Chapter 6
Cognitive Biases, Heuristics, and Overdesign: An Investigation on the Unconscious Mistakes of Industrial Designers and on Their Effects on Product Offering

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Abstract This chapter reports the preliminary findings of an empirical study aimed at understanding whether and to what extent cognitive biases determine overdesign. Overdesign occurs when designers develop product that exceed customers' needs. This phenomenon—which results in higher costs and in some cases also in lower revenues—can be determined by some behavioral problems, as the willingness to develop the "best possible product", regardless of customers' needs. Thus, building on previous studies on cognitive biases, we have conducted a survey among industrial designers, in order to check whether overdesign is driven by cognitive biases. The preliminary evidence shows that this assumption is confirmed. However, the direction of the relationship is negative. This means that the higher the magnitude of the bias, the lower the overdesign. Thus we claim that, in the sample analyzed in this study, we are not in presence of "cognitive biases", but of "heuristics" that can mitigate overdesign. We conclude that designers' experience can be the condition that must occur in order to have a bias turned into a heuristic.

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1 Introduction

This chapter presents the preliminary findings of an empirical study aimed at understanding whether and to what extent cognitive biases determine overdesign. Overdesign occurs when designers develop new products whose features exceed the requirements of the customers or of the market. Previous studies on this topic claim that this attitude can be due to organizational problems (i.e., poorly designed performance measurement systems, pricing policies, budgeting rules) and to behavioral ones. While the impact of the former has been already addressed, the latter is still to be analyzed.

Recently, a new stream of research has been started that concerns Behavioral Operations, which aims at incorporating behavioral and cognitive factors in operations management studies. Thus we build on the existing literature on cognitive biases and test the hypothesis according to which cognitive biases are a relevant driver of overdesign.

In the remainder of this paper, a brief literature review is reported. Then the research methodology is explained and the empirical findings and conclusions are drawn.

2 Literature Background

2.1 The Dimensions of Overdesign

Overdesign has been defined as “designing and developing products or services beyond what is required by the specifications and/or the requirements of the customer or the market” (Ronen and Pass 2008; Coman and Ronen 2009).

Building on this definition, two main dimensions of overdesign can be identified. The former has to do with the problem of excessive product variety; the latter refers to the misalignment between the actual performance of the product and the one that customers could be willing to pay for.

According to Ulrich (2010), product variety depends on the combination of three typologies of attributes: fit, taste, and quality. Fit attributes “…are those for which the user’s preference exhibits a single strong peak for a single value of the attribute, with satisfaction falling off substantially as the artifact diverges from this value” (Ulrich 2010, p. 115). An example could be the size of a garment. Taste attributes show a multimodal customers’ preference function in that the user could have a remarkable preference for a given value of the attribute but at the same time he/she could also praise some alternatives. It is the case of colors for a given garment. Finally, quality attributes are those for which customers would prefer the highest (or lowest) value if this would not have an impact on price. This can be the case of durability for a garment, where customers would theoretically maximize the number of washing cycles if price would not change as a function of this attribute.

If we describe variety in terms of attributes, two measures can be obtained (Ulrich 2010), which refer to the total number of stock-keeping units (SKU) offered by the company and to the number of attributes that each SKU is endowed with. Thus, although numerically two companies can have the same number of SKUs, the complexity involved by their product range can be different if a company has endowed its products with a higher number of attributes. This has great relevance especially in cases where the bill of materials is wide and encompasses several components (Ramdas et al. 2003; Randall and Ulrich 2001).
Thus, building on Ulrich's taxonomy, we can claim that overdesign can be observed from the following perspectives:

- number of SKUs;
- number of attributes per SKU.

It must also be considered that, especially for quality attributes, the management has to choose the level of intensity of the attribute (i.e., if product durability is concerned, the company might be willing to set it at the maximum possible level) and the degree of tolerance around it. When taking these decisions, the company can exceed what the target client wants to receive. This is likely to happen also for fit and taste attributes, where the risk is that the company offers a too wide range of alternatives (e.g., too many colors). Furthermore, designers often set too tight tolerance intervals, which are not consistent with the natural tolerance of the manufacturing process. This leads to treat as a scrap a final product whose actual performance can comply with customers' expectations. Thus, we can claim that overdesign can be also assessed in terms of:

- intensity of the average performance (or number of alternatives) of an attribute.

While the above-mentioned concepts refer to functional overdesign, another dimension of this phenomenon exists that concerns esthetics.

