

Chapter 17

A Theoretical Approach to Intuition in Design: Does Design Methodology Need to Account for Unconscious Processes?

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17.1 Introduction

This chapter introduces a theoretical approach that explains the occurrence and consequences of the use of intuition in the design process. It characterizes design intuition as a function of the designer's experience, his/her awareness for new elements in the current situation, and contributing contextual factors such as time pressure and team dynamics. We postulate that designers are more likely to rely on intuition when their experience is high, and their awareness of the current environment (i.e., situational awareness) is low. In addition, contributing contextual factors—mainly time pressure—also play a role in increasing the reliance on design intuition.

At a broader level, our consideration is an integral part of the “Human Behavior in Design” (HBiD) framework [2], which focuses on the cognitive processes of the designer and his/her interactions with the environment such as decision making and creative problem solving. The intent of the HBiD framework is to understand the complex interplay between the designer, design process, design outcomes, and contextual variables. A key component of design methodology is conceptualized as a prescriptive structuring of the design process, and is meant to support the designer so that he/she can influence the design situation in an appropriate manner.

As documented in the empirical dimension of this chapter, when design practitioners are asked about how they make decisions on a daily basis, most of them report situations in which their decisions were driven by intuition. Intuitive judgments and/or decisions elicit behavior and reasoning processes that require the thinker to act on knowledge without knowing *how* he/she knows. This “de-coupling” between thinking and conscious awareness can make intuition a kind of mystical process in the eyes of the acting person and observers, and is often associated with strong positive feelings.

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Historically, design methodology has been developed in response to intuitive approaches with the rationale that intuition often involves arbitrary choices of problem decomposition and solution generation [16]. On the other hand, several empirical studies over the last 50 years have shown that designers do use other “strategies” than structured design methods to arrive at new ideas, solutions, products, etc. (e.g., Gunther and Ehrlenspiel [12]). However, design methodology seems to ignore intuition as an elementary part of the thinking and acting of the designer.

Intuition plays an important role for planning and decision making in other fields as well. For instance, the mechanisms of intuition are being studied in organizational management, philosophy, and psychology. However, so far, the widespread interest has not led to a more comprehensive empirical investigation on this phenomenon in design research (Kathri and Ng [18]). Even the basic question, “does a designer relying on his/her intuition exhibit good or bad design behavior” is not being asked in a rigorous manner, and, thus, not being answered in the scientific literature.

In addition to the lack of answers provided by design research, there seems to be an even more conflicting situation in practice: On the one hand, management of product development organizations pursue process standardization certifications such as ISO 9000/9001, and, on the other hand, self-reports of designers imply that they do not follow those processes by frequently relying on their intuition. Which approach is the desirable one? Who would feel safe on an airplane where key design decisions have been made by intuition and “gut feeling” instead of explicit and structured reasoning?

In the following sections, we first integrate results from the literature to shed some light on previous research on intuition and define the process of intuition. We then illustrate the use of design intuition in practice by analyzing a set of interviews with professional designers of varying degrees of experience in different fields.

Our goal is to understand the role intuitive processes play in the thinking and acting of designers. Although we are particularly interested in the connection between intuition and decision making, we recognize that design intuition encompasses more, and will consider its multiple facets.

Before we begin our exploration, we should stress that we do not see any evidence for the somewhat common assumption that intuitive processes follow completely different rules compared to the rational decision making process [19] (see Sect. 17.2 for a detailed discussion).

Our exploration will enhance our understanding of how intuition is used in different stages of the design process, the characteristics of the individual designer, and the contextual factors relating to the team and the organization. The driving research questions are:

- What is the nature of design intuition?
- How does intuition influence design processes and performance?
- How do designers conceptualize that influence?
- Should intuitive processes in design thinking be supported? If so, how?

17.2 Intuition and Rational Decision Making: Complementary or Conflicting Behavior?

As the data we will present during our empirical consideration also indicate, when a practicing designer is asked how he/she arrives at a decision while dealing with a complex problem, he/she is likely to reveal that his/her way of working is not necessarily “rational,” and that he/she does not always use explicit criteria to compare the utility of generated alternatives when arriving at a decision.

