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SEARCHING FOR INSPIRATION DURING IDEA GENERATION: PICTURES OR WORDS?

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1. Introduction

People from different professional arenas search for inspiration in a number of sources, be it in memories from past experiences or in the physical environment that surrounds them. Purposefully or unconsciously, scientists, artists, writers and different types of designers for instance, come across diverse types of stimuli that they expect might help them in understanding, developing or working out a situation at hand. In design, particularly, looking for inspiration is a frequent activity, which can take place in the designers' mind, but also while browsing and interacting with existing types of precedents, with design practitioners being quite sensitive to various types of external stimuli, especially visual representations in their surroundings. This is often the case because most designers aim at generating creative design ideas, and exposing themselves to an amalgamation of directly and indirectly related information is expected to trigger novel ways of solving problems. This is also related to the constant demand to be both updated as well as ahead of existing competitors, with the ultimate aim of generating innovative creative ideas.

2. The prevalence of pictorial stimuli

It is generally accepted that designers have a tendency to physically or mentally retain diverse visual representations they come across, aimed at serving as inspiration in different points during their creative processes [Goldschmidt and Sever 2010]. Whilst confirmation of this practice is mostly anecdotal, there are a few accounts of designers acknowledged preference for visual representations during idea generation [Hannington 2003], [Muller 1989]. Numerous research studies have discussed the superiority effect pictures have over text, the former being easier than the latter in memory recall situations [Lutz and Lutz 1978], [Paivio 1968]. Pictures are not only reported as easier to memorise than words, they are also more quickly connected to semantic memory (i.e. conceptualized information that is on the basis of our general knowledge of the world) than words.

One of the theories that discuss the thesis that pictures are more easily remembered than words is Paivio's [1968] dual coding theory. Paivio's theory [1968] proposes that one processes information through two channels, a verbal (which includes text or audio) and a non-verbal or pictorial (images and sounds). Whilst the theory indicates that both channels can work independently, they are also presumed to be interconnected. Generally speaking, Paivio [1968] claimed that people recall pictures better than words they have seen, and picture-word combinations better than any modality alone. Whereas the dual coding theory has been challenged, a number of empirical studies have provided evidence for its applicability.

External pictures and written words one might come across though, are perceived in different ways. In very generic terms, pictures are processed via a system of pattern perception, which includes attributing meaning to what one sees based on innate but also learned visual experiences. Written words are perceived via one's knowledge of a particular language, which generally includes the use of

a complex system of socially invented and arbitrary symbols and grammar. Pictorial representations can support the quick perception of an entity by allowing a person to look at any part, at any time and in any order of the representation. Ultimately, such representations enable one to freely explore structures and relationships between attributes/objects. Written language can support the perception of complex logical relationships between different concrete or abstract ideas/concepts/objects. However, one has to generally follow the represented narrative in a sequential fashion, which is governed by conventions of syntax. Ultimately, when representing the structure of simple three-dimensional objects, pictures have the potential to be more succinct and easier to perceive and interpret than its written version describing the same object. Hence, identifying the represented entity in a pictorial representation is obviously faster than reading through a written representation equivalent.

Not surprisingly, a number of studies have shown that when exposed to visual stimuli, designers opportunistically and successfully, made use of such sources during idea generation [Casakin and Goldschmidt 2000]. Hence, it has been postulated that displaying visual representations in the work environment can act as triggers to facilitate design problem-solving. This behaviour is to some extent explained by the fact that pictorial stimuli seems to elicit the use of mental imagery – an internalised active process which takes place in the absence of external stimuli and that it is constructed from material from one's memory.