Gaining an insight into the role of the aesthetic dimension in product design is relevant, due to the increasing importance of "designers"—and not just "engineers"—in NPD. In fact, as documented by Perks et al. (2005), in the past years the degree of involvement of designers in this process has remarkably increased and in some cases they act as process leaders. While this evolution can bring a high level of innovation in the product range, especially if a differentiation strategy is pursued, it can be also a threat if the market knowledge of the designer is low. Furthermore, when designers are poorly aware of manufacturing constraints and, namely, of the tolerances of the process, they can take value-destroying decisions (Di Stefano 2006). Thus, on the basis of this evidence, Perks et al. (2005) call for an accurate training of the designers, aimed at endowing them with a wider set of skills and competencies, and also for a recruitment policy focused on the selection of designers with a long experience in the industry.

Although the esthetic dimension (and, generally speaking, the design saliency) is essential in many cases, namely for design-intensive products, few studies have provided a comprehensive framework suitable for understanding how it must be considered within the whole set of "tangible" and/or "measurable" attributes that describe a product. Previous contributions have brought evidence of the impact not only of technical newness but also of the esthetic one on the economic performance of the firm (Talke el al. 2009; Hertenstein et al. 2005). However, it is still hard to perform an analysis on the alignment between the esthetic content of a new product and the one that the customer is willing to pay for.

A major contribution in this regard is the one of Bloch (1995), which is the first notable attempt to observe product form and its effect on customers' response. According to Bloch, "product's form represents a number of elements chosen and blended into a whole by the design team to achieve a particular sensory effect". Although Bloch provides and detailed description of the elements in his framework, "product form" itself remains a kind of "black box" that evokes both esthetics and functionalities, which however are not precisely defined. Noble and Kumar (2010) have tried to expand Bloch's concept of "product form", providing a new reference model. Its most notable feature concerns the fact that, according to these authors, both customers and designers share a value-based view of the product; namely they distinguish among rational, kinesthetic, and emotional value. However, as highlighted by Noble and Kumar, customers and designers can have different perceptions of such value. This can be a source of overdesign.

The evidence brought by Noble and Kumar is confirmed by recent studies in the stream of research concerning the effectiveness of product positioning decisions. Indeed, a driver of this phenomenon could be the way in which customers perceive some specific attributes of the products. However, it has been demonstrated that the way in which customers "see" and praise the product is different from the schematic way commonly used by the company. In this regard, Fuchs and Diamantopoulos (2012) have recently argued that it is almost impossible to predict the positioning success of a new product on the basis of customers' assessment of each distinctive feature of the product. In fact, they claim that most products are endowed with several complex attributes, which cannot be assessed by the customers since they do not have good enough technical competencies. Furthermore, products often have some intangible features (as image and brand identity) that cannot be easily assessed by customers, who, on the contrary, evaluate the product as a whole. The rationale of this paper is actually confirmed by other studies, which demonstrate that, for example, customers praise well-designed objects (Gabrielsen et al. 2010; Kristensen et al. 2012), as well as the presence of visual art in a product (Patrick and Hagtvedt 2011; Hagtvedt and Patrick 2008).

Although the extant literature on product form does not provide specific tools or metrics suitable for measuring this kind of overdesign, it clearly highlights that overdesign is a major issue and that it concerns not only the esthetic dimension of the product but, generally speaking, all its attributes. Furthermore, even though this stream of research does not provide any definition that can be operationalized into an assessment tool, it is possible to build on it and claim that overdesign exists in all cases where:

- the features of the product exceed customers' requirement (or perceptions).

2.2 Behavioral Problems as a Source of Overdesign

Given that overdesign can affect a number of products/industries, it is worthwhile understanding its causes and its consequences. The designers' attitude toward overdesign has been observed and documented especially in technology-based industries, as electronics and IT applications, where rather often companies launch new items that exceed customers' requirements, thus leading to some unexpected and unfavorable outcomes. First of all, firms that experience overdesign suffer from long times to market, which often result in delays in the product launch. In time-based industries, as consumer electronics, this can determine a poor economic and market performance of the new product, due to a problem of rapid technical obsolescence. Second, when overdesign takes place, products tend to be too complex and customers are not able to properly use them. This turns into poor customer satisfaction and, in some cases, also in damages and in subsequent returns. Furthermore, when designers add to the product excessive features, so as to make it suitable for any potential customer (and not just for the target one), the selling price is generally higher, with a negative effect on the market share that the product can reach in its target segment. All of these unfavorable effects of overdesign can destroy a company's value, thus it is a major issue to understand why this phenomenon takes place and how it can be reduced.

