The Design of Everyday Things
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Chapter 1: The Psychopathology of Everyday Things

- 2 of the most important characteristics of good design:
  - discoverability: can we figure out what actions are possible and how and where to perform them?
  - understanding: what does it all mean? how is the product supposed to be used?
- Engineers are trained to think logically and therefore impose such logics into their designs. Users -- a.k.a humans -- are not always logical. We're imaginative and creative creatures who are not trained to read the manuals the engineers hoped we had. It's important to design for the users' mind, not the engineers'
  - Machines, software, technology, etc are orderly, static, and logical. People are not
- Human-centered design (HCD), a design philosophy that puts human needs, capabilities, and behavior first, then design to accommodate them
- Discoverability results from appropriate application of 5 fundamental psychological concepts:
  - Affordances
    - A relationship between an object and a person that helps him/her know what to do or how to interact with the object
    - Note that this is a relationship, not a property
    - Ex: door knobs afford turning, pushing, and pulling. Slots are for inserting things into, etc
  - Signifiers
    - Affordances determine what actions are possible, but signifiers communicate where the action should take place
    - When external signifiers have to be added to something so simple (like doors), it's a bad design
    - Affordances can be ambiguous, but signifiers must be perceivable, else they fail to function
  - Constraints
  - Mappings
    - Spatial correspondence between the controls and the items being controlled
    - Use natural mappings for best results. For example, it is very natural to intensify something by raising it up in a vertical direction
  - Feedbacks
    - Must be immediate, or else it'll cause unpleasantness
    - Bad feedbacks are worse than no feedback at all
    - Feedback should be prioritized in level of importance and should not be too obtrusive or annoying
- The conceptual models/ Mental models
  - An explanation, often highly simplified, of how something works. It doesn't need to be complete as long as it is useful
  - Design that creates false conceptual models can cause a lot of confusions and unexpected behaviors
  - Mental models depend on how much information is given to the users and their personal experiences
  - Good conceptual models are the key to understandable and enjoyable products. Good communication is the key to good conceptual models

Chapter 2: The Psychology of Everyday Actions

- When people interact with anything, they are faced with 2 gulfs
    - Gulf of interaction
        - Figuring out what operations to do
        - Designers bridge this gulf with mappings, constraints, and a conceptual model
    - Gulf of evaluation
        - Figuring out what happened because of the operations
        - Designers bridge this gulf with feedback and conceptual models
- There are 2 parts to an action:
    - Executing
        - Requires understanding of how the item works
        - 3 stages:
            - Plan, Specify, Perform
            - These become subconscious when the person becomes skilled
    - Evaluation
        - Requires understanding of what it produces
        - 3 stages: Perceive, Interpret, Compare
- Most innovation is done as an incremental enhancement of existing products. Radical ideas come about by reconsidering the goals and always asking what the real goal is
    - Ex: when people go buy a quarter-inch drill, that's not really what they want — they want a quarter-inch hole. But that's not deep enough; they actually want to use the hole to hang a bookshelves on. A radical idea would challenge this goal: do you really need a hole? What if you can design a bookshelves that can just be attached without holes. Then you wouldn't need the drill. What if books don't need to be shelved (Kindle)? Then you don't really need a shelf at all
- Most of human behaviors are subconscious. That's why we don't always know or understand ourselves even though we think we do. An illustration:
    - You immediately know the answer to these questions or immediately know that you don't know the answer. This is because of declarative memory. You don't remember how you know or don't know the answers — you just do.
        - What's your friend's phone number? What's Mozart's?
        - Capital of U.S? Of Brazil? Ethiopia?
- You take a lot longer for this:
    - In the house you lived in 3 places ago, was the door knob on the left or right of the front door? This is procedural memory
- Thought cannot be separated from emotions. Our subconscious drives most of our decision making based on past experiences. It's good at recognizing patterns that fit our survival. Our conscious mind provide us with logic and facts to justify the reasons to ourselves and others
- Cognition and emotion are modeled in 3 levels of processing:
    - Visceral
        - "The lizard brain", responsible for unconscious fight or flight decisions and reflexes
        - Tight with muscular motors, hence visceral responses are quick and unconscious
        - Doesn't have direct correlation to how pleasant a product is, but great designers know how to use aesthetics to invoke positive visceral responses
    - Behavioral
        - The conscious mind achieves learned-tasks automatically. You don't think about how to do a well-learned task, like picking up a cup. You think of a goal and your hand and fingers automatically adjust
        - Great designs fulfill users' behavioral expectations in the form of quick feedbacks
    - Reflective