Many decades of research on human decision making model the human being as a “rational decision maker.” This model explains the behavior as a probabilistic approach: The decision maker chooses the alternative that delivers the highest utility, which is estimated based on the available information. Thus, the chosen option is optimal in a probabilistic sense. However, the view of human decision making as a purely rational process has been promptly questioned. The most well-known “critique” of the rational problem solver was brought up by Simon [24], who introduced the notion of “bounded rationality,” and within that concept, the claim that humans make satisficing rather than optimizing decisions due to limitations associated with unreliable information about alternatives and their consequences, human memory, and resources (also claimed by Kahneman [17]).

Moreover, many studies yielded results about human fallacies in a variety of tasks requiring judgment and decisions—the main reason being that humans base judgments on beliefs and intuition rather than a logical reasoning process [8, 28]. On the other hand, it has been argued that intuition can be a successful element in human’s acting and decision making. For instance, the naturalistic decision making research community emphasizes “the power of intuition.” A thesis of the book, “Start with intuition, not with analysis,” gets that point across [19, p. 88].

If, at the same time, we consider that humans make a variety of mistakes—some with catastrophic consequences—when relying on intuition, we must ask: Are human beings prone to choosing the wrong tool/approach for attacking different kinds of problems? Obviously, more insights are necessary to understand the role of intuition in different types of decision processes. Moreover, there seem to be intuitive mechanisms which are built into the human brain that provide benefits to the decision maker and beat the limitations with a cognitive-emotional weapon.

So let us face the question: What is intuition?

17.2.1 Defining Intuition

Intuition is what we consider as behavior we cannot observe; in research terms, intuition is a hypothetical construct. A hypothetical construct can be defined as “an abstract concept used in a particular theoretical manner to relate different behaviors according to their underlying features or causes” [14].

In order to grasp the most relevant aspects of this construct, we first survey criteria which are used in different definitions of intuition. A comprehensive definition is given by Webster's Dictionary: "A looking on; a sight or view; but restricted to mental view or perception. Particularly and appropriately, the act by which the mind perceives the agreement or disagreement of two ideas, or the truth of things, immediately, or the moment they are presented, without the intervention of other ideas, or without reasoning and deduction... We know by intuition, that a part is less than the whole." [32].

The so-called gut feeling is closely related to the phenomenon of intuition. The definitions of gut feeling vary in how far the conscious part plays a role.

Le cœur a ses raisons que la raison ne connaît pas. [21, p. 277].

The most well-known reference to "gut feeling" has been made by pascal [21] in the sixteenth century. In this proverb, he describes the heart as the place where information is processed and decisions are made, which are not being understood by the rational part of the information processing system.

Gigerenzer, a cognitive psychologist, defines gut feelings as rules of thumb which "provide knowing without thinking," and uses "the colloquial rule of thumb synonymously with the scientific term heuristic" [11, p. 18]. Gigerenzer presents his doubts on the dogmatic view of rational decision making and portrays an adaptive toolbox as an alternative approach to the "new land of rationality" [11, p. 19].

In order to decompose and further support these definitions, we present a framework that characterizes the nature of intuition and consists of the following dimensions:

- Intuition is related to unconscious and subconscious processes

Although it is widely agreed that intuition is not a conscious process, there is disagreement on the extent it is unconscious or subconscious. However, a person not being able to explain the rationale behind an intuitive decision does not mean that there has not been any reasoning associated with the decision. The assumption that intuition takes place without reasoning and deduction has not been proven and is open to discussion (see Sect. 17.4 for a more detailed discussion).

- Intuition associates to the totality of the situation

Intuition is seen as a synthetic as opposed to an analytical function that apprehends the totality of a situation [30]. This aspect is often addressed within the notion of a holistic approach.

In addition to the un/sub-conscious and the holistic feature, many definitions stress the attribute of affect-relatedness of intuition. For example, Dane and Pratt define intuition as "affectively-charged judgments that arise through rapid, non-conscious, and holistic associations." [5, p. 40] This definition stresses four characteristics of intuition: unconscious, time-related, emotion-related and holistic (see below).

- Intuition is accompanied by affects/feelings/emotions

Many authors also add that the situations in which intuition is used are often accompanied with strong feelings of what will occur—of consequences of pursuing different sets of actions. Vaughan [30], who distinguishes four levels of intuition, physical, emotional, mental, and spiritual, refers also to tension which can be indicated by bodily messages from which further information can be gained and used for coping with the situation at hand. For instance, a sudden bodily discomfort can be interpreted as a source of warning.