2.1 The effect of visual stimuli during idea generation

Research on the use of visual stimuli during idea generation has empirically demonstrated that visual images can have a positive effect in helping designers generate potential creative ideas. Also, research on creative problem solving has shown that the use of pictorial stimuli by itself or combined with word stimuli, leads to more creative solution ideas than word stimuli alone [Malaga 2000]. However, despite the widespread preference amongst designers for using pictorial representations as inspiration sources during idea generation, previous research has shown that at times such examples can hinder the creative process (e.g. [Chryisikou and Weisberg 2005], [Smith et al. 1993]). The problem arises when prior knowledge, which in this case could include stimuli recently perceived, is inappropriately applied to new situations. Such inappropriateness has been termed *cognitive fixation* (or design fixation in creative problem solving) when it describes a negative transfer of knowledge between a source (perceived stimuli) and target (solution idea/concept) [Smith et al. 1993]. In design contexts, this happens when one's adherence to elements of previously seen examples leads to the generation of sub-optimal applications in the current context [Chryisikou and Weisberg 2005]. Hence, we can argue whether there is too much importance given to images both in design education and in practice, instead of more balanced selection and use of diverse representation stimuli (for instance, text and physical objects). Texts, for instance, seem to be as easily accessible and widespread as images, yet they are far less utilised, when they actually have the potential to positively inspire designers [Goldschmidt and Sever 2010].

2.2 Beyond pictorial stimuli

Research on the impact of inspiration material during idea generation has until now predominantly focused on the possible impact of pictorial representations. Such studies have been quite pertinent given designers' acknowledged preference for visual stimuli [Hannington 2003], [Muller 1989]. However, while searching for inspiration, design practitioners also come across other types of information, such as: external encoded sources like books, existing physical designs and its contexts, and their own recollection of background experiences. Despite designers' allegedly preference for visual representations, especially pictorial ones, it seems appropriate to assume that other sources might also be utilised when generating creative design ideas.

Our study expanded on previous research by exploring to what extent different representation modalities, namely pictorial and textual stimuli, would play a role during an idea generation exercise. We were particularly interested in investigating how attributes represented by previously seen stimuli would affect the new solution ideas, and how would this relate to the creative diversity of such concepts. Therefore, to compare the *functional utility* of diverse representation modalities, even if usually less preferred ones, we posed the following questions:

HUMAN BEHAVIOUR AND DESIGN

1. How do different representation modalities, used as potential sources for inspiration, affect designers' creative behaviour during idea generation?
2. How do designers retrieve attributes from available precedents and how do they (re)use them when generating new solution ideas?

Consequently, we generally hypothesised that a written description of an existing product solution could constitute an inspiring alternative to the typical pictorial examples designers utilise. We anticipated that such lexical representation would be more open to interpretation than, for instance, its pictorial counterpart, hence leading to ideas that differed from the product selected. Therefore, we investigated how far exposure to a photographic versus a written representation of the same product would influence a group of novice designers during an ideation phase. In order to conduct a direct comparison between the influence of both pictorial and textual representations, the latter was devised to comprise the same semantic meaning as the former (Figure 1).

3. Method: design experiment and analysis

The following sections describe the experimental setup and data analysis.

3.1 Design brief and priming stimuli

The design brief utilised in this experiment asked participants to individually sketch ideas for human transportation in the future. The brief was as follows:

"Since ancient times, transportation of people and goods has always been an essential human activity. (...) Despite the rapid technological developments in the field of human transportation, it is still uncertain how this area will unfold in the future. Your task is to think about how human transportation will be like in 2050. You are kindly asked to draw as many different ideas as you can in 45 minutes."

Additionally, participants were asked to write short explanations/keywords if they considered necessary to clarify their concepts in terms of user-product/system interaction, mechanisms, principles and so forth. To test the impact of different stimuli upon the participants' creative processes, we produced two representation modalities of the same product/system, namely: a pictorial (photographic) version and a textual description. We purposefully utilised a concrete and direct example that could potentially tackle the problem at hand, as stimuli directly associated with the problem stated are reported as less likely to trigger the generation of original and diverse ideas. Hence, we wanted to find out how far participants would be anchored to the solution represented and whether there would be a difference when exposed to a pictorial or to a textual version of the example. The *pictorial* and *textual* stimulus can be seen in Figure 1.