According to previous studies (Coman and Ronen 2009; Ronen and Pass 2008), overdesign has several sources, which can be summarized as follows:

- *behavioral problems*. As maintained by Simon (1957), managers tend to have an *Optimizer Approach* to their work activity. Indeed, in many different fields people struggle to achieve the best possible solution, regardless of the negative effect that this can have on the amount of resources necessary to reach this aim. In R&D projects this approach is rather common. In fact, developing the "best possible" product can theoretically bring about some potential benefits, as the possibility to reach a larger part of the market or to anticipate some future evolutions in customers' requirements. However, this approach has proved to be ineffective in several cases (Coman and Ronen 2009). Previous studies claim that it is rooted in a lack of knowledge of the market and of the manufacturing processes, common to R&D people, who are willing to enrich the product with a number of features that the client is not interested in or that can be hardly obtained with the available equipment and machinery (Coman and Ronen 2009). The Optimizer Approach is also due to a problem of culture, since designers and engineers measure their own professional success on the basis of the technological performance of their products rather than on the basis of the value created by them;
- *organizational problems*. Some organizational mechanisms, as performance measurement, pricing policies, and budgeting rules, are relevant drivers of overdesign (Ronen and Pass 2008). As extensively proved in the literature on these issues, people's behavior is strongly influenced by the way in which they are assessed. Thus, if the designer's professional performance is measured according to the number of new products conceived, he/she will tend to work on

as many projects as possible, thus boosting overdesign. Also, the pricing policy can be a driver of this phenomenon. If the selling price of a product is defined through a "cost plus" approach rather than through a value analysis, designers will be less concerned with the total cost incurred by the company to develop and launch the new product. Finally, some budgeting procedures can lead toward overdesign. In companies where R&D financial resources can be allocated only to customers projects, designers and engineers willing to work on new technologies have to embed them in the new products in order to obtain a budget.

While the second source of overdesign has been addressed by several studies in the fields of performance measurement, marketing, and accounting, the first one (i.e., behavioral problems) has recently become popular among management scholars. Building on the seminal works of Kahneman and Tversky and on the Prospect Theory conceived by these two authors (Kahneman and Tversky 1979), new streams of research have been started, aimed at incorporating behavioral and cognitive factors in management studies. Recently, a behavioral perspective has been adopted also in the field of operations management, where the opportunity to analyze the cognitive issues peculiar to product development and project management has been highlighted (Gino and Pisano 2008). In fact, as claimed by Kahneman and Tversky, human beings suffer from a number of cognitive biases and frequently adopt heuristics (availability, representation, anchor-and-adjustment) that often lead them to take irrational decisions (Kahneman and Tversky 1974, 1979). Also, the way in which people *frame* their decisions can lead to contradictive and counterintuitive outcomes (Kahneman and Tversky 1981). Building on this approach, it can be argued that some of the behavioral problems that lead toward overdesign can be analyzed moving from the contributions of Kahneman and Tversky. Although this can be an innovative and fruitful approach, most studies that adopt this perspective are based on experiments that are not carried out specifically in R&D teams. Thus, it is necessary to understand how these heuristics and cognitive biases can be defined and measured in such an environment before analyzing the problem of overdesign from this perspective.

In this regard, two recent contributions seem to be the most relevant, i.e. Lovallo and Sibony (2010) and Kahneman et al. (2011). The former contribution builds on the idea that executives can be aware of the cognitive biases that affect their choices, however, they might not know how to "debias" decision making processes. On the basis of an extensive survey, Lovallo and Sibony (2010) identify five key typologies of cognitive biases peculiar to executives and propose precise definitions for each of them:

- *action-oriented biases*. They concern the excessive optimism that often drives decision making and that is often accompanied by the tendency of neglecting competitive responses;
- *interest biases*. They take place in presence of conflicting incentives, namely at corporate and functional levels;

- *pattern-recognition biases*. They take place when decision making is heavily based on past experiences;
- *stability biases*. They concern the tendency toward inertia in case of uncertainty;
- *social biases*. They arise when people have a preference for harmony within the group rather than for discussion of counterarguments.