- Intuition is fast

Intuitive judgments and decisions surface rapidly. The person suddenly becomes aware of the outcome of the intuitive process, and as mentioned earlier, does not have direct or conscious access to the process itself.

- Intuition uses multi-sensorial stimuli

Intuition can be prompted by different senses such as auditory and tactile input. Especially, expert knowledge is often a combination of haptic, visual, and olfactory knowledge, which only the expert is able to elicit in a specific situation and to gain further information.

- Intuition develops with experience

We can assume that all human beings possess basic behaviors which relate to intuition—primarily linked to survival mechanisms—and that they also learn from experience and internalize knowledge. In other words, it is reasonable to assume that new knowledge is processed into strategies or heuristics in the form of intuition that can provide guidance in the future (see [Sect. 17.4](#) for a more detailed discussion).

- Intuition can stimulate creative solutions

A connection between intuition, creativity, and innovation is implied in the dimensions outlined above. Albert Einstein refers to the outstanding impact of intuition on creativity: “(empirical) knowledge is necessary, too. An intuitive child couldn’t accomplish anything without some knowledge. There will come a point in everyone’s life, however, where only intuition can make the leap ahead, without ever knowing precisely how. One can never know why, but one must accept intuition as fact” [15, p. 173]. With further enthusiasm for intuition the author finally states: “For it is intuition that improves the world, not just following the trodden path of thought. Intuition makes us look at unrelated facts and then think about them until they can all be brought together under one law. To look for related facts means holding onto what one has instead of searching for new facts. Intuition is the father of new knowledge, while empiricism is nothing but an accumulation of old knowledge. Intuition, not intellect, is the ‘open sesame’ of yourself” [15, p. 16].

Albert Einstein’s position values intuition as a road to new knowledge, and emphasizes its impact on the creative sense-making process.

17.2.2 Theoretical Approaches

There are no theoretical approaches that claim to address intuitive decision making in design. However, in other disciplines, mainly in the area of decision making, there are theoretical approaches which attempt to explain the different facets of human decision making as rational and intuitive. These approaches build on the dual process theory [7, 8, 26, 27], which treats intuition and rational decision making as competitive modes of thought.

These two different modes of thoughts were articulated in detail by James [13] and Freud [10]. Freud distinguishes the associative and unconscious primary system from the conscious and rational secondary system. Similarly, James separates associative and what he called “true reasoning.” According to James, associative knowledge is re-productive as it is built from past experiences, and relies on reasoning processes such as comparison and abstraction. Associative thinking is the “true reasoning” modus as it is also the tool for dealing with unexpected and new situations [13].

About 50 years later, Tversky and Kahneman [22, 23] pursued the idea of two separate systems, which they called the Intuitive System 1 and the Analytical System 2. Embracing an evolutionary view, the intuitive system works fast and automatically, and has an emotional component with focus on survival and reproduction. The person might be conscious about the final product but not about the generating processes. System 2 is slower and is activated when System 1 cannot resolve the issue. System 2 uses conscious judgments and deliberate attitudes to generate new knowledge.

17.2.3 Integrating the Mechanisms of Intuitive (System 1) and Analytical (System 2) Processes

Does the assumption of two different mechanisms of human reasoning deliver an explanation of intuitive behavior? Our position does not assume the existence of two reasoning mechanisms with separate process flows, but integrates both reasoning mechanisms into one process flow instead.

Humans apply different heuristics and strategies when dealing with complex and uncertain problems; these types of problems do not necessitate one single correct solution but follow the criteria of wicked [20] and ill-defined problems [25]. Heuristics are defined as cognitive strategies which are applied when people must decide, and do not have sufficient information, or in cases of information overload.

We postulate that human perception works in a way that in any situation a continuous comparison takes place between expected and actual occurrences with respect to key parameters. When this check results in a significant discrepancy (a mismatch above a threshold), an inquiry is prompted: “What was that?” The

analytical system will be activated only in such unexpected or surprising cases. Then, the conscious analysis provides new information, which is integrated into the existing mental model, resulting in the generation of new knowledge. Depending on the outcome, this process might be repeated several times, but after a certain amount of events it will become “routine” and will decrease the conscious attention. Neuroscientists have found that, after a decision, the match between expected and actual occurrences will produce the so called “feel-good” hormone dopamine, whereas in non-expected occurrences the dopamine production is decreased [33].

