Motivation-biased design

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Abstract

Motivation-biased design concerns how positive attitudes of designers can inhibit critical evaluation of their designs. Good intentions, admiration for certain design elements, or even concern to make a good impression on others can inhibit designers from being sufficiently critical of their designs. The result may be designs that are not as good as they would be otherwise. This article presents examples of motivation-biased design, explores cognitive mechanisms that might explain it, and considers how knowledge of the phenomenon might be useful in improving design practice.

Keywords: design; motivation-biased design, bounded rationality; good intentions; just a tool; social cognition; moral capital; positive attitudes; errors.

Best laid plans

The City of Los Angeles experiences chronic water shortages, making water conservation increasingly pressing. In the summer of 2009, the City instituted measures designed to conserve water usage by citizens. Included in the measures were items such as lawn-watering restrictions: Citizens in a given area were allowed to water their lawns, for example, only on Mondays or Thursdays. The measure proved to be highly successful: City officials claimed that water usage by citizens in 2009 was the lowest in 31 years (Zahniser and Garrison, 2009).

Curiously, the summer of 2009 also saw a record number of water main leaks and bursts. A "blue ribbon" panel of scientists was convened in order to investigate the plague of breakages. The panel concluded that the water conservation measures themselves were partly to blame. On days when lawn-watering was allowed, water pressure dropped considerably as Angelenos took the opportunity to water the grass. On days when lawn-watering was not allowed, water pressure rose considerably. In the opinion of the expert panel, the unaccustomed swings in water pressure were too much for many of the City's aging pipes. They accelerated the effects of corrosion and metal fatigue, resulting in the record number of breakages (Zahniser and Garrison, 2009).

Good intentions

How did the City engineers and counselors not anticipate this serious problem with their design for water conservation? The implications of the measure for pressure in the pipes, and the subsequent effect on the pipes themselves, seem straightforward enough. Also, these effects are clearly quite relevant for the effectiveness of the plan. Yet, the problem was not anticipated by its designers.

Undoubtedly, the full explanation is a complicated one. Other cities, such as Long Beach, had instituted similar plans, without suffering similar consequences. In addition, however, the attitudes of the planners themselves may well have been a contributing factor. In fact, Councilman Paul Koretz summarized this issue succinctly (Zahniser and Garrison, 2010):

> "'It was such a well-intentioned program," he said. "But I think intuitively, once somebody raised the idea, it made perfect sense; you have brittle pipes and you have dramatically increasing and decreasing water pressure."'

Koretz identifies the *good intentions* as a contributory factor. Briefly put, the fact that the engineers and council members had a good feeling about the goal of the design helped to make them less critical in evaluating it. Water conservation is a good thing, and is a pressing priority for a huge city with low water supplies. Unfortunately, if Koretz is correct, this feeling itself helped to prevent the council members and the City engineers from identifying problems that were, certainly in retrospect, reasonably evident.

Motivation-biased design

The potential for good intentions to suppress critical appraisal of designs is an instance of what I will call *motivation-biased design*. Motivation-biased design occurs when a designer's motivations tend to inhibit rational assessment of the design at issue. In the case of the Los Angeles water-conservation plan, the positive attitude that the designers held towards the goal of the plan, namely water conservation, inhibited their assessment of its relevant consequences.

The purpose of this article is to provide a broad characterization of motivation-biased design and to sketch out an explanation for it. This sketch will then set the scene for further investigation.

Naturally, all design is motivated. That is, the act of designing usually includes a set of goals that the designer attempts to satisfy. Those goals constitute the designer's motivation. However, motivations can also arise in other ways. The example above suggests that some of the effects of motivations arise not because of their status as goals per se but because of an *attitude* of the designer towards those goals. A positive attitude towards a goal helps to motivate the designer to achieve it but may also inhibit the designer from evaluating promising candidates as carefully as possible.

