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Interliminal Design: Mitigating Cognitive Bias and Design Distortion

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"Design is an inquiry for action" - Harold Nelson, PhD

Liminal: from the Latin word līmen, a threshold

"Our values and biases are expressions of who we are. It isn't so much that our prior commitments disable our ability to reason; it is that we need to appreciate that reasoning takes place, for the most part, in settings in which we are not neutral bystanders." - Alva Noe

In this globally interconnected and information-rich society, complexity and uncertainty are escalating at an unprecedented pace. Our most pressing problems are now considered wicked, or even super wicked, in that they commonly have incomplete, continuously changing, intricately interdependent yet contradictory requirements, urgent or emergency status, no central authority, and are often caused by the same entities charged with solving them (Rittel & Webber, 1973). Perhaps similar to philosopher Karl Jaspers' Axial Age where 'man asked radical questions' and the 'unquestioned grasp on life was loosened,' communities of all kinds now face crises of "in-between"; necessary and large-scale dismantling of previous structures, institutions, and world-views has begun, but has yet to be replaced.

Such intense periods of destruction and reconstruction, or liminality, eliminate boundary lines, reverse or dissolve social hierarchies, disrupt cultural continuity, and cast penetrating onto future outcomes. Originating in human ritual, liminal stages occur mid-transition, where initiates literally "stand at the threshold" between outmoded constructs of identity or community, and entirely new ways of being. In both contexts, disorder is the prerequisite for revolutionary change; only amidst the fluidity and malleability of chaos can truly novel ideas, practices,

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and foundations emerge and take hold.

At its best, design is directed by purpose and intention. It's becoming increasingly clear that to take substantive action in today's wicked problems and their broadly ataxic context, design thinking (Nelson & Stolterman, 2003)must be rooted in a deep understanding of systems and relationship. Furthermore, in light of apparently epidemic societal ambiguity, disorientation, and irrationality, also characteristic of liminal periods, design thinking is now under increasing pressure to develop improved judgement and decision-making strategies. As a result of its intrinsic reliance on heuristics (see below), human cognition is highly vulnerable to various biases that distort perception and reason in all dimensions of the design process. Thus, we refer to the unintended mismatch between desired and actual design outcomes as "design distortion," and propose Interliminal Design (ID) as both a mindset and methodology that can specifically address irrationality in design.

Personal cognitive systems

Cognitive heuristics are mental shortcuts adapted to enable rapid interpretation of the complex environment in which we evolved and currently live (Tversky & Kahneman, 1974). They are inherent, inevitable, and necessary, and have both individualized and universal characteristics. Importantly, they resist modification, i.e., require attention and energy to recognize and alter. Application of heuristics outside the appropriate context underlies systematic errors in human reasoning, and is termed cognitive bias. Design thinking on an individual level is vulnerable to unnoticed and unaddressed personal biases that can readily induce design distortion affecting multiple dimensions of an issue.

Structural systems

The physical design space and design team infrastructure, including interpersonal and group process navigation dynamics, are considered structural elements of design thinking. A balanced and well-functioning structural system intrinsically applies and perpetuates appropriate heuristic utilization, acting to minimize detrimental effects of cognitive bias. However, individuals in groups do not "average out" their personal biases; instead, biases common across individuals, as well as imbalanced or dysfunctional group dynamics, are typically negatively reinforcing, further distorting the process and outcomes. Thus, the collaborative group as a whole must also work to mitigate bias.

Built on the premise that every design task occurs within an evolving ecology of individuals and systems in both conscious and subconscious relationship, ID is particularly well-suited for complex and wicked problems. In such dynamic environments, learning, emergence and adaptation are frequent and nonlinear; thus, clear intention, flexibility and creativity can be maintained throughout the design process by compensating for the habits and cognitive tendencies that breed design distortion. Designers must exert continual effort toward recognition

and mitigation of individual biases, as well as awareness and counterbalance of structural biases when acting in collaborative groups. The multi-layered ID approach, integrating natural, social and political science perspectives with imagination and art, promotes emergence of the elegant, apperceptive designs needed to most effectively address complex and wicked problems.