Moreover, human thinking is based on representations of reality—that can be described as accumulated experience—that are built in order to understand, predict and explain the world. Thus, the identification of a discrepancy and the selection of adequate actions must be based on prior experience within a similar situation. The identification of relevant “pieces of experience” is most likely based on the similarity between the given situation and the schemata stored in memory. Our assumption is that if this similarity-check does not lead to a clear association or fit with an adequate automatism (fixed predetermined response to the cue), then cognitive strategies such as predefined rules or heuristics come into play. Heuristics are built from prior cases of successful experience, but do not guarantee a successful result. In non-routine situations where no suitable schemata are available, new schemata need to be generated. As a consequence, uncertainty surfaces and affects thinking and acting on each level of behavior.

Thus, thinking is primarily steered by (adequate or inadequate) existing schemata, which is very effective and efficient in routine situations and makes the major part of our daily lives more comfortable. We do not need to create a new strategy for each new situation, but can quickly react on the basis of earlier experience. Accordingly, unconscious adaptations and minor modifications frequently occur at the boundary of intuitive and analytical processes.

Imagine a designer whose goal is to redesign a printing machine. In order to assess the current design, he/she will start with scanning the variables he knows being the key parameters of the system [28]. At the same time, the designer will also monitor—not necessarily consciously—other variables whether they are in accordance with his expectations. If there is no discrepancy, further actions in regard to these variables will not become priority of the activities of the designer.

However, new information (can be a specific smell, a noise, or a vibration) might cause him/her to unconsciously recognize a discrepancy. In this example, it is unlikely that he/she can access a successful automatism providing a direct answer because the system encompasses many different components with complex relationships.

Since an automatism was not activated, the designer will be suddenly struck by the intuition—become aware of the issue—that the machine is not operating properly without being able to “put a finger on it.” He/she will consciously try to recall other potential relevant information (and rules) from his/her experience. If there is still no pattern match, he has to generate new knowledge in order to develop new solutions to meet his/her goal.

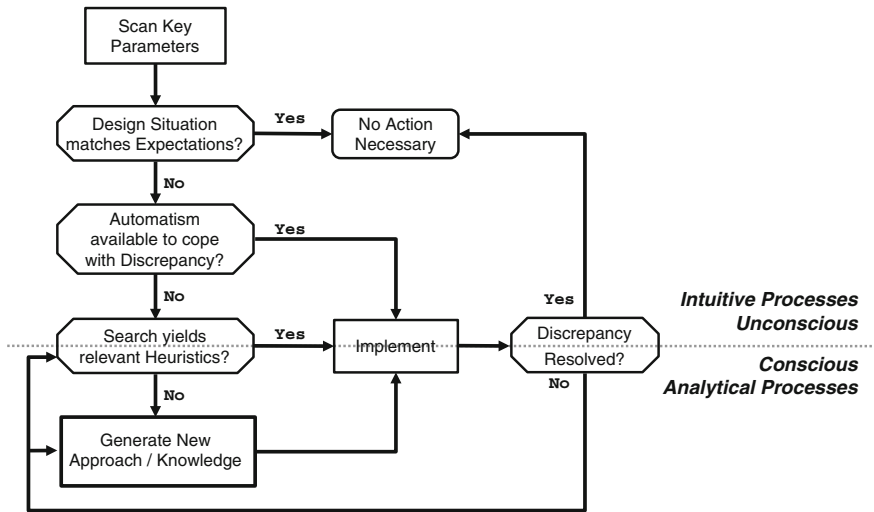


Fig. 17.1 A flow-diagram of conscious and unconscious behavior regulation: Processes integrating the application of automatisms, the search for existing rules, and the generation of new knowledge

In essence, this model assumes that the intuitive and analytical systems are interlinked in a process flow (see Fig. 17.1). They are connected through an intermediate process which is the application of strategies that have been proven to be successful. Also, note that the search of heuristics and implementation (of automatisms, heuristics, and new approaches) are seen as actions that have conscious and unconscious components.

In a similar way, Klein emphasizes the necessity of cooperation between the two systems [19]. Recently, within the “naturalistic decision making” domain, Klein developed the RPD (recognition primed decision) framework [19], which jointly accounts for intuition and analysis. Klein claims that intuition is a pattern-matching process that generates valid solutions to problems; the person quickly identifies the feasible courses of action without a need to compare options. Experts use analysis to consciously and deliberately review the courses of action.