"Imagine a new concept for future public transportation where an electric-powered vehicle drives over traffic jams. Its design resembles a modern tram with a wide stretched cabin covering a two-lane motorway. This vehicle is a little wider than two contemporary motorcars placed side by side, and its length is about six cars in a row. Supported by extended 'legs' which run on rail tracks on both sides of the road, the vehicle's cabin is elevated above the cars on the motorway. Cars can drive under the vehicle when it is stopped on designated (elevated) passenger stations."

Figure 1. Transportation system represented in two different modalities: Pictorial stimulus on the left-hand side (presented to the pictorial group); textual stimulus on the right (presented to the text group)

Attempts were made to devise a text excerpt that described as clearly as possible the pictorial representation provided to the participants (Figure 1). This was achieved on a more qualitative manner in a pilot test. That is, once the text was generated it was given to a few people that had to sketch the

entity described, without seeing the pictorial version. All sketches ended up being quite similar to the public transport depicted in Figure 1. Although we consider that it would be virtually impossible to measure how semantically equivalent both stimuli were when used in the experiment, we thought the text devised was appropriate for our purposes.

3.2 Participants

The study here described involved the participation of 60 fourth-year master students from an industrial design engineering course. The initial number of participants was eventually reduced to 58 as outliers were identified (i.e. people not from an industrial design engineering background). To investigate the possible influence of the priming materials utilised, the participants were randomly allocated into three groups:

- Control group (n=18): this group was presented with the design brief only (Section 3.1);
- Pictorial group (n=20): this group was given the brief and a photographic version (priming material) of a conceptual solution (Figure 1);
- Text group (n=20): this group was given the brief and a short text (priming material) describing the conceptual solution represented by the picture provided to the photo group (Figure 1). As a manipulation check, we asked the participants to highlight keywords in the short text to ensure they actually read it.

3.3 Data analysis

The participants' sketches constituted the main source of analysis on the influence of the priming examples upon the three different groups. The sketches were assessed in terms of: *fluency* of ideas (i.e. quantity); *flexibility* of ideas (number and type of solution categories generated); *repetition* of key attributes (present in the priming material); and *originality*.

3.3.1 Fluency

Fluency of ideas is a relatively objective measurement, compared to other more qualitative evaluations. Nevertheless, to minimise possible ambiguities when counting the actual number of meaningful ideas generated by the participants, we approached this in two ways. Firstly, all participants were asked to number each single idea in a sequential manner (e.g. 1, 2, 3, etc., or A, B, C, etc.). Afterwards, the first two authors on this paper counted all the ideas separately. While in this occasion the authors' separate counting of ideas was not statistically computed, this was thoroughly compared and any difference of opinions emerging was discussed and clarified afterwards. The criteria used to score any single idea as meaningful was based on the clear identification of the functions being depicted and how these were fulfilled. Whilst the majority of ideas generated were presented as sketch-word combinations, there were a few occasions where only sketches or written words were used.

3.3.2 Flexibility

Flexibility was determined after analysing the different idea categories/approaches emerging from the participants' sketches. Similar to the counting of ideas (Section 3.3.1), flexibility was assessed and coded separately, and then compared and discussed together by the first two authors in this paper. Therefore, the analysis of flexibility for the exercise of generating ideas for future human transportation was grouped into three main categorical approaches, which in turn were divided into sub-categories:

Type of entity

These categories refer to the physical characteristics of the type of transportation devised, subdivided as follows:

- *Single vehicle*: ideas for the use of single transportation units of variable size (same category represented by the priming material, Figure 1);

- *Infrastructure*: ideas that involved changes in the infrastructure (e.g. roads, buildings, etc.) of a particular urban location;
- *System*: ideas for devices/systems that were neither a single moveable vehicle nor a change in the infrastructure, these were often for instance the idea of teleportation.