Social scientists have long recognized a similar phenomenon involving the effects of motivations on inference. Kunda (1987) explored the nature of *motivated*

inference, that is, biasing effects that a person's goals can have on the conclusions that they draw. Basically, people are motivated to believe in things that they want to believe in, or that it is in their interest to believe in. People who score highly in an intelligence test, for example, are more likely to believe in the aptness of the test than are people who score less highly. This bias occurs not because people merely believe what they want to believe but because their goals bias how they gather and evaluate the relevant evidence. They may pay more attention to evidence that supports their views, or they may seek out evidence via a method that is biased towards producing confirmatory evidence. The result is that people's motivations can undermine the rationality of their beliefs.

Motivation-biased design points to a similar phenomenon. In both cases, the attitudes of designers involved skew their evaluation of some cognitive construct. In motivated inference, the construct is a belief. In motivation-biased design, the construct is a design.

Bounded rationality

One important characteristic of motivation-biased design is that it has the potential to lead to sub-optimal design results. In other words, motivation-biased design can be considered irrational. To see how, the concept can be compared with Simon's (1981) general treatment of rational design and design under bounded rationality.

As Simon characterized it, the general form of a design problem consists of a set of means, laws, and ends. The means comprise the available design components, the laws comprise the unalterable constraints on how the means may operate, and the ends comprise the set of goals the design is to achieve. The problem faced by the designer is to configure the means, none of which solves the problem on its own, so that the configuration does solve the problem. This characterization applies to any kind of design problem, from the design of an item of material technology, to the design of a medical treatment, a foreign policy, etc.

On this view, a design is *rational* insofar as it satisfies the goals and laws in an optimal way. Simon recognized that this model of design did not apply to many real-world instances of design. This issue arises because the model assumes an idealized designer with (1) a perfect knowledge of the design situation, (2) an indefinitely large computational capacity to foresee all the consequences of each design alternative, and (3) an objectively true representation of the world in which the design is to operate.

To acknowledge these limitations, Simon described the concept of *bounded rationality*. A design is boundedly rational insofar as it satisfies the goals and laws in an optimal way, within the limitations of the designer. These limitations include (1) an imperfect knowledge of the design situation, (2) a limited computational capacity to foresee all the consequences of each design alternative, and (3) subjective representations of the design and the world in which the design is to operate. In short, Simon acknowledged that any real-world designer would labor under certain cognitive limitations but that designs could still be considered rational once these limitations were taken into account.

Design with attitude

Much of the response to Simon's characterization of rationality and design has focused on methods that people may employ to deal with their limitations as cognitive agents. For example, Gigerenzer & Todd (1999) discuss heuristic methods that people adopt to optimize their plans and inferences.

Until recently, research in this area tended to overlook the importance of attitudes as opposed to methods. Perhaps this oversight is a result of the traditional view of attitudes as inherently irrational. However, attitudes constitute an important part of human problem-solving cognition (Thagard 2006) and, perhaps, the problem-solving apparatus of any limited cognitive agent. Thus, attitudes should be expected to play an important role in design thinking, whether to the betterment or to the detriment of the result.

Before sketching a model of motivation-biased design, I will provide further examples that illustrate additional aspects of the phenomenon.

Just a tool

The water-conservation example illustrates how the attitude of a designer towards their design goals can influence the outcome of the design process. However, designers may have attitudes towards other components of the design situation that can generate similar results. They may, for example, have influential attitudes towards the *means* available.

Corrigan (2008) discusses the plans of the Irish government to introduce e-voting in that country's national elections. There are many reasons to support such a plan. Other nations have used e-voting technology with some degree of success. Networked computers are very good at acquiring and manipulating all kinds of data, so adding votes from a distributed network of polls seems like a straightforward application of this technology.

In addition to these sound reasons, there is the simple sex appeal of computerized voting. It is futuristic. Thus, anyone who wants to see progress in the pursuit of democracy should consider instituting e-voting as an integral part of that progress. Corrigan (2008, p. 147) notes that the Irish Prime Minister of the time, Bertie Ahern, seemed to love the idea of e-voting in Ireland:

> '"We are not going to go back to pushing pieces of paper around the place" and [he] accused critics of wanting "to keep old ways, old things, the old nonsensical past".'