17.3 Implications for Design Methodology

The discussion presented above is primarily a summary of the findings of social and cognitive psychology research. In addition, in the last decade, business and management disciplines have expressed growing interest in non-rational strategies in order to compliment traditional management strategies. However, empirical

research on intuition in the design discipline is scarce; the few empirical studies on intuition are mostly conducted in the area of strategic decision making [22].

Although design researchers seem to acknowledge that designers “use” intuition on a daily basis, there is hardly any targeted empirical work in order to understand whether intuition works in designing, and if it does, how and in which phases of the design process it matters the most.

According to the design science approach of Hubka and Eder [16] the designer should work on a knowledge-based level (conscious level), and avoid jumping to conclusions (jumping to solutions) and the use of intuition without thoroughly investigating the problem.

However, if a designer were to absolutely stick to the principle of “not jumping to conclusions,” he/she would be paralyzed. “Macroscopic” decisions such as choosing one of the down selected three–five alternatives a designer arrives at after concept selection and testing can lend themselves to such structured analysis fairly well. However, how about the hundreds—maybe even thousands—of “microscopic” decisions that a designer has to make on a daily basis when scoping the project and generating alternatives? It would be almost impossible to strive to attain statistically meaningful information necessary to carry out a structured and explicit process for those decisions; such an approach would bring the design process—especially its front end—to a halt.

In design methodology, the role of intuition as a potential supportive element during the design process has not elaborated. However, Pahl and Beitz state in that intuition might be another reasonable way to arrive at a good solution (1988). In fact, they see both approaches as mutually supportive and claim that a balance would be needed.

Until now this position has not been taken into consideration in the development of design methodology, but there seems to be a trend toward paying more attention to the unstructured and partly unconscious moments of designing. Newer frameworks [31] describe design activities that are opportunistic with hierarchical episodes, from pre-existing plans satisfying constraints, e.g., cognitive economy.

17.4 Design Intuition as a Specific Type of Design Thinking

Cross has reported that professional designers often refer to “intuition” when characterizing their design thinking [3]. He sees that appropriation as a shorthand that describes what really happens in design thinking, and relates it to the notion of abductive reasoning in design. We do not fully follow Cross’ argument because, as we stated earlier, we do not see why the development of design intuition has to exclude inductive and deductive reasoning processes, or rather, their outcomes, which may have been internalized as design heuristics. In order to articulate our position, we will focus on and further articulate the experience dimension of the framework we used earlier to characterize intuition.

Expertise in design has been a topic of study for decades. Several studies report that experts, compared to novices, tend to focus less on problem analysis, quickly impose an initial framing of their own on the problem, and generate a relatively small number of solutions [4]. The causes behind this rapid formulation process are unclear, but it is often speculated that past experiences allow the expert to quickly see/recognize/conceptualize the problem in a meaningful way [6].

Our inference is that past experiences do not constitute actionable knowledge by themselves, and, as such, cannot be directly responsible for the reported expert behavior in design. As we argued earlier, there has to be some type of past and current processing connecting experiences to current design situations, which need to be elicited by a situation-driven affordance or by intentions built from the current situation. Our core proposition is that such processing is the basis for design intuition, which does not necessarily deem the use of intuition in design thinking an irrational approach.

In other words, relying on intuition in order to arrive at design decisions might be just as rational as using a systematic and explicit decision making method. One can argue that, given the availability of resources, a systematic decision making method might yield higher quality information, but that does not deem the use of intuition irrational either. Moreover, as we mentioned earlier, resources are often rather limited, so in many design situations, the information an intuitive approach would act on might be of higher quality than the information that can be acquired through a systematic approach under the resource limitations.

Our position is supported by a study carried Ahmed et. al, who also explicitly relate design intuition to experience as a part of an exploratory study (Ahmed et. al [1]). Their preliminary findings, based on interviews of three expert designers, suggest that experts themselves might conceptualize design intuition as *unconsciously* relying on past design experiences while making decisions.