Transportation mode

These categories refer to how and where the transportation takes place in spatial terms, subdivided as follows:

- *Above ground-terrestrial*: ideas that depicted transportation entities travelling above ground (same category represented by the priming material), including for instance suspended cable car systems;
- *Underground-terrestrial*: travelling entities/systems taking place underground;
- *Aerial*: any flying transportation entity;
- *Fluvial*: any solution idea illustrating travelling on (or under) water;
- *Teleportation*: idea solutions that illustrated the (theory and notion concerning the) transfer of matter (in this case people) from one point to another without traversing the physical space between them.

Commuting mode

These categories refer to whether the solutions depicted private or public means of transportation, subdivided as follows:

- *Private*: transportation entities that only carry one person;
- *Semi-private*: transportation entities where a person travels in their own vehicle, which in turn becomes attached to a larger transportation vehicle/system;
- *Public*: any type of public transport (same category represented by the priming material).

3.3.3 Repetition of key attributes

Repetition of key attributes was captured by assessing the new solution ideas on their similarity to the priming examples (pictorial and text stimuli). In order to search for repetition in the outcome of the treatment groups, we devised a system of categorisation based primarily on the physical and functional characteristics of the example solutions presented to the participants (Figure 1). Participants repeated key attributes if their solution ideas that exhibited the following:

- Travels above traffic (this excludes flying vehicles)
- Runs on tracks (any sort of predetermined track, above or underneath the vehicle)
- Tram/train like vehicle
- Extended legs
- Electric powered

Based on the above system of categorisation, one single solution idea could comprise the repetition of *zero* up to *five* key attributes. Identifying the reproduction of key attributes enabled us to ascertain how far the participants in the treatment conditions conformed to the examples provided and whether they managed to diverge onto different solution ideas. As with the counting of fluency and flexibility, the analysis of repetition of key attributes was assessed and coded separately, and then compared and discussed together by the first two authors in this paper.

3.3.4 Originality

Originality, or novelty, in this study is interpreted as a measure of how unusual an idea is when compared to the other ideas generated, as well as to existing concepts or actual entities one might be aware of at the time of the analysis. Unlike the assessment of the other dimensions used here (Sections 3.3.1 through to 3.3.3), the analysis of originality was carried out by four independent expert judges, unaware of the conditions being assessed. Inter-rater agreement between judges was measured using Cronbach's Alpha coefficient. Each single idea generated by the different groups was assessed using Finke's [1990] originality scale, which ranges from: 1 (not original at all) through to 5 (very original).

4. Results

The following sections present the results gathered from this experiment in terms of: fluency, flexibility, repetition of attributes and originality.

4.1 Number of ideas

Despite some numerical differences between the number of ideas generated by the three groups, examination of the average number of ideas per participant, using a one-way analysis of variance (ANOVA) shows no significant differences. The number of ideas per group were as follows:

- Control group = 97 ideas ($M = 5.39$; $SD = 2.57$);
- Pictorial group = 114 ideas ($M = 5.7$; $SD = 1.52$);
- Text group = 101 ideas ($M = 5.05$; $SD = 2.21$)

4.2 Flexibility of ideas

Figure 2 presents the results on the frequency of flexibility of ideas emerging from the participants' sketches. The results show that the:

Type of entity

- *Control* group developed significantly fewer *single vehicles* than both *pictorial* ($p < .05$) and *text* ($p < .001$) groups;

Transportation mode

- *Control* generated more ideas with *teleportation* than both *pictorial* ($p < .01$) and *text* ($p < .01$) groups;