Ahern continued to hold this attitude in the face of obvious problems with the scheme. By 2004, the government had spent €60 million but still felt unable to go ahead with it. In 2006, the Commission on Electronic Voting presented a report saying it could not recommend the system. The system was deemed less reliable, less secure,

and more confusing than the existing paper-and-pencil system. Even so, Ahern and his government pressed ahead, stating that Ireland would be a laughing stock if it did not get rid of its old-fashioned system with "our stupid old pencils" (Seaver, 2009). The scheme was finally abandoned in 2009.

The persistence of the government in the face of obvious and serious problems has many sources. One of those sources appears to be motivation-biased design. In this case, the Irish Prime Minister had a highly positive attitude towards electronic voting machines. They were attractive and futuristic, in contrast to the paper-and-pencil system that Ireland inherited from the 19th-Century. Because of this attitude, Ahern seemed to be convinced that the machines must be a part of any electoral reform. It took many years and millions of dollars in fruitless outlay before the difficulties of this position were properly acknowledged.

Corrigan notes that this sort of problem is not unusual, especially with respect to computerization. Many designers view computers very positively, and thus seek to incorporate them into their designs, whether it would otherwise seem appropriate or not. Corrigan does not have a negative view of computers but argues, instead, that they should be treated as "just a tool." In other words, designers should not let their admiring attitude towards computers influence them to incorporate computers into their designs where that would not otherwise be rational.

Social attitudes

Construction of the main (or "high") Aswan Dam in Egypt commenced in 1960 and took ten years to complete. There were many reasons for its construction at this time. The most obvious reason was to control the flooding of the Nile. The "low" Aswan dam, built in 1902 by the British, had nearly been overtopped by a flood in 1946. A larger dam, located downstream, would achieve a greater degree of control over the flow of the Nile through Egypt. A second reason was to cement an incipient relationship between Egypt and the USSR. The United Sates and the USSR were competing for influence in the Middle East in that era, providing Egyptian leadership with an opportunity to elicit assistance with the project. The USSR provided a large loan on favorable terms. The third reason was that a major construction project would demonstrate the vitality of the newly independent nation of Egypt, which had overthrown the pro-British king Farouk I in 1952. The Chinese government under Mao had constructed the Banqiao Reservoir Dam on the Ru river in 1951, with Soviet assistance. Likewise, the construction of a major dam on the Nile would signify that the Egyptian republic was a fully modern nation (McCully, 2001).

It is the third reason that is relevant here. In effect, the Egyptians decided to construct the dam, in part, because of the attitudes of other nations towards huge public projects of the type. The Egyptian policy makers reckoned that other nations saw such projects as a symbol of vitality and modernity. Wanting to associate that attitude abroad with respect to the Egyptian republic further motivated planners in their desire to build the dam.

The case is similar in many respects to the Irish government's plan to adopt e-voting discussed above. However, an additional element comes to the fore in this case. The Egyptian planners were influenced not merely by their own attitudes towards the dam but also by *the attitudes of others* towards dams. Put another way, one of the purposes of the dam was to impress citizens of Egypt and politicians abroad. The fact that those people saw dams as more than "just a tool" fostered an admiring attitude in the planners of the dam themselves.

As with the case of e-voting in Ireland, the result was an uncritical approach to the design of the dam itself. Wahhid Moufaddal, a remote-sensing scientist at the National Institute of Oceanography & Fisheries in Alexandria, notes that the attitude of planners towards the dam compromised their sense of caution regarding it (Bohannon, 2010):

> '"There was no discussion" about the merits of such a potent source of pride for the newly independent nation, says Moufaddal. "It was a giant experiment," yet, he notes, there was no plan for collecting environmental data.