Our formulation of design intuition can be seen as being similar to case based reasoning, but there may some differences—to the extent that we can “observe” design intuition at work. The most significant potential difference stems from the reflective nature of design practice [23], which implies that designers engage in the processing of an experience without waiting to run into a situation that might be relevant to specific past experiences, and that such processing is ongoing, and most likely, cumulative. Another potential difference is the “holistic” nature of intuition (see Sect. 17.2.1), which seems to suggest that intuition can act at a rather abstract level.

To be perfectly clear, our intent in this section is not to judge if design intuition offers more utility than systematic design methods since, based on our discussion, that type of valuation depends mainly on the design situation, experience base of the designer, the ability of the designer to process those experiences, and the availability of resources to collect/generate and process new information. For instance, there is evidence suggesting that novice designers who self-reported higher levels of engineering intuition achieved lower design outcomes than novice

designers who self-reported lower levels of engineering intuition [34]. That discrepancy can be attributed to any of these factors. *Our main intent is to differentiate design intuition from irrational—and mysterious—behavior.*

Finally, it is relevant to consider if design intuition is different from intuition as it may be experienced in other domains. In other words, is design intuition a specific type of intuition? We postulate that what differentiates design intuition is the context in which it is exercised: shaping and solving complex ill-defined problems. As we outlined in Sect. 17.2.2.1, in routine situations—provided the problem solver possesses the relevant schemata—the intuitive system will most likely be able to handle the problem without invoking the analytical system. However, most design situations will invoke the analytical system as well since shaping and solving a complex problem is unlikely to be accomplished by relying on existing schemata alone. Moreover, as documented extensively in the design research literature, the generation of a “satisficing” solution [25] in such a scenario results in iteration, which means that both systems will be invoked repeatedly, and quite possibly, even simultaneously. It can even be argued that this is a fundamental characteristic of goal-oriented creative behavior when tackling complex problems.

17.5 Intuition in Design Practice: Interviews with Designers

In this section, we will put our theoretical framing into context by illustrating it with qualitative data on the role of intuition in design practice.

The data were collected by the master’s students in our Design Theory and Methodology course during interviews with professional designers from various domains. The course aims to expose students to a reflective meta-view on the design process and its constituents. More specifically, students learn to study their own design process as well as the design processes of other designers in order to identify key variables and their effects on design outcome. In the last assignment of the course, students plan and carry out interviews with professional designers from different disciplines. The interviews, in combination with the course reader containing literature on fundamental issues in design theory, act as the knowledge base for analyzing the design processes of professional designers. This year, students were asked to pick two topics of interest from the course reader and explore them in the context of their interviews. Therefore, not all students focused on the same topics. The data referenced here were collected during 15 interviews that directly focused on the role of intuition in design practice.

We interpreted and grouped the transcript sections addressing design intuition into factors/themes that are relevant to our theoretical consideration. We will describe and illustrate each theme with excerpts from the transcripts below.

17.5.1 Clients Pay Designers for Their Intuition but also Might Fire Them for Relying on it

While several designers reported that clients hire them because their intuitions are of value to the clients, other designers reported that not being able to present clear rationale for making choices to the client can result in skepticism. Naturally, excess skepticism displayed by the client toward the designer's choices will result in the designer failing to convince the client to go along with the design, which is never a desirable outcome from the designer's perspective.

I would like to follow my intuition, but most times I have to follow the rational outcomes of research because the rational outcome is more convincing to clients.

Architect with 3 years of experience

The opinion expressed above illustrates this point. However, it also implies that there is a discrepancy between the outcomes of his intuitive and "rational" approaches. Is that because the two approaches fundamentally yield different results, the architect's intuition has not developed sufficiently, or his/her "rational" analysis is flawed? However, the client does not seem to be particularly concerned with this question, and would rather be presented with the "rational" approach.

17.5.2 Novice Designers Should not Rely on Intuition Because They Lack Experience

As we discussed earlier, experience seems to play a critical role in how designers develop intuition in that it is a prerequisite to having sound design intuition but does not necessarily guarantee it. Most of the interviewed designers recognized the link between gaining design experience and developing design intuition. Some went as far as stating that novice designers should not rely on their intuition because of their limited experience.

The more you experience and know, the greater your intuition would be. Otherwise, if you are a junior designer, choosing the outcome of a rational method is better. Your intuition may mislead you. Therefore, for junior designers, the most important thing is to gain experience.

