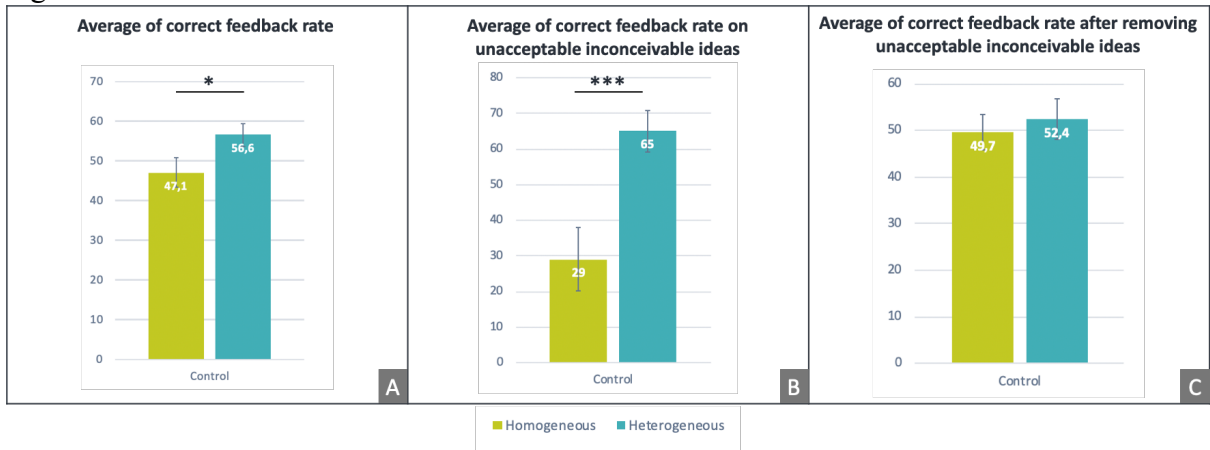


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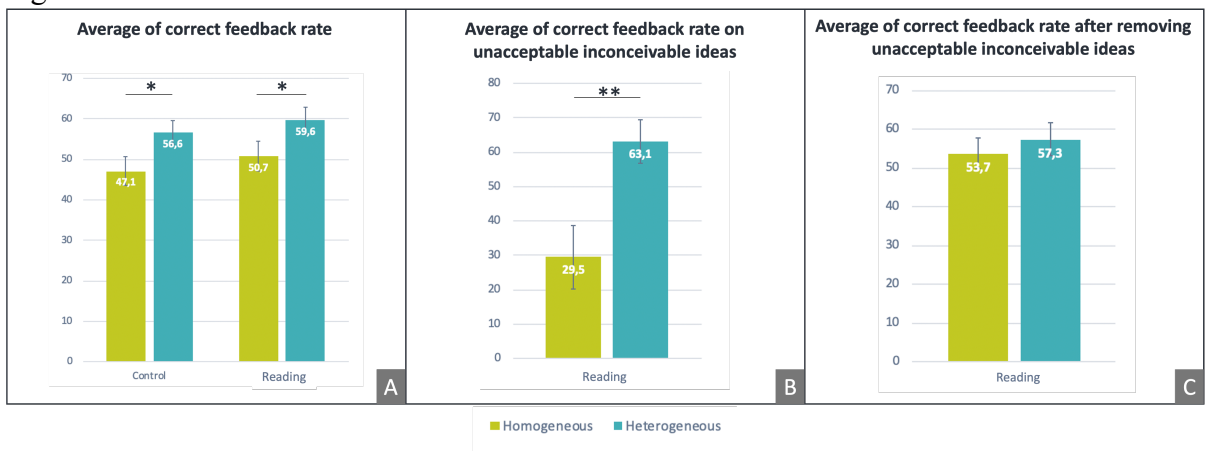