As part of the elective curriculum in the Collaborative Design MFA program at Pacific Northwest College of Art, the authors developed and taught a course called Design Thinking and Cognitive Biases. Coursework was directed towards an exploration of the influence of heuristics and bias on design processes and outcomes. An additional goal was to formulate specific techniques that could readily illuminate personal and structural biases, thereby promoting the effective collaboration, process navigation, and enhanced awareness necessary to ultimately reduce design distortion. Students in the course identified two potentially effective approaches to mitigating cognitive bias in collaborative design. The Designer's Bias Lounge consisted of a physical space to hold constructive, interactive dialogues with fellow designers to facilitate challenging bias-related self-assessment and inquiry. As a student project, a board game, "BIAS!" was designed by and played in small design groups to increase knowledge and awareness of cognitive bias in the context of real world examples. For more information on these student projects and to download the BIAS! game board and rules, please see www.codepdx.com.

Common Heuristics and Biases

The following are several important cognitive heuristics and commonly associated biases. Design distortion arises from their unacknowledged or inappropriate use, while awareness facilitates intentional application that can be leveraged to improve design. Specific mitigation techniques are suggested, particularly in the context of collaboration and wicked problems, as well as points of inquiry to be asked throughout the design process at all levels, i.e., by individuals in personal reflection, between team members, and of the team as a whole.

The Framing Heuristic

The Framing Heuristic describes how the way in which a problem is presented determines the solution set generated; variations in the framing of options, e.g., in terms of gains or losses, yield systematically different preferences (Tversky & Kahneman, 1985).

Example

In response to a recent major flooding incident, a design team has been hired to address desertification of a large piece of rural land. Slightly more than half of the land is dedicated to agriculture and ranching, with the rest comprised of townships, recreational, and open space. As part of the initial design brief, a key stakeholder presents to the team a detailed description of ranching activity over the last several years, including economic returns, ecological impact on local flora

and fauna, and water utilization. No background information on the other land uses was provided. After the brief, the team begins to map out a strategy for reducing livestock numbers.

Biases

- *Observer-expectancy bias:* Expectations of a given result unconsciously manipulate or sway the collection or misinterpretation of data.
- *Functional fixedness:* Perception of an object or situation is restricted to the traditional, conventional, typical, or cliche.

Mitigation

- Generate a "wide-cast" list of possible frames at the initial design brief, including extremes. Refer to, and expand, this list throughout the design process. If conditions have changed, make an entirely new list.
- Revisit the chosen frame at each decision point, and modify according to the most current conditions.
- Step back, figuratively and literally, from the design challenge as it's currently conceived. Repeat this at least once; several repetitions can drastically reduce cognitive myopia or scotoma (blind spot), and promote epiphany.

Questions to Ask

How could the issue be framed more neutrally? Or be asked as to invite surprise? Is the question (still) as open as it could be?

Availability or Exposure Heuristics

The Availability Heuristic, sometimes termed the "Mere Exposure Effect", describes the way in which the frequency or probability of something is judged by the ease with which it comes to mind. Not only probability, but also the acceptance, trust, or agreement, e.g., a piece of information, that results from repeated exposure, regardless of accuracy or actual net utility (Schwarz, Bless, Strack, & Klumppłdots, 1991; Tversky & Kahneman, 1973).

Example

On Oct 1, 2013, the US national health care system opened for online enrollment. Within minutes, large system failures became obvious, as almost none of the tens of thousands of people who attempted to enroll could successfully complete the procedure. In the following days the system was widely condemned by media and the President for its inability to handle such a high flow of traffic. Initial redesign efforts were directed toward the development of high-flow software systems. A Federal government investigation has since revealed that the system contains several major glitches, none of which affected its function during high traffic flows.

Biases

- *Herding bias:* Adoption of those opinions, beliefs, or behaviors held by the perceived majority, or faction with large numbers, high status, or salient influence. Also referred to as *norming*, *group-think*, or *bandwagon effect*.
- *Recency bias:* Overweighting recent events relative to earlier events.
- *Confirmation bias:* The tendency to search for, interpret, and remember information that confirms preconceptions or existing beliefs.
- *Attentional bias:* The neglect of relevant data in favor of dominant environmental stimuli. Information that is sensorially vivid, unusual, or emotionally charged is usually disproportionately influential.
- *Observational selection bias:* Erroneously judging that the frequency of an event has increased when it is actually the frequency of noticing the event that has increased.