Architect A with 3 years of experience

However, it can be argued that the lack of experience and well developed intuition might be advantageous since that might cause the designer to be more critical of his/her work. For instance, in the context of the quote below, it is debatable who the better boat designer is: the senior engineer who sizes components based on his/her intuition, or the junior engineer who makes the same type of decisions through analysis?

I admire the knowledge of experienced guys in the field that are able to make assumptions by using some rules of thumb... The information collected to analyze the design problems is gathered by using the gut feeling... I like to affirm those rules of thumb by calculations, but experienced colleagues almost never fail.

Naval Engineer A with 2 years of experience

The engineer's last sentence is particularly interesting because he/she realizes that the "rules of thumb" approach does indeed fail at times. The consequences of failure can be catastrophic depending on the context of the decision. It is plausible to argue that: an experienced designer who knows how to use his/her intuition well will not use it in critical situations; whereas an experienced designer who does not know how to use his/her intuition will use it in critical situations, and eventually cause a catastrophe?

17.5.3 Understanding the Basis for Your Intuition is Necessary

Not all interviewees who viewed intuition favorably accepted it as is. An artist was supportive of it although she seemed to think that it was not useful unless one knew its basis.

Intuition often proves to be right, as long as you know where it comes from.

Artist A with unknown duration of experience

Sometimes gut feeling also plays a role in the decision process... Sometimes this has an influence on the process, but needs argumentation.

Architect B with 5 years of experience

They might have been simply expressing the need to understand the automatism or heuristic at play before feeling comfortable enough to apply it. In other words, listen to your "gut," but do not trust it unless you understand its rationale. Of course, this viewpoint expresses the need for a designer to be open to the possibility that one's intuition might simply be misleading, but it also limits its efficiency. By definition, intuition is efficient because we do not have to think about its rationale before acting on it. Also, by definition, it is highly unlikely that its basis can be fully understood.

17.5.4 Intuition Tells the Designer When a Project Is Finished

Design methodology would advocate that a design project has been successfully concluded when its requirements are met by the solution at hand. That is normally done by applying a set of requirements, metrics and targets that have been made

explicit upstream to formally evaluate the performance of the design. Instead, several interviewees reported that they simply rely on their intuition to tell them when the design is “done.”

When you’ve been working for some years, you know when something is good or not.
Urban Planner A with unknown duration of experience

When a song is finished, it’s finished. We [the band] just know.
Musician with 5+ of experience

Designers internalizing the requirements and continuously (and unconsciously) assessing them in real-time is a potential explanation of this viewpoint. However, it has been argued that it is not possible for humans to keep track of a complex list of pros and cons for multiple alternatives to unconsciously arrive at a critical decision [11].

17.5.5 Time Pressure Necessitates the Use of Design Intuition

In according with Cross’ view [3], several interviewees saw intuition as a short-cut in decision making, which simplifies and makes the process manageable given the complexity of real-world design situations.

Sometimes, time pressure is also a very big...under that pressure sometimes you have to be inventive, you have a lot of ideas but you don’t know how to deal with it and then you have very little time, and you have to take a decision, to make it simple, because you don’t have time to make a complex. Sometimes it’s very hard to take all the elements to get them all together, so you have to ignore or find it out later.
Architect C with 10+ years of experience

In certain situations, ignorance can be beneficial. For instance, Gigerenzer claims that heuristics that drive our intuition might allow us to make certain decisions without a comprehensive information base [11], and that the fact we are ignorant of certain information might actually reveal the irrelevance and insignificance of that information. Of course, there are significant drawbacks to that position as the consequences of ignoring relevant information can be severe.

Project timelines, and thus, the nature of the design work, also have implications for how intuition is perceived with respect to time pressure.

One interesting set of interviews revealed that a flamenco composer with 10 years of experience did not prefer to rely on intuition because the timescale of his projects are rather long, and that he does not feel under pressure to finish a piece and works on it “rationally” until it is done. In contrast, an art director at a large market leading videogame company reported that, under pressure from the competition developing similar products in the marketplace, she almost always relies on intuition to make critical design decision because there is never any time to explore and test the alternatives in a rigorous manner.