The latter contribution (Kahneman et al. 2011) has further developed the idea of Lovallo and Sibony (2010) and has operationalized it into a self-assessment of 12 questions to let companies (or groups) understand whether they suffer from some specific cognitive biases.

Although these two contributions are not specifically tailored on product development and project management, nevertheless they often discuss cases concerning R&D environments. Thus, it can be argued that the cognitive biases as defined by Lovallo and Sibony (2010) and by Kahneman et al. (2011) can be used to study the impact of behavioral problems on R&D activities and, namely, on the phenomenon of overdesign.

This kind of analysis can be useful, since there is not any study that has tried to check and to quantify the extent to which cognitive biases determine overdesign. This analysis can be fruitful because, as demonstrated by Lovallo and Sibony (2010), companies, which are aware of their biases and are able to "debias" their decision making processes, are likely to reach a higher level of effectiveness.

3 Research Question and Methodology

On the basis of the literature analysis, we wanted to carry out an empirical investigation aimed at understanding *whether and to what extent cognitive biases determine overdesign*.

Building on previous contributions, we developed the reference framework described in Fig. 1.

According to this framework, the phenomenon of overdesign can be explained by a bundle of cognitive biases. Namely, we described such biases using the five typologies identified by Lovallo and Sibony (2010). Furthermore, we assumed that the direction of this influence should be positive, so that the higher the magnitude of the bias, the higher the overdesign. This assumption is consistent with previous studies on cognitive biases, which consider them as negative factors that can lead human beings toward irrational decisions. Lovallo and Sibony (2010) and also Kahneman et al. (2011) present biases as phenomena that should be removed in order to improve the effectiveness of the decision-making processes. In fact, Lovallo and Sibony (2010) clearly point out the necessity for companies to "debias" these processes so as to foster their overall effectiveness.

Given the nature of the research question, we decided to adopt a quantitative methodology and, namely, to carry out a survey.

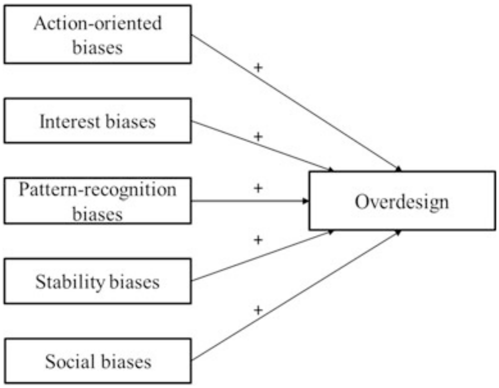

Fig. 1 The reference framework

To operationalize our framework, we developed a questionnaire made of 24 statements reported in Table 1. For all of them, assessments on a Likert scale from 1 ("totally disagree") to 7 ("totally agree") have been requested. For item 10, the scale has been later reversed, so as to make it consistent with the construct to be measured.

The statements concerning cognitive biases (from 8 to 24 in Table 1) have been based on Lovallo and Sibony (2010) and Kahneman et al. (2011). For all of them, we have built on the original statements proposed by these authors, just adapting their contents to a typical NPD environment.

For the "Overdesign" construct, we have built on a wider range of extant contributions. Indeed, given that overdesign has not been operationalized into specific dimensions yet, we have developed seven statements (namely, items 1–7 in Table 1) that capture the perspectives from which this construct can be observed. In particular, questionnaire items 1 and 2 build on Ronen and Pass (2008) and on Coman and Ronen (2009), according to whom overdesign is a pathology that results in a long time to market and in frequent delays in the innovation projects. Items 3 and 4 are also based on Ronen and Pass (2008) and on Coman and Ronen (2009) and on the literature about "product form", which highlights how designers tend to enrich their products with functional and/or esthetic features to pursue a differentiation strategy or just for a lack of market knowledge (Perks et al. 2005).

Items 5, 6, and 7 build on Ulrich (2010) and aim at assessing overdesign from the perspective of product attributes. Namely, item 5 explicitly refers to the attributes ("features") of the product and to the possibility that they can exceed customers' needs. Items 6 and 7 concern product range (which results from all the possible combinations of the attributes) and point out the problem of its constant renewal (item 6) and widening (item 7).