Mitigation

- Use multiple, diverse information-gathering techniques
- Invite the user to participate directly in the design conversation or process
- Perform a group role exchange exercise, e.g., Red Team-Blue Team[4]
- Construct a genuine argument directly opposed to the preferred stance/opinion

Questions to Ask

What is the source of the information? What motivation(s) might be at play? What first-hand experience do I/you/we have? Where can more evidence be found to verify or refute it?

Anchoring and Adjustment Heuristic

The Anchoring and Adjustment Heuristic is the unconscious fixation or attachment on and subsequent adjustment toward a reference point ("anchor"). This is an exceptionally robust and pervasive phenomenon, occurring independently of the relevance of the anchor or expertise of persons involved. It is also highly resistant to temporal dilution and direct attempts at correction through explicit descriptions of the effect or how to avoid it (Tversky & Kahneman, 1974).

Example

A designer is asked to estimate the time required to complete a new project. She has some experience with similar projects and knows approximately how long

[4] A contrarian, two-phase method for modeling multiple approaches to solving a problem. In the first phase, two (or more) teams each analyze the problem, deliberately adopting opposing viewpoints. In the second phase, the relative merits of each proposal are openly debated.

each phase of a project typically takes, though this project is in a new city. In order to prepare a rough estimate, she adds together the typical times required for each phase, and then adds a "fudge-factor" to account for unexpected delays. When the project undertaken, it turns out that the project required twice as much time as anticipated.

Biases

- *Conservatism bias:* Insufficient weighting of new evidence in favor of general statistical information.
- *Status quo bias:* Over-reliance on the current protocol or conditions, or overvaluing what has been done or worked in the past. Related to loss aversion, endowment effect, system justification, and resistance to change.
- *Planning fallacy:* The tendency of even experienced project planners to underestimate the duration of projects.

Mitigation

- Demonstrate the phenomenon, e.g., the Stanford random number exercise(Mussweiler, Englich, & Strack, 2004)[5]
- Practices that expand perception and creativity, e.g., mindfulness
- Ethnographic research
- Systems/relationship analysis, i.e., causal loop modeling, to facilitate recognition of underlying patterns or previous unknowns

Questions To Ask

What am I/you/we certain of and how do we know this is true? What is not known? What might we not yet know that we don't know, i.e., unknown unknowns? Why am I/you/we choosing this answer/direction/decision? (repeat at least 3 times on each answer/direction/decision).

Representativeness or Attribute Substitution Heuristics

The Attribute Substitution Heuristic is defined as judging the probability or likelihood of something based on preconceived prototypes or representative entities, or the replacement of an attribute or question that is computationally complex with another that is judged or answered more easily (Kahneman & Frederick, 2002).

Example

The 2010 Haitian earthquake caused massive destruction and fatalities. Incredibly, an even more severe disaster ensued during reparation efforts, as an outbreak of cholera rapidly became epidemic, killing several times more citizens than the earthquake itself. Although previous natural disasters were almost

[5] The Standford exercise consists of assigning random high numbers to one group and low numbers to another group, then asking for estimates of an unrelated and probably unknown fact, such as the number of countries in Africa. Typically, the high number group responses will average higher than the low number group responses, demonstrating anchoring and adjustment.

ubiquitously associated with similar outbreaks, cholera had not been seen in Haiti during the prior century; thus, no preventative efforts were made.

Biases

- *Base rate neglect:* Overweighting new evidence at the expense of acknowledging general frequencies, i.e., failing to incorporate statistical information (base rates).
- *Gambler's fallacy:* The erroneous reasoning that previous events have an influence on the likelihood of future events.
- *Projection/false consensus bias:* The assumption that others share your thoughts, feelings, or beliefs, or that we accurately know these about others. Also refers to the overestimation bias that is very common.