- The after feelings and reflection on something that already happened
- Often a slow and thoughtful process

- People are natural story tellers; our brains creatively generate theories to explain phenomenons that we don't understand. For example, when you want the thermostat or the oven to reach a certain temperature, do you turn the knob to maximum to speed up the process? That is a false conceptual model that our brains paint up since we don't have enough external information or feedback from the oven or thermostat. Our brains try to rationalize a theory, but that's now how heaters or ovens work: they're either on or off, no in-between. They turn on until the set temperature is set and off when that happens
- Learned helplessness: when a series of non-causal, succeeding events that make a person believe he/she is to blame for the inability to use a piece of technology. This is often because of a bad design rather than the user's idioticity. But they perceive their actions and the results (or lack there of) to be causal, resulting in a self-fulfilling prophecy
- 7 stages of action lead to 7 design principles:
    - Discoverability: what are possible and what state am I in
    - Feedback
    - Conceptual model
    - Affordances
    - Signifiers
    - Mappings
    - Constraints

Chapter 3: Knowledge in the Head and in the World

- Everyday we encounter countless interfaces and devices with very incomplete or even sometimes incorrect knowledge, but we still manage. The combined knowledge in the head and in the world help us get through a lot of precise tasks without precise knowledge. Do you precisely remember how a U.S. penny looks like? You don't have to precisely remember its appearance in order to correctly use it
- Precise behaviors can emerge from imprecise knowledge because
    - Knowledge is both in the head and in the world: combining what you know and your interpretation of the information presented in the world
    - Great precision is not required
    - Natural constraints exist in the world
    - Knowledge of cultural constants and conventions exists in the head
- Although it is best when people have considerable knowledge and experience using a particular product — knowledge in the head (or knowledge stored in memory) — the designer can put sufficient cues into the designs — knowledge in the world — that good performance results even in the absence of previous knowledge
- There are a lot of knowledge in the world and the amount we need to learn to operate is very minimal. We only need to remember sufficient knowledge (a very tiny subset of everything there is to learn) to get our tasks done
- People function through 2 kinds of knowledge:
    - Declarative knowledge — knowledge of
        - Ex: stop at red lights, NY is north of Rome, China has twice as many people as India
        - Just because people possess declarative knowledge doesn't mean they will obey them or the knowledge is true. A lot of people still run red lights. NY is actually South of Rome and China only has about 10% more people than India. The point is declarative knowledge is easy to write and teach
    - Procedural knowledge — knowledge how
        - Ex: return a tennis serve, play Beethoven's Sonata No. 17