In fact, the Dam has had a number of significant detrimental effects that, because of the lack of oversight, were not detected until fairly recently. These include (1) subsidence of the Nile Delta due to lack of incoming sediment from Nile floods, (2) diversion of the entire river flow before reaching the Mediterranean, leaving no flow to wash pesticides and other toxic chemicals away from the Delta, and (3) salt water leaching into the Delta's water table from the Mediterranean, threatening the supply of fresh water in the Delta.

The decision to build the Dam and, moreover, not to monitor the consequences, displays the symptoms of motivation-biased design. In this case, the influence of the attitudes of others towards dams, as the planners understood them, inhibited the planners from evaluating their design critically enough. The result is that the Egyptian government is facing the prospect of another massive public works project in order to mitigate the problems generated by the Dam.

The design situation

The examples above suggest that designing can indeed be significantly affected by the attitudes of the designer(s). Moreover, these examples suggest that the role and influence of attitudes can be systematically accounted for.

Motivation-biased design may occur in a design situation containing the following elements:

1. A set of means and ends;
2. A design to meet the ends using the means;
3. A set of designers' attitudes towards (1); and
4. A set of designer's attitudes and beliefs about the attitudes of others towards (1).

The interactions among these elements in a design situation is captured in Figure 1**Error! Reference source**

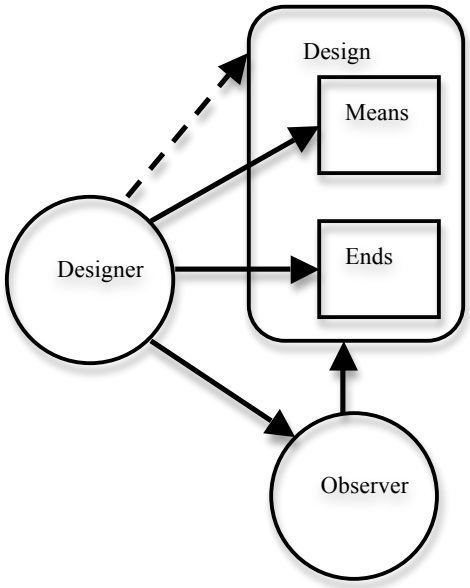

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Figure 1: Attitudes in motivation-biased design.

attitudes that the participants have towards other elements of the design situation. The dashed arrow represents the uncritical attitude that the designer has towards the design as a result of the other attitudes and elements in play. It is this uncritical attitude that can make motivation-biased design problematic.

Explaining motivation-biased design

Given the existence of motivation-biased design, we come to the matter of how it occurs. There are at least four perspectives to help explain the phenomenon, based on (1) explanations of motivated inference, (2) positive illusions, (3) explanations of conflicts of interest, and (4) explanations based on the concept of *moral capital*. Each explanation is considered in this section.

Motivated inference

Motivated inference concerns the undue influence that people's goals can have on the conclusions that people draw (Kunda 1987). For example, a member of one political party might uncritically accept the conclusion that a politician of another party is a liar, even where this conclusion is not justified by the full body of evidence. The personal goal in this case is the party-member's opposition to the politician. Having this goal influences the way that people identify the evidence that is relevant: Instead of asking themselves, as it were, "What evidence makes the liar hypothesis better than other hypotheses?" they ask themselves, "What evidence justifies the liar hypothesis?" Some evidence can doubtless be found to support the liar hypothesis, so the party member weighs the evidence and reaches a biased conclusion. This bias in the characterization of relevant evidence can be amplified by the social situation at hand. When the member discusses the matter with friends, who are also probably members of the party, they will also engage in a one-sided process of evidence collection that further supports the conclusion.

A similar process may occur in cases of motivation-biased design. In these cases, designers have a positive attitude towards some means or end involved. This attitude may influence how evidence for the appropriateness of the item is characterized. Instead of asking themselves, as it were, "What makes this design better than the alternatives?" they ask themselves, "What makes this design a good one?" This way of framing the project of design evaluation biases the evaluation process by leaving relevant but negative evidence out of consideration. As a result, an uncritical evaluation is reached.