Commuting mode

- *Text* group generated fewer *private transportation modes* than both *control* ($p < .01$) and *pictorial* ($p < .001$) groups.
- *Text* group generated fewer *semi-private transportation modes* than both *control* ($p < .01$) group.
- *Text* group generated more *public commuting modes*, compared to both *control* ($p < .01$) and *pictorial* ($p < .001$) groups.
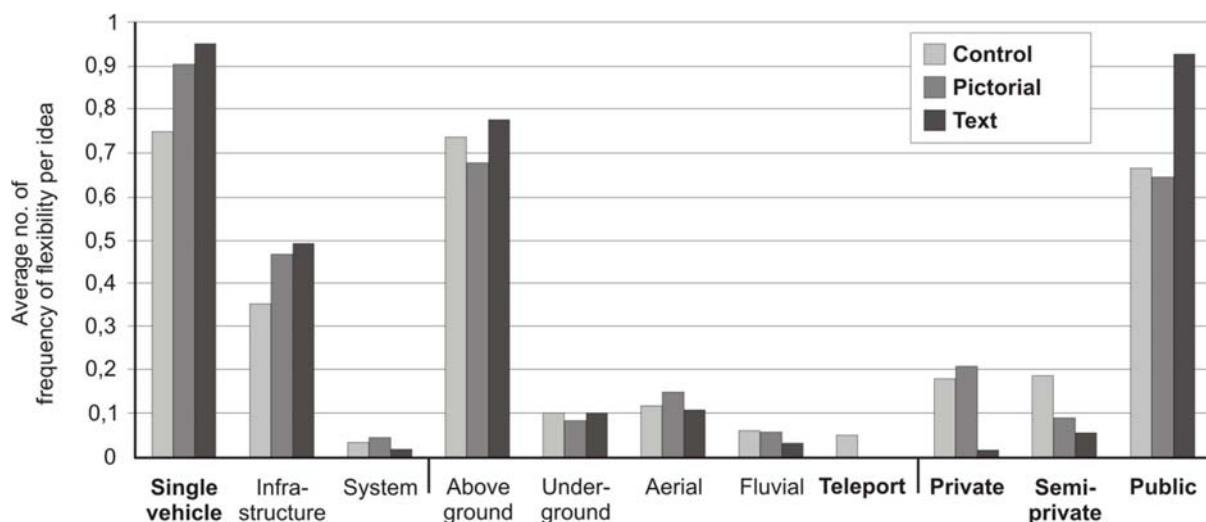

Figure 2. Differences in frequency of flexibility of solution ideas between control and treatment groups (categories where there was a significant difference highlighted in bold)

4.3 Repetition of key attributes

Analysis of results regarding repetition of key attributes was computed using one-way analysis of variance (ANOVA). The frequency of repetition of key attributes per idea from each group (per participant) shows that the solution ideas generated by the *text* group significantly repeated elements of the priming example when compared to the *control* or the *pictorial* conditions (Figures 3 and 4). As the control group did not see the priming example, we use their level of repetition as the *baseline* for determining the level of attribute repetition for the two treatment groups. No significant differences were found between *control* and *pictorial* conditions on repetition of key attributes.
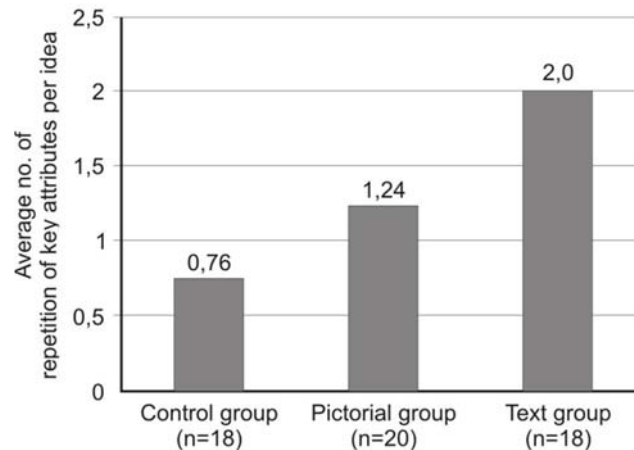
Figure 3. Overall average number of repetition of key attributes per participant per idea (one single solution idea can present from *zero* up to *five* repetition aspects)

Figure 4 presents the results on the repetition of key attributes across the different categories for the three experimental groups. The results show that the *text* group generated significantly more ideas that:

- *travel above the traffic* compared to the *control* group ($p < .01$);
- *run on tracks* compared to both the *control* ($p < .01$) and the *pictorial* ($p < .05$) groups;
- looked like *trams/trains* compared to both the *control* ($p < .001$) and the *pictorial* ($p < .05$) groups;
- were *electric powdered* compared to the *control* group ($p < .05$).
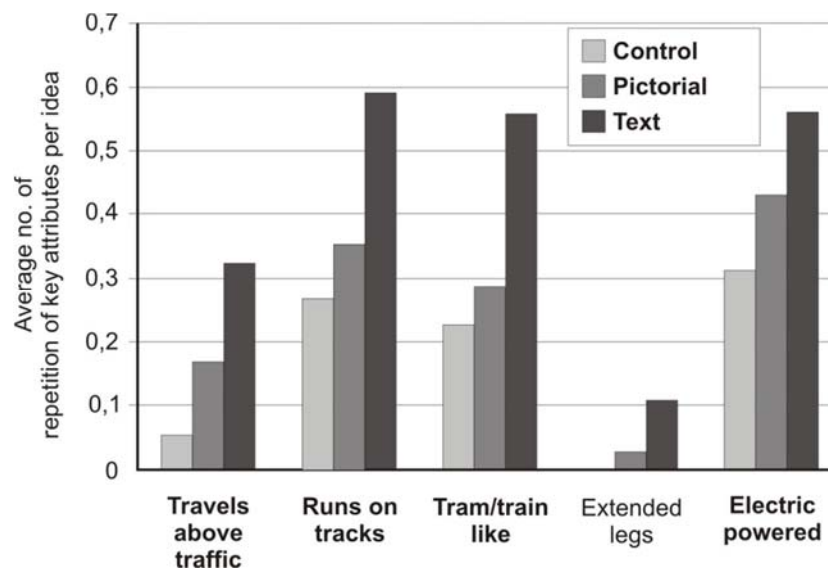
Figure 4. Average number of repetition of specific key attributes per idea across conditions (attributes where there was a significant difference highlighted in bold)

4.4 Originality

Assessment of originality of ideas was carried out by four independent judges whose level of agreement was computed using Cronbach's alpha coefficient. The four judges showed an *acceptable* agreement when assessing the originality of all three conditions ($\alpha = .76$). This supports the use of this coding system as a reliable measure to categorise the data on originality. However, a one-way analysis of variance (ANOVA) on the judges averaged scores shows no significant differences between the level of originality of each condition:

- Control group ($M = 2.62$, $SD = 0.23$);
- Pictorial group ($M = 2.86$, $SD = 0.23$);
- Text group ($M = 2.71$, $SD = 0.37$)

Therefore, on average the ideas developed by each group fall within *marginally original* and *somewhat original* - points 2 and 3 on Finke's [1990] originality scale.

5. Discussion and conclusions

The findings from this study were surprising in relation to how we foresaw that the different stimuli used would impact the participants undertaking the task at hand. We anticipated that the *pictorial* group would be significantly more influenced by the stimuli they were exposed to, when compared to the *text* condition. That is, we would expect that aspects of the visual stimuli would reappear in the pictorial group's output, generally limiting their solution space. Such assumption stems from two aspects. On the one hand, it originates from the dual coding theory postulated by Paivio [1968], which would support the idea that images are easier to memorise than text. Hence, we would expect that the pictorial group would more easily sustain a clearer mental imagery of the entity in question, than those using the textual counterpart. On the other hand, we actually came across a different set of results in previous studies. We found out in another design exercise that novice designers were strongly fixated on *pictorial*, but not *written* stimulus they were exposed to. However, the results presented here demonstrate that, at least within the set-up of this experiment, the textual representation of an existing conceptual design led its respective group to become limited in terms of generating more diverse and new ideas. Therefore, the dual coding theory does not explain the underlying mechanisms that led the text group to reused aspects of its priming material in such high frequencies.