        - Impossible or difficult to write down or teach — it is best learned through years of practice
        - Procedural knowledge is largely subconscious, residing a the behavioral level of processing
- Sufficient knowledge can only get us through as long as the knowledge in the world doesn't render them insufficient. Remember the Susan B. Anthony one-dollar coins? People were confused as hell because that one-dollar coins look very similar to the existing coins. Then how come we're not confused by the dollar bills? Humans look for distinguishing features. For coins, they look for colors and sizes to distinguish, explaining why the Susan B. Anthony one-dollar coin was a bad idea. But for our dollar bills, we know that they are all identical in size, so the distinguishing factor would be the image and the number on the corner.
- When the rules for discrimination (distinguishing) in the world change, people can become confused and make errors. Good products can fail and bad ones can succeed. The world is weird and complex
- Constraints simplify memory
- Short term memory (STM) or working memory helps retain small bits of information for a short amount of time unless the person is distracted. Make sure your design takes this into account
    - Ex: a nurse tries to input patients' sensitive medical records into a computer system but is often interrupted with questions, so she writes the information down on her hand before the computer locks her out, hoping to protect the patients' privacy
    - Use visual, auditorial, touch (haptic) cues to aid with STM retrieval. Make your design easy to serve as a STM dump
- Long term memory (LTM) are not exact recordings of any event or experience. Rather, LTM is a re-interpretation of distorted bits of the original experience
- It's best for the design to not require any toll on LTM or STM. Provide a structure with functional constraints, good natural mappings, and instantaneous feedback. The best way to help people remember is to make it unnecessary
- Experts at a skilled behavior have minimized the amount of conscious reasoning required to accomplish a task. To simplify your thinking, consider approximate models:
    - Convert Fahrenheit to Celsius: subtract 30 then divide by 2. Technically incorrect, but good enough to decide whether to wear a sweater
- Knowledge in the head requires you to store and retrieve them, which might require a considerable amount of learning. Knowledge in the world requires no learning, but can be more difficult to use and usually depends heavily upon the continued physical presence of the knowledge
    - Design with "out of sight, out of mind" in mind
- Mappings
    - Best: controls mounted directly on the item to be controlled
    - Second-best: as close as possible to the object being controlled
    - Third: arranged in the same spatial configuration as the objects to be controlled
- Different cultures can dictate the mappings of many interfaces. For example, a 2-button Keynote controller, 1 top and 1 bottom, which one advances the Keynote? It depends on the person's perspective of how the future is mentally drawn. To some, the future is a mental road where you're moving on the road toward the future. To others, you're static on the road and the road is moving toward you. To people with right-to-left writing systems like Arabic or Hebrew, the future advances left. To those who speak English, the future advances right
- What is "natural" depends on the point of view, and therefore, on the culture

Chapter 4: Knowing What to Do: Constraints, Discoverability, and Feedback

- We use constraints to figure out how to interact with things we have never seen before

- 4 types of constraints:
    - Physical
        - With enough physical limitations, people can figure out what to do and what not to do with objects
        - Ex: 9V batteries won't physically fit into cylindrical AA batteries slots
        - Physical constraints are great when they are easy to see and interpret
        - Legacy problem: features/characteristics that have been so deeply baked into so many products, making improvements difficult and costly
            - Ex: orientation-less batteries - great idea but would require all the existing slots to change
            - Keys and locks: we don't really need them. We only need a mechanism to control access, but it'd take a lot to change them
    - Cultural
        - Likely to change with times
        - How we know how to behave in a restaurant we have never been to before or know to pause at red signals
    - Semantic
        - Semantic is the study of meaning; relies on our knowledge of the situation and the world
            - Ex: Wind shields should be in the front and brake lights in the back
        - Like cultural constraints, semantic constraints will change too. When vehicles become fully autonomous, why would we even need brake lights?
    - Logical
- Breaking any constraints, especially cultural ones, will render you as an outsider
- Constraints that force desired behaviors
    - Forcing functions: inserting and turning the car key to ignite the engine
    - Interlocks: preventive mechanisms like shutting down electric power when microwave's door opens, foot on the brake before switching from Park position
    - Lock-ins: a mechanism that keeps an operation from exiting preemptively. Things like "save before exiting?" or a manufacturer creating a suite of products that are so good and intuitive to use that once users grow accustomed to the system, they hesitate to switch to the competition
    - Lock-outs: a mechanism that prevents an operation from happening, often for safety purposes. Ex: a gate preventing people from running downstair to the basement in case of occasional hazards, but not enough of a nuisance that people can't get to the basement in normal day-to-day use cases, incentivizing them to prop open the gate, hence negating its intended purpose
- Convention is a special kind of cultural constraint. New ideas are hard to adapt because it is the change that is upsetting, not its merits
    - Ex: destination control elevators are efficient, but horrifying to first time users
    - Ex: Liberia, Myanmar, and the U.S are the only 3 countries not using the metric system
    - If the merits of a change outweigh the cost and pain of implementing it, then everyone should change. Otherwise consistency is preferred. Just because something is different doesn't mean it's bad