Mitigation

- Intentionally employ the anchoring and adjustment heuristic
- Perform a group role exchange exercise, e.g., Red Team-Blue Team*
- Construct a genuine argument directly opposed to the preferred stance/opinion
- Careful, neutral, focused listening
- Reflective communication skills, i.e., confirmation that what was heard accurately reflects what was meant

Questions To Ask

What stereotypes or archetypes (people or situations) are involved? What assumptions am I/you/we making based on these? What evidence supports or refutes these assumptions? What are other possible explanations? Do I understand you correctly? (then repeat back your understanding)

Affect Heuristic

Strong emotions have a tendency to unduly influence, and often override, neutral or evidence-based consideration. This is termed the Affect Heuristic. Due to the involvement of deep, primal, and unconscious nervous system functions required for survival, the resultant attachment or aversion is associated with varying degrees of physiological arousal (Slovic, Finucane, & Petersłdots, 2007).

Example

An enthusiastic group of MFA students in design is asked by the county to consult on redrawing boundary lines to improve funding dispersal for public schools in an economically disadvantaged area. Although the team members come from backgrounds of relative economic privilege, they are passionately dedicated to equity, education, and diversity, and excited by the opportunity to make real progress on these critical social issues.

Biases

- *In-group bias:* Overestimating the abilities, opinions, values of the identified social group at the expense of those perceived as outside.
- *Negativity effect:* Overweighting the importance or accuracy of "bad news," i.e., information that evokes discouragement, fear, sadness, or other "negative" emotions. This tendency is thought to provide an evolutionary survival advantage, affording increased vigilance and protection from threat.

Mitigation

- Team diversity; members of varying backgrounds/expertise will unlikely hold the same attachments. Consider incorporating into design teams at least one member with the following strengths: 1) subject matter knowledge + openness to challenge/argument, 2) technology specialist, 3) devil's advocate, 4) aesthetics/artistry, 5) cognition/psychology, 6) systems/big picture thinking + futurist tendencies.
- Work from interests rather than positions/titles, particularly when multiple stakeholders are involved.
- Invite an entirely neutral party into the discussion and solicit frequent feedback.

Questions To Ask

What emotions (or physiological sensations) do I/you/we have regarding the design challenge or proposed course of action? Where/when does insistence, resistance, anger, or discomfort arise? Elation, exuberance, excitement? What viewpoint(s) is not represented?

Temporal (Hyperbolic) Discounting

Individuals, depending on their backgrounds, tend to value immediate payoffs more than delayed payoffs, and more than is accounted for by a logarithmic discount curve; in addition, increasing proximity of both payoffs to the present enhances the effect (Strotz, 1955).

Example

There is a vast array of data indicating that cigarette are carcinogenic. However, cigarette smoking is the cause of 1 in 5 deaths per year in the United States alone. A design firm is retained by the Department of Health to devise a public service announcement campaign to help reduce smoking, and thereby decrease the incidence of cancers and death due to smoking, and the attendant medical costs. To meet this challenge, the designers must understand why smokers continue to smoke despite knowing the health effects. Smokers tend to make statements such as, "Not everyone gets cancer." or "I will quit eventually."

Biases

- *Remoteness of impact bias:* Discounting the impact or consequences of future events. Increasing the time and/or space between an action and its consequences decreases the motivation to perform a different action.
- *Optimism bias:* Overestimating the likelihood of encountering future positive events, and underestimating future negative events.

Mitigation

- Emergent maps of the adjacent possible
- Scenario planning
- Rapid prototyping
- Calculating and building in a optimism bias factor

Questions To Ask

What are the main drivers or leverage points of the primary system(s) in question? What are the possible outcomes of altering these drivers? What are the worst outcomes we can imagine, i.e., what would complete failure of the design look like?

Interliminal Design Model

A conceptual model of ID is shown in Figure1. Arrows emphasize the multidirectional, non-linear flux that occurs within the space between systems, nodes, and boundaries.

ID leverages several critical aspects of a systems approach to design, and makes explicit the knowledge that biases exist on multiple levels, must be actively mitigated, and are magnified in group settings. Bias mitigation can act on both personal and structural systems. Personal bias mitigation comes through the active practice of intentional methods to enhance the accessibility of deliberate and corrective thought processes. Structural bias mitigation addresses how the system operates on processes, ideas and knowledge, specifically through group collaboration. Collaboration and systems thinking are in vogue among designers; with intention, they can be used to mitigate bias.