This explanation does seem to capture important aspects of motivation-biased design. In the water-conservation plan, for example, the laudability of the goal of water conservation did seem to direct attention towards how the plan could meet the goal and also away from examination of the plan's effects on the water system itself. So, it seems plausible to say that the characterization of relevant evidence was biased in this case.

It also comports well with the social causes that can apply to motivation-biased design. The Aswan Dam example illustrates that designers may be led to consult others who are themselves biased in the matter at hand. The result is, again, a one-sided characterization of what counts as relevant evidence for design evaluation.

Positive illusions

However, there is an issue in play in these examples that is not present in mechanisms posited to explain motivated inference. As Corrigan points out, designers sometimes have an exaggerated sense of the command they have over the situation in which the design is to operate. In other words, designers may believe that they are in a better position to determine the outcome of their decisions than they truly are in.

If so, then the problem of *positive illusions* may be at work in motivation-biased design. In particular, Langer (1982) notes that people may labor under the *illusion of control*, that is, the exaggerated impression that they control the outcome of some operation, especially if the operation requires a degree of skill. Designing a dam or an e-voting system requires a degree of skill, so it is plausible to think that illusions of control may come into play.

An illusion of control could contribute to motivation-biased design in the following manner: Instead of asking himself, as it were, "What things could go wrong with this design?" the designer asks himself, "What things can I prevent from going wrong?" The two questions characterize the relevant data in different ways. Any kinds of problems might be relevant to the first question. However, only those problems that the designer is familiar with and used to controlling are relevant to the second question. The second question focuses designers' attention

on design elements that they are familiar with, and problems that they are used to dealing with. Confusing the second question with the first one could result in an uncritical evaluation of a design.

Affective afflictions

Thagard (2007) provides a discussion of conflict of interest that is relevant here. He discusses the case of a city official who, after a few rounds of wining and dining by a private company, endorsed a contract on ruinous terms between the company and the city. The official seemed to display no awareness that the good treatment he received from the company might have compromised his ability to evaluate their proposals. Thagard seeks to address the question, "How could someone in that situation be so blind?"

Thagard frames the issue in terms of *affective afflictions*, that is, the systematic distortion of decisions by emotional attachments. These distortions result from facts about human neuroanatomy that are outside the scope of this article. However, he raises two points that are relevant here.

First, he points out that conflicts of interest involve not only the past situation but anticipations of the future (2007, p. 373). Because of their mutual past, the city official may have made his uncritical decision because he anticipated further, pleasant occasions with company executives. Also, he may have feared to disappoint his new friends there by examining their proposed contract too thoroughly.

Second, Thagard explains why people tend to be unaware that this sort of thing is going on with their cognitive processes. In rough terms, the emotional calculations going on in these situations occur not in brain areas associated with conscious thinking, e.g., the prefrontal cortex, but in areas associated with unconscious, affective thinking, e.g., the nucleus accumbens (2007, p. 374). Although people may be aware of their positive or negative feelings about a given thing, they may well not be aware of the role that those feelings play in determining the relevant of data for their cogitations.

Both points are important for explaining motivation-biased design. When designers evaluate their designs, they are thinking about the future. They may imagine the praise that others will bestow on them for a particular design or design element. They may also imagine the scorn or disappointment others will feel for their omission of some element or goal. This issue seems to be particularly relevant for the Aswan Dam example, in which designers were motivated, in part, to display their competence before their peers abroad, and to show off the modernity of their nation before Egyptians and foreigners. The dam was not merely a material object but a performance before an audience whose response the designers were concerned to manipulate as much as the waters of the Nile.

Moral capital

Another important aspect of motivation-biased design concerns the attitude of the designer towards herself. In the water-conservation example, for instance, it seems plausible that having good intentions about water conservation also implies having a positive attitude towards oneself. That is, having good intentions implies that one is a good person. This sort of positive self-image may also contribute to the inhibition of critical reflection evident in motivation-biased design.