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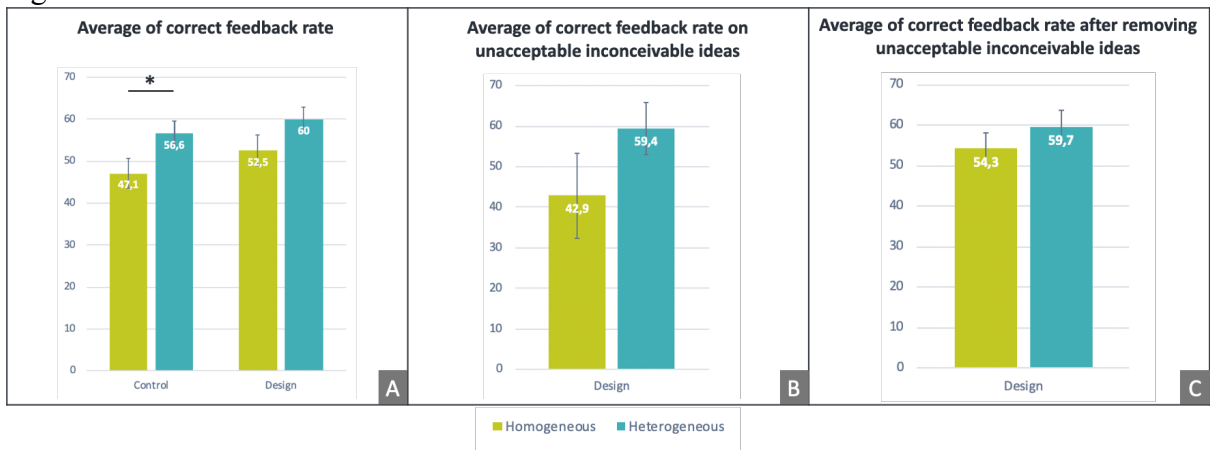
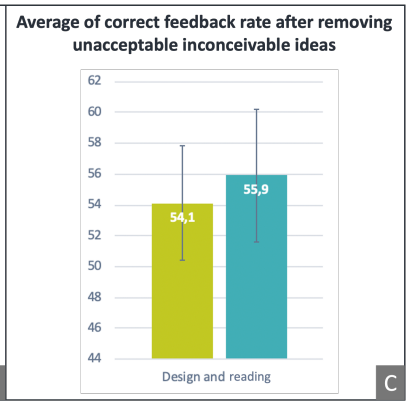
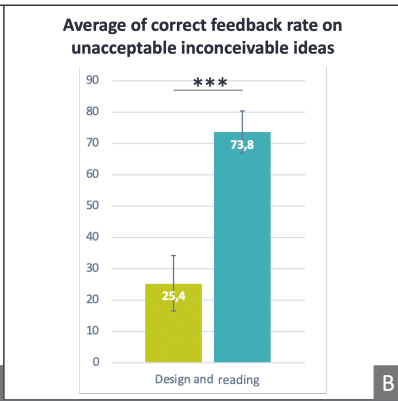
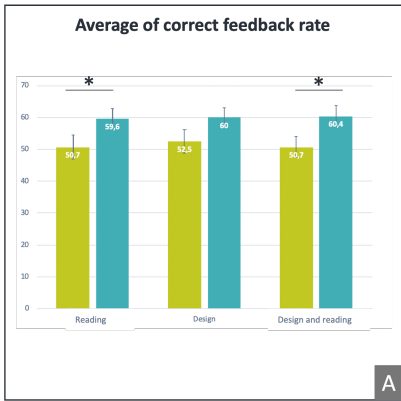


Figure 7.



■ Homogeneous ■ Heterogeneous

## Figure captions

Figure 1. Conceptual model

Figure 2. Diagram of the interaction between the participant in the role of leader and the ideator

Figure 3. Main steps of the experimental protocol according to conditions

Figure 4. Results for the control conditions. A: Average correct feedback. B: Average correct feedback on unacceptable inconceivable ideas. C: Average rate of correct feedback after removing unacceptable inconceivable ideas. \*:  $p < .05$ , \*\*\*:  $p < .001$

Figure 5. Results for the reading conditions. A: Average correct feedback. B: Average correct feedback on unacceptable inconceivable ideas. C: Average rate of correct feedback after removing unacceptable inconceivable ideas. \*:  $p < .05$ , \*\*:  $p < .01$

Figure 6. Results for the design conditions. A: Average correct feedback. B: Average correct feedback on unacceptable inconceivable ideas. C: Average rate of correct feedback after removing unacceptable inconceivable ideas. \*:  $p < .05$

Figure 7. Results for the design and reading conditions. A: Average correct feedback. B: Average correct feedback on unacceptable inconceivable ideas. C: Average rate of correct feedback after removing unacceptable inconceivable ideas. \*:  $p < .05$ , \*\*\*:  $p < .001$