The questionnaire has been sent by e-mail to the members of the Italian Association of Industrial Engineers (AIPI). It totally counts 264 members, but only 187 have provided the Association with their e-mail address. The questionnaire collection was started in November 2011 and, at the end of December 2011, 47

Table 1 Constructs and questionnaire items

Constructs	Statements
Overdesign	(1) Our projects are never delivered on time (2) The milestones of our projects are never met (3) Our products are ahead of our competitors (4) Most of our effort in developing new products is driven by the needs of potential new customers (5) The features of our products always exceed customers' requirements (6) Our product range is constantly enriched and renewed. We always add new products to our offering (7) The number of products is constantly growing
Action-oriented biases	(8) The members of the team are, in general, optimistic about the outcome of planned actions and of the overall project (9) The members of the team are, in general, optimistic about the skills of the team itself compared to those of the competitors. They think that these skills can lead to positive outcomes of planned actions and of the overall project. (10) In assessing the success of the new product, all necessary information is gathered, including those concerning how competitors will react
Interest biases	(11) When assessing and conducting a project for a new product, team members often pursue individual (or team) goals rather than corporate goals (12) When working on a project, team members seem to be emotionally attached to the new product they are developing (13) When assessing and conducting a project for a new product, team members are unclear about corporate goals, their hierarchy and possible trade-offs
Pattern-recognition biases	(14) When assessing a new product or project, team members give more relevance to evidence and information that support the project rather to those that can lead to a negative judgment (15) When assessing a new product or project, team members recall recent or memorable examples (16) When assessing a new product or project, team members recall examples or stories that are frequently told in their company (17) When assessing a new product or project, team members give more relevance to the track record of the person presenting the project than to the evidence that supports it
Stability biases	(18) When assessing a project or a product (e.g. margins generated by the product, market share, time necessary to complete the project, number of designers required etc.), the team (or the project leader) moves from a reference value defined on the basis of available information (historical data, competitors etc.) and then adjusts it (19) In the overall assessment of a project or product, team members are more cautious when facing a risk of lower future profits (20) In the overall assessment of a project or product, team members often undertake actions that increase development costs, if they are suitable for improving the performance of the product (21) When deciding whether to complete a project or not, the team members pay much attention to the sunk costs (22) In managing projects, the team tends to replicate practices and decision-patterns already experimented in the past
Social biases	(23) In managing the development team, a major importance is given to the consensus of the team members in the overall assessment of the project or product (24) Team members tend to agree on the viewpoint of the team leader

questionnaires were collected. Then, a new mailing has been sent to other associations of designers in early 2012 and the questionnaire collection process is still in progress. This paper reports the preliminary findings of this research project, based on the data collected in 2011 from AIPI members.

4 Empirical Evidence

To test the validity of the reference framework reported in Fig. 1, a factor analysis and then a regression analysis have been conducted. The former step was undertaken in order to check whether the factors coming out from the analysis are consistent with the reference model. The latter aimed at testing the hypothesis that cognitive biases are relevant predictors of overdesign.

As far as the factor analysis is concerned, we retained only the factors with an Eigenvalue higher than 1 (Hair et al. 2006). Items have been retained if their factor loading was higher than 0,5 only for a single factor and lower than this threshold for all the others (Hu and Bentler 1999; Stevens 1986).Table 2 reports the questionnaire items and the corresponding factor loadings.

As it can be seen, this analysis highlights the existence of a factor that seems to describe the "overdesign" construct (Factor 1). Moving to the other factors, it can be seen that group cognitive biases in a way that is slightly different from the typologies defined by Lovallo and Sibony (2010). The reliability of the scale adopted to study these phenomena has been tested computing the Cronbach's alpha for each factor. These values, being all higher than 0,7, bear witness to the reliability of this measurement instrument (Nunnally 1978).

Table 2 Rotated factor pattern

	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7
IT1	0,811						
IT2	0,812						
IT6	−0,680						
IT7	0,744						
IT8		0,766					
IT9		0,699					
IT20		0,699					
IT15			0,781				
IT16			0,784				
IT22			0,676				
IT14				0,716			
IT17				0,702			
IT24				0,672			
IT10					0,730		
IT23					0,749		
IT18						0,837	
IT21							0,832

Factor 1 encompasses the following questionnaire items:

IT1. *Our projects are never delivered on time*

IT2. *The milestones of our projects are never met*

IT6. *Our product range is constantly enriched and renewed. We always add new products to our offering*

IT7. *The number of products is constantly growing*

Such a factor clearly refers to overdesign. In fact, two items (1 and 2) concern the problem of long time to market and frequent delays that, according to Ronen and Pass (2008) and to Coman and Ronen (2009), are a typical negative consequence of overdesign. Items 6 and 7 describe overdesign from the perspective of product range (Ulrich 2010) and, namely, point out the problem of its frequent renewal and widening.