Effective collaboration and process navigation are key structural elements that can be leveraged to reduce cognitive bias-induced design distortion. A collaborative Do it Together (DIT), vs DIY, mindset is marked by seven key qualities: 1) mutual respect, 2) receptive listening, 3) diversity, 4) equality, 5) generosity, 6) flexibility of mind, and 7) humility. Skillful process navigation embraces a non-linear approach that can be conceptualized as an agile flow between members and design actions. Each design iteration represents the confluence of each individual's current perspective with the new perspective that emerges from the interaction of individuals.

Conclusion

Interliminal Design illuminates cognitive heuristics and biases, and can significantly improve intention, decision-making, and outcomes in design. Those revealed as inappropriate for the design goals can then be compensated for, optimal cognitive model or analysis technique. This inquiry-driven approach furthers the evolution of design thinking by adding a metacognitive dimension, i.e., thinking about design thinking. The increased accessibility of corrective or rational thought, and the resulting ability to flexibly shift between perspectives and states, is a potent tool for reducing the distortion of both individual and collaborative design processes.

> **"... it would be wrong to conclude...that having biases, values and interests is an impediment to sound reasoning that we'd be better off without. It is one of the conditions of human being, after all, that we care about things and that caring colors our attempts at logical judgment. It is just something that always needs to be taken into account when the stakes are high and we are not, as we so rarely are, entirely detached from a problem or situation." - Alva Noe, PhD**

Figures

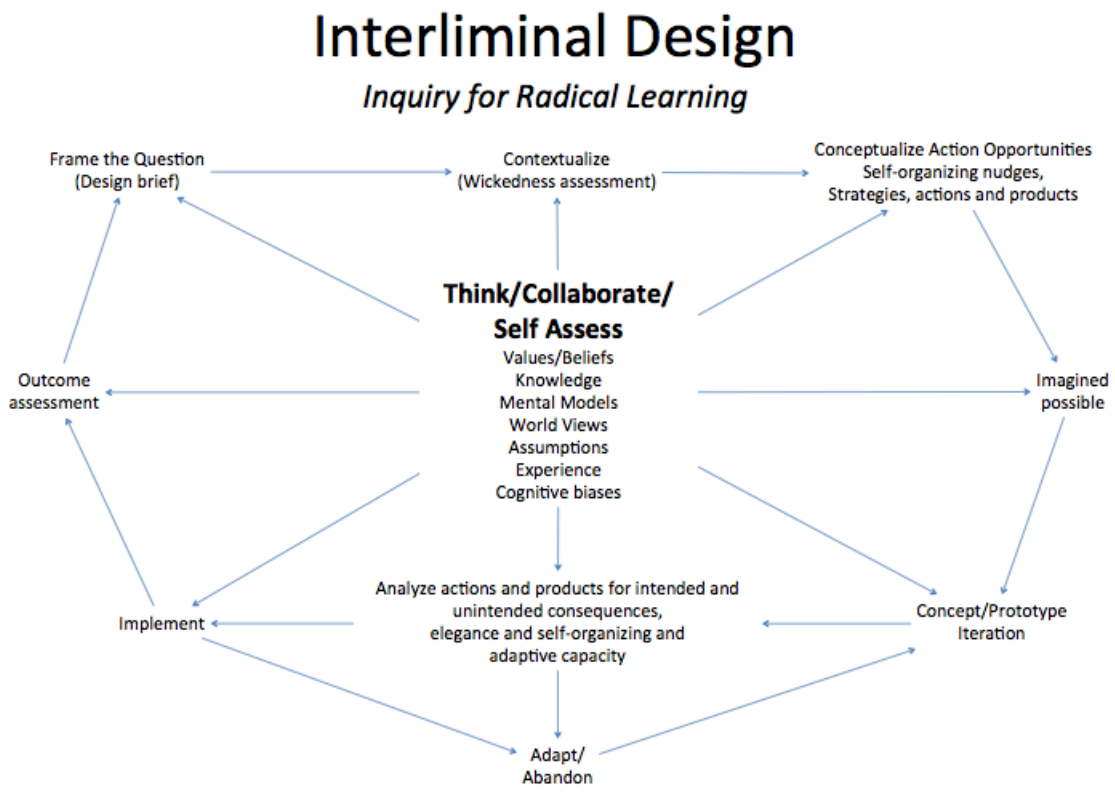

Figure 1. A flow model of the elements central to Interliminal Design

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