17.5.6 When Working in Groups, Relying on Intuition Is Nuanced

Intuition does not seem to always offer a short-cut to making decisions. A product designer found relying on intuition to be problematic in a group setting because groups are not likely to accept the position of individuals unless individuals offer rationale. However, when he reflected on individual work, he said:

I often have a gut feeling which direction is the right one to go in.
Product Designer A with 5+ years of experience

In contrast, a choreographer perceived a different group effect, which seems to highlight the relevance of the necessary information for making decisions emerging out of social interactions within the group.

With the preparation I think in a logical way. I think of a theme and make associations on the theme. After that I am reasoning logical steps, the tasks for the dancers. Working with the groups is more feeling and intuition, I see and feel things.
Choreographer A with 25+ years of experience

17.5.7 Intuition Can Lead to Decisions but Does not Tell the Designer how to Implement Them

Several interviewees made a distinction between arriving at a decision based on intuition and implement that decision. They saw intuition being more relevant to the former.

Intuition tells you what way to go, but the how to go there is something different.
Software Designer A with 10+ years of experience

I see the solution in one second! But then I need months to build them.
Artist B with 10+ years of experience

This might indicate that some designers are more aware of the role intuition plays in conceptual design thinking. Intuition must come into play during detail design and implementation as well, but the interviews did not perceive its influence downstream in the design process. Conversely, this might be related to the differentiated role analytical thinking might play in the different phases.

17.5.8 Intuition Can Act as a Warning Flag

Intuition does not always tell designers where to go; it can also tell them where not to go. In fact, as we referenced earlier, research has shown that our nervous system unconsciously detects an error before we become aware of it.

When my gut feeling would say that a certain direction is not a good idea, I had no reason to not listen to that. You then would think about changing your principal or system as soon as possible, based on your gut feeling.

You try to get rid of gut feelings...Sometimes you would not get rid of your gut feeling, but you cannot find any alternatives. This usually happens when you get an assignment from the boss and you immediately think that it will fail. Having to design an engine that runs on water, for example.

Machine Designer A with 23 years of experience

17.5.9 Intuition can Lead to Subjective Thinking and Fuel Creativity

Although a core criticism against relying on intuition is its subjectivity, that limitation can also be seen as an advantage in terms of creativity.

I think in most cases I rely on my logic thinking more because architecture is mainly about function. The space you design need to be a fit for the users. Therefore, it is all about fitting the regulation and the rules. And the logic thinking as a framework, under the framework you will still using your gut feeling to design. And that's why different designers will design differently under the same regulation and rules.

Architect D with 28 years of experience

Since no two designers are likely to have the same set of experiences and reflections around those experiences when faced with the same design situation, they are likely to experience (slightly or drastically) different intuitions. Naturally, that can be a source of diversity in approaches and solutions, which can be beneficial for creativity.

17.6 Conclusions and Future Work

Intuition has been reported to be an important aspect of judgment and decision making in many domains. In this chapter, we focused on the role of intuition in design thinking and acting, and argued that theoretical integration and empirical investigations that would allow us to understand the mechanisms of design intuition are missing. In response, we offered a detailed theoretical exploration of the concept, and proposed a framework on the nature of design intuition that can lead to a theory of design thinking.

We supported and extended the theoretical framework with empirical findings on how and when practicing designers rely on intuition. More specifically, different situational variables such as time pressure and group and client interactions seem to influence the use of design intuition. Knowing when to trust your intuition surfaced as a critical factor in the use of design intuition.

In conclusion, comprehensive theories of design thinking need to take into account unconscious processes such as intuition. From a methodological perspective, design methods should acknowledge the designer's need to rely on intuition in certain situations—especially under time pressure. At a more advanced level, design methods should support the designer in assessing the limitations and benefits of utilizing intuitive approaches.

There is still much to be learned on the relationships between the use of structured design methods, intuition, and design performance. This work led us to develop the following research questions as the future work:

- In what situations should designers rely on design intuition rather than structured/explicit approaches for better performance? More importantly, how can designers make that decision in real-time during design practice?
- Is the above determination different for novice versus expert designers? Can experts leverage intuition more than novices, and conversely, is it more risky for novices to rely on their intuitions?
- If intuition indeed develops in parallel with experience, and hence is learned to a certain extent, how can design methodology facilitate that learning process?
- How can design methodology, advocating a hierarchically structured design process, integrate design intuition into existing design methods and process models?

Although our exploration deals with these issues and offers preliminary positions on several of them, these are major questions that warrant more detailed and systematic considerations.

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