In order to check whether and to what extent Factor 1 (i.e., Overdesign) depends on cognitive biases, a regression analysis was conducted using the six remaining factors as determinants of "Overdesign". The outcome is reported in Fig. 2.

It can be noted that Factors from 2 to 7 (which express different typologies of cognitive biases) explain 48 % of the variance of Overdesign, with a very good level of statistical significance (p value $< 0{,}001$). Focusing only on factors that are statistically significant drivers of overdesign, some interesting conclusions can be drawn on their meaning and on the kind of effect that they produce.

Factor 3 seems to express a kind of "backward looking approach", since it is described by the following questionnaire items:

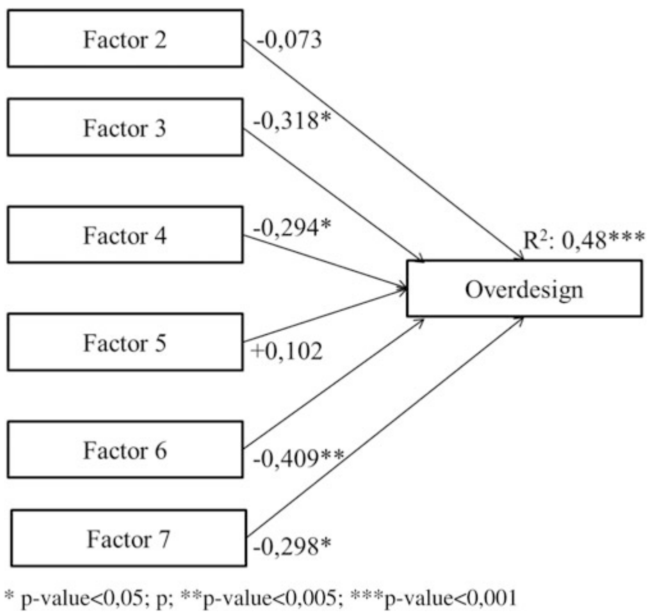

Fig. 2 Evidence from the regression analysis

IT15. *When assessing a new product or project, team members recall recent or memorable examples*

IT16. *When assessing a new product or project, team members recall examples or stories that are frequently told in their company*

IT22. *In managing projects, the team tends to replicate practices and decision-patterns already experimented in the past*

Factor 4 seems to refer to the way in which designers select and interpret information suitable for assessing new products which they are working on. The statements that describe this construct are as follows:

IT14. *When assessing a new product or project, team members give more relevance to evidence and information that support the project rather to those that can lead to a negative judgment*

IT17. *When assessing a new product or project, team members give more relevance to the track record of the person presenting the project than to the evidence that supports it*

IT24. *Team members tend to agree on the viewpoint of the team leader*

Factors 6 and 7 are described by a single statement each:

IT18. *When assessing a project or a product (e.g., margins generated by the product, market share, time necessary to complete the project, number of designers required* etc.*), the team (or the project leader) moves from a reference value defined on the basis of available information (historical data, competitors* etc.*) and then adjusts it*

IT21. *When deciding whether to complete a project or not, the team members pay much attention to the sunk costs*

Factor 6 seems to refer to the anchor-and-adjustment bias, while Factor 7 seems to be related to the so-called sunk-cost fallacy.

What is worthwhile noticing is the direction of the standard regression weights. As a matter of fact, the four significant predictors (Factors 3, 4, 6, and 7) show a negative coefficient of regression. This is an unexpected finding since we expected to observe a positive relationship between the various typologies of cognitive biases and the Overdesign construct.

For Factors 3, 4, and 6 a reason for such negative regression coefficients can be the level of experience of the designers involved in this survey and the know-how that they have accumulated over time. If designers enjoy a long and fruitful experience in the industry, they are likely to leverage it in order to prevent overdesign. This can be the case of Factor 3 ("backward looking approach").

Factor 4, which seems to describe how designers select information to assess the new product, can be also influenced by the length of the professional experience. In fact, experienced designers are more likely to identify and discard poor projects since the very beginning of the development process and to invest their efforts only on the high potential ones. In this case, even though they can seem to "sponsor" some new products and/or functionalities, these will not result in any kind of redundancy in the eyes of the customers. In this setting, leveraging not only the personal experience and intuition, but also the ones in the rest of the group and of the team leader can further boost the ability of an NPD team to rapidly identify projects with a high potential. By contrast, a young designer can have the same attitude toward the selection of information, but without a long enough length of service and an experienced group to work with, he/she is likely to keep working on value destroying projects because he/she has not been able to recognize them.