This aspect of motivation-biased design may be captured by the concept of *moral capital*. Mazar and Zhong (2010) describe moral capital as a person's sense of their own moral credentials. A person who feels that they have acted in a morally upright manner will feel that they have acquired strong moral credentials. Oddly, this feeling can license a drop in performance of moral behavior.

Mazar and Zhong found that people who bought "green" or environmentally friendly products were more likely than others who bought similar, non-green products to subsequently lie or steal. It is as if, having acquired a quantity of moral capital through patently good actions, these people then spent the capital on themselves through morally dubious actions. The behavior is reminiscent of the medieval practice of *indulgences*, an indulgence being a pardon from a sin or a duty to the Church granted in exchange for a cash payment. The Church reckoned that it had a store of excess merit from which it could make up the shortfall created by the indulgence. Mazar and Zhong observed that people who had behaved in a moral manner conspicuous to themselves then acted as through they had acquired excess moral capital that they could then spend on themselves through indulging in a dubious act.

A designer with a positive attitude, conspicuous to themselves, towards some design element they have incorporated into a design could fall prey to the same effect. Engineers examining a water-conservation measure, for example, might feel that this good deed gave them a fund of moral capital that they could then redeem by saving themselves some of the trouble of examining the scheme very thoroughly.

One advantage of this perspective is that it takes into account the temporal unfolding of design evaluation. That is, designers may begin the design process possessed of a positive attitude towards some design element. As the design comes together and the admired element is included, the designer acquires moral capital. In later phases of design, where evaluation becomes more important than configuration, the moral capital is available to be expended and licenses a more cursory effort. The previous perspectives examined, such as motivated inference, tend to overlook the temporal element of design reasoning, which this perspective helps to capture.

Design fixation

The phenomenon of motivation-biased design may help to explain other aspects of design cognition. For example, Jannson and Smith (1991) demonstrated *design fixation*, that is, the tendency of designers to over-commit to design elements or principles that they had recently been reminded

of, even where the result is inappropriate or sub-optimal. One reason why designers might display fixation is that they have a positive attitude towards the element or principle in question. Ahern could be said to have fixated on the use of computers in Ireland's new electoral system, for example, because he thought so highly of them and how they would reflect well on the technological progressiveness of the Irish government.

Conclusions and future work

Motivation-biased design describes how the attitudes of designers towards elements of the design situation affect their evaluation of the design in question. In particular, the examples discussed above suggest that positive attitudes towards the means, ends, or observers of a candidate design can inhibit the designer from viewing the design with a sufficiently critical eye. The result is the adoption of designs that, at least in retrospect, are clearly sub-optimal.

The reasons for the occurrence of motivation-biased design are complex. To a first approximation, they seem to concern how designers' attitudes affect:

1. How they characterize data relevant to evaluation of the design;
2. Which consequences of the design's operation are within their control;
3. Their perception of the impressions of others and its consequences for their evaluation of the design; and
4. Their self-impression and its consequences for their evaluation of the design.

Further research is needed to better characterize the phenomenon and its cognitive mechanisms. This research would consist of investigation of this phenomenon in actual practice, laboratory studies under controlled conditions, and computational simulations.

Further questions concern relationships between motivation-biased design and other cognitive phenomena. For example, how is it related to lapses of judgment occurring in the presence of conflicts of interest? Also, what are the effects of *negative* attitudes on design evaluation? It seems plausible to think that negative attitudes could make designers more critical in evaluation, even hypercritical.

Finally, it is appropriate to wonder how the problems brought on by motivation-biased design can be mitigated. One possibility would be to make a study of design errors that occur as a result of motivation-biased design. The Canadian NGO *Engineers Without Borders* has recently issued an "error report", containing mistakes that members have made in their projects in Africa (Bunting 2011):

> "While working in a project in Zambia, Mark Hemsworth thought his task to support local enterprise was straightforward – a carpentry business needed a planing machine. He supplied the machine but it was badly damaged when fitted. Like plenty of unused machinery lying around rural Zambia, parts and repairs were hugely difficult to arrange."

It might help if such reports were a more regular part of design practice and the errors studied and available for others to learn from.

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