Chapter 5: Human Error? No, Bad Design

- Errors occur because people have to do things unnaturally. When accidents happen, we punish and hold people accountable. We train or jail them. Then we feel good because we caught the "culprits". This won't cure the problem; we need to redesign
- Root cause analysis: don't stop at identifying the human error - find out what led to that error

as well

- 5-why's is a method that helps identifying root cause. Keep asking Why's until root cause is determined. Not guaranteed but will get you close
- People hesitate to even recognize a design change is needed because it often requires a lot of time and resources. You sometimes even need to change a whole culture to adapt to the redesign
- Human errors are categorized into 2 forms:
    - Slips
        - Occur when the goal is right, but the execution is flawed
        - Action-based: wrong action is performed
            - Ex: poured milk into coffee mug and then put the mug into the fridge instead of the milk
        - Memory-lapses: memory fails so the intended action is not done or its results not evaluated
            - Ex: forget to turn off gas burner on the stove after cooking
    - Mistakes
        - Occur when the goal and/or plans are flawed
        - Rule-based
        - Knowledge-based
        - Memory lapses
- Design for errors
    - Add constraints to block errors
    - Allow undo options
    - Display confirmation and error messages
- The Swiss cheese model of how errors lead to accidents
    - A metaphor in which each slice of cheese represents a condition in task being done and an accident can happen only if holes in all slices are lined up just right
    - Then, by the same analogy, to avoid errors:
        - Add more slices of cheese
        - Reduce the number of holes or make them smaller
        - Alert a human operators when several holes have lined up

Chapter 6: Design Thinking

- Never solve a problem that you are asked to solve because more often than not, that isn't the real, the root, or the fundamental problem
- Engineers and businesspeople are trained to solve problems. Designers are trained to discover the problems. Solutions to the wrong problem is worse than no solution at all
- Design thinking: don't start looking for solutions until you have truly discovered the problem. Then, consider a wide range of creative options
- Double diamond model of design: discover (divergence of the problem), define (convergence of the problem), develop (divergence of solutions), and deliver (convergence of solutions)
- HCD Process
    - Observation
        - Not similar to scientific observations which try to find new natural laws
        - Observe potential customers in potential environments
        - Make sure the environment is natural -- applied ethnography
        - Design wants to know what people really need and how they actually will use the product or service under consideration
        - Marketing wants to know what people will buy, which includes learning how they make purchasing decisions

    - Idea generation (ideation)
        - Generate numerous ideas
        - Be creative without regard for constraints
        - Question everything
    - Prototyping
    - Testing
        - 5 is the magic number when it comes to how many subjects you should at least test prototypes on
- Activity centered design
    - The only way to satisfy the masses is to focus on the activity they're trying to accomplish, not the individuals
    - The reason why Apple's iPod is so successful is because it encompasses the entire activity of "enjoying music". From discovering music, purchasing music to developing sharable playlists to actually getting the sound to your ears via whatever accessories Apple chooses
    - In practice there are only 2 drivers of new products:
        - Adding features to match the competition
        - Adding some feature driven by a new technology
        - Very typical in market-driven companies
    - Don Norman's law of product development
        - The day a product development process starts, it is behind schedule and above budget
        - Design is hard work and there will always be excuses to do it right the next time
    - Complexity is good; it's the confusion that is bad
    - Design is a marvelous discipline, bringing together technology and people, business and politics, culture and commerce. Designers must always keep foremost in mind that the products are to be used by people

Chapter 7: Design in the World of Business

- In the real world, constraints are conflicting and it's almost impossible to follow HCD strictly. Compromise where you can but don't fall for featuritis
- Featuritis is a "disease" in which designers feel the urge and pressure to add new features to keep customers interested, drive profits, or beat competitions. Eventually the products will be bloated with features
    - Technology will be the main driving force that will fuel featuritis. It can be for the better or for worse
- Apple bought Fingerworks, a startup that was about to die and whose multitouch technology powered much of Apple's products. It took more than 3 decades for touch control to become natural for people
- Innovations come in 2 flavors: incremental and radical. The former is just as important as the latter, yet is often overlooked. Technology changes fast but cultures take time to adopt it. It's the incremental innovations - the "minor improvements" - that normalize innovations