One of the most noticeable differences lie in some of the *flexibility* categories of the ideas generated. The results indicate that participants in the *text* condition were anchored to some of the characteristics of its respective stimulus (by generating more *single vehicles* in their ideas, for instance, Section 4.2). This propensity suggests that this group was less flexible in spending the same amount of effort in equally exploring other possible categories of solution ideas. Conversely, whilst people in the control condition generally share the same emphasis on the most explored categories (Figure 2), this group was relatively more diverse on their approaches to future means of transportation.

At this stage, we are not arguing that one group had 'better' ideas than another. In fact, in terms of originality there is no apparent differentiation between (Section 4.4). Nonetheless, it is interesting to notice that both pictorial and text stimuli seemed to have imposed a more realistic frame of reference in regard to the type of ideas the respective participants could devise. One such example is the far-fetched, yet potentially creative, idea some participants in the *control* group had of using *teleportation* or *human cloning* as novel means of transportation. These types of ideas were absent in the other groups. The realistic nature of the stimuli presented could have led the participants in the treatment conditions to unconsciously refrain themselves from going beyond the domain of such examples. The possible limitations caused by such realistic material, would be congruent with empirical investigations indicating that exposure to exemplars from *distant* domains increases the likelihood of generating more of novel ideas.

The unexpected 'attachment' that the *text* group demonstrated to the content of the excerpt they read extends further than limiting their flexibility of ideas. As the results show (Section 4.3), a significant number of ideas generated by the text group repeated key physical and/or functional attributes of the priming solution, compared to the other two groups. As the dual coding theory does not explain the behaviours in this study, it is (arguably) plausible to consider another viewpoint. One possible

explanation would be in alignment with an hypothetical finding from a study on the *fixation effects* caused by exposure to existing precedents. In that occasion, excessive repetition of attributes from seen examples was (hypothetically) related to the complexity of the example design. That is, the more complex the information represented by a given stimuli, the greater the difficulties of moving away from the perceived entity. In our study, it could be the case that the participants in the *text* condition had to pay more attention to the written stimulus, by carefully reading through the excerpt to visualise and understand the entity being described. This would be in agreement with the superior level of 'effort' required to perceive text stimulus, compared to perceiving an equivalent pictorial counterpart (Section 2). This exposure to an imposed interpretation of a sequential narrative could have been intensified by another aspect: the cognitive biases termed *primacy* and *recency* effects. The former refers to the tendency that people have to remember more easily words read or heard first, for instance, at the beginning of a list or text. Conversely, the latter (i.e. recency) refers to people's tendency to more easily retain the last few words read or heard. This could potentially explain, for example: why the *text* group generated so many ideas that depicted *vehicles that drive over traffic* – words found in the first sentence of the text excerpt (Section 3.1); such a large number of ideas where *cars can drive under the vehicle* – on the last sentence of the text excerpt; or numerous ideas presenting *electric-powered vehicle* – first sentence of the text excerpt.

As the assessment of originality did not discriminate between the three experimental conditions, we need to be conservative when making any claims about the *functional utility* of the different stimulus utilised here. Therefore, the main issue here is whether it is worth exploring the use of different types of priming material (represented in diverse modalities) during idea generation. We postulate that more research is required in light of the contradictory empirical findings within our studies as well as that of others, showing both the positive and negative effects of pictorial and textual stimuli. We argue that despite the attractiveness, memorability and accessibility of pictorial stimuli designers so often prefer, creativity is about diversity and this should expand to the sources of inspiration one searches for. If concrete textual stimulus (and concrete pictorial, for that matter) hinders the generation and exploration of new solutions ideas, one interesting alternative might be investigating the impact of varying the level of abstraction presented by such type of stimulus. In the same line of thought that pictorial distant examples might trigger the generation of novel ideas, more abstract texts could also follow the same tendency. We think it is important to consider the value in widening the search for different stimuli typologies and modalities as cues to creative problem solving. Ultimately, a major challenge lies in acquiring the mechanisms to conduct a timely and appropriate selection of functionally useful stimuli amongst the overwhelming paraphernalia of available resources.

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