Factor 6 expresses the phenomenon called "anchor-and-adjustment". If designers are able to exploit their experience so as to set reasonable "anchors" for their analyses and decisions, they are likely to identify and reject value destroying projects.

These interpretations for Factors 3, 4, and 6 are backed by the mean age of the respondents (equal to 49 years), the mean length of stay in the current company (15 years) and in the current industry (25 years).

Finally, the negative regression coefficient of Factor 7 can depend on the fact that if sampled designers have a strong commitment to "value creation" and select their projects accordingly, they are likely to rapidly identify bad projects and reject them. If this holds, only a few, good projects are launched and, for these, a strong commitment to value creation and to cost saving is observed.

These intuitions, based on the preliminary findings of this study, show that, rather than being in presence of "biases" (which are supposed to have a negative effect on decision-making processes), we observe the existence of effective heuristics. This is consistent with the recent contribution of Gigerenzer, according to whom human beings tend to adapt themselves to the environment in which they live and to develop "rules of thumb" that, in specific conditions and situations, prove to be effective (Goldstein and Gigerenzer 2009; Gigerenzer and Selten 2001). This concept has been called "ecological rationality" (Gigerenzer 2000). Consistently with this assumption, Gigerenzer has demonstrated the existence of several heuristics, which are frequently adopted in a number of situations and of professional environments, as justice, medicine, and management. One of the most relevant heuristic is the "recognition" one, which refers to the ability of rapidly reach ("recognize") the correct solution to a problem (Goldstein and Gigerenzer 2002). A distinctive feature of such heuristic is that people who adopt them generally use a few pieces of information and apparently decide on the basis of an "instinct" (Goldstein and Gigerenzer 2009).

In fact, this new perspective on biases and heuristics has been adopted also by Kahneman, who, in a recent publication (Kahneman 2011) explicitly claims that intuition and rationality coexist in human beings and that good decisions should involve both of them. Kahneman calls these two approaches to decision-making "System 1" and "System 2". The former is emotional, intuitive and fast. By contrast, the latter is more logical and slower. Kahneman argues that in some cases System 1 (i.e., intuitions and emotions) can lead to effective and fast decisions. However, in order to prevent some biases and distortions that System 1 can determine, its decisions must be somewhat validated by System 2 (i.e., rational analysis).

This can be the case of our sample, in which it is likely that respondents, leveraging their long working experience, have developed the ability to recognize products with a good market potential. Furthermore, it can be assumed that this ability is not a peculiarity of the single designer but of the group as a whole. In this concern, “storing” knowledge in the form of memorable examples and stories and then “retrieving” them when an analogy is found can be an effective way to leverage designers’ intuitions. In fact, this organizational mechanism implies that, while the analogy can be intuitively identified by an individual, the final assessment on the product is based on a discussion with the team members. This can be actually a rational “gate” that leads toward sound decisions and that works properly if all team members share a deep knowledge of the product and of the process.

5 Conclusions

This paper presents the preliminary findings of a survey aimed at understanding *whether and to what extent cognitive biases determine overdesign*. The evidence reported is based on 47 questionnaires collected among the members of the Italian Association of Industrial Engineers. However, since the collection is still in progress, the final outcome of this research project could be slightly different from that reported in this paper. Based on these preliminary findings, we can confirm that cognitive biases are a relevant driver of overdesign, but two interesting outcomes arise from this study. First of all, we initially moved from five typologies of biases, based on previous studies on this topic. Our study reveals that at least in R&D environments it is still necessary to clearly define the nature of such biases. Second, it comes out that some of these biases are negatively correlated with the phenomenon of overdesign, in that when they occur, overdesign decreases. This evidence needs to be confirmed analyzing other datasets. However, if it is confirmed, it could be worthwhile studying why this counterintuitive relationship is observed. An explanation builds on the level of experience and of know-how of the designers, which can bring about some effective heuristics (and not “biases”) that can help in mitigating overdesign. If this evidence is confirmed in future studies, then it could be worthwhile understanding the conditions under which cognitive biases can be turned into effective heuristics.

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