momentum × HTEC GROUP

Rethinking Jobs to Be Done for the AI Era: A Cognitive Design Approach

November 10, 2023

David Thomson, CEO of Momentum Design Lab
Sava Marinkovich, Head of Healthtech at HTEC Group
Joe Preston, Vice President of Product & Design at Intuit

Momentum Design Lab, an HTEC Group company - Silicon Valley + NYC + London
300 8th Ave Suite 200, San Mateo, CA 94401

Introduction

> Designer: An individual or a team responsible for envisioning and shaping the form, function, and experience of a product, system, or solution.

At Momentum, we believe in the power of marrying traditional design thinking with the emerging potential of Cognitive Design.

Our approach seamlessly blends artificial intelligence (AI) techniques with innate human capacities like memory, creativity, and learning. The aim is to create intuitive experiences that align with the thought processes of the user. By moving beyond surface-level tasks, such as a worker following a pre-determined process, we tap into core cognitive mechanics that will optimize AI to bolster human strengths.

Artificial intelligence is a fast-paced world where adaptability is key. That's why our Cognitive Design methodology builds upon classic, time-tested design principles to drive innovation. We view it not as a replacement, but as an evolution — one that furthers our commitment to human-centric solutions.

As AI systems evolve, they present new possibilities to augment human cognition by addressing the user's cognitive needs precisely when and where they emerge. That means prevailing design frameworks like Jobs to Be Done must now adapt. Although the Jobs-to-Be-Done framework provides valuable surface-level insights, it often overlooks the deeper cognitive processes in which AI can truly assist.

This is where the concept of "Cognitive Jobs" comes into play. Cognitive Jobs reveal opportunities for AI to strengthen human cognition through the identification of tasks that happen beneath our conscious awareness.

Understanding these hidden tasks requires innovative research approaches that highlight moments of cognitive struggle. Once identified, designers can prioritize the delivery of targeted support within the user's natural context. As we focus on AI cognition, it is vital that we invent new, human-centric design paradigms that can transcend mere updates to existing, inefficient frameworks.

Cognitive interviews, walkthroughs, and similar techniques become indispensable tools for mapping these tasks as they manifest in real-world situations. As a consequence, we can design AI systems that proactively engage deeper cognitive tasks to support users without disruption.

In this white paper, we will explore:

- The limitations of the surface-level Jobs-to-Be-Done framework in the AI era.
- Innovative user research techniques that uncover hidden cognitive tasks.
- AI design principles that harmonize with human cognition.
- The imperative of Cognitive Design for the future of human-AI interactions.

By adopting a Cognitive Jobs perspective, we can launch a new era of AI that feels not just natural, but human. Let's begin our journey.

The Limits of Surface-Level Jobs in AI

Jobs to Be Done has traditionally focused on the tangible, physical activities and outcomes that customers seek. For a ridesharing app, the job might be “reach a destination on time.” For a messaging platform, it could be “facilitate synchronous and asynchronous communications with connections.” But as AI grows more advanced, these surface-level jobs provide an incomplete view of true user needs.

For example, a surface-level analysis of an AI legal research assistant’s role might indicate that their job is to find relevant case law documents. This type of job is centered around pattern recognition. Pattern recognition is a cognitive function in which AI-based neural networks surpassed humans a decade ago, and it is nearly impossible for humans given the scope of the data set to be reviewed.

Advancements in large, AI-based language models can broaden and deepen the analysis of surface-level pattern and anomaly-detection job. In addition to finding relevant case law, AI now enables a more sophisticated Cognitive Job: assisting lawyers with the construction of mental models that will not only interpret the law, but also propose new legal arguments that are more persuasive and compelling.

We can even consider examples from creatives fields, such as music. Generative music AI can use the Cognitive Jobs approach to enable much more than song composition. It could help creators discover new musical possibilities and directions. For example, generative music AI can accelerate the task of adapting new musical arrangements for orchestras.

In other words, AI has the potential to enhance invisible, yet vital cognitive processes — how we think, reason, synthesize information, generate ideas, and make decisions. Limiting our focus to

surface-level jobs would miss this enormous opportunity to design better AI that can improve upon human cognition.

Limitation 1: Task-Focused Lens

Jobs to Be Done (JTBD) emerged from the work of Harvard Business School professor Clayton Christensen. In his groundbreaking book “The Innovator’s Solution,” Christensen describes how “customers buy products and services to get a job done.” This spawned JTBD’s core premise, which is that people “hire” products to achieve functional goals and satisfy emotional needs.

Christensen is an advocate for the study of customers in their personal contexts: watching their actions and understanding their motivations. But the types of questions that JTBD researchers ask often prioritize concrete tasks and outcomes.

For a product aimed at home cooks, JTBD researchers may ask:

- What are you trying to accomplish when cooking a meal?
- What steps do you take to cook a certain dish?
- What challenges do you face in meal preparation?

These are useful questions for identifying surface-level jobs. Nevertheless, they neglect the underlying cognitive processes that cooking involves. How does a home cook diagnose issues and debug errors? What strategies do they use when combining ingredients and flavors? What mental models do they form in their use of techniques and recipes? A task-focused view overlooks these critical Cognitive Jobs.

JTBD also centers on the idea of progress, such as helping users achieve goals and complete tasks with greater ease. This fails to capture how some of the most powerful Cognitive Jobs do not center progress whatsoever. Rather, they involve discovery, creativity, iteration, and open-ended exploration. An AI assistant that can provide factual answers to questions makes research more efficient. But an AI assistant that can help users synthesize, conceptualize, and arrive at new insights fosters creativity.

In short, the traditional Jobs to Be Done theory adopts a production-focused, task-driven lens. It overlooks opportunities in which AI can spark, as well as optimize new ideas, rather than simply streamline existing processes.

Limitation 2: Narrow View of "Job"

When it comes to AI, JTBD’s definition of "job" is too narrow. JTBD theory conceptualizes a job as the progress that users want to make in a given circumstance. Here, a “circumstance” is the situation that arises in a user’s life, while a “job” is the user’s desired outcome.

This is a paradigm steeped in situational and historical context, but it lacks much of the deeper cognitive context found within a user's mind. The JTBD theoretical approach emphasizes the job as a sequential set of decisions and tasks. Meanwhile, it glosses over the complex set of non-linear mental processes that are necessary to achieve that job.

For example, when a bartender mixes a drink, they appear to have the straightforward job of preparing a cocktail. A surface-level understanding of the bartender's role seemingly involves the successful execution of a series of tasks. But context reveals that at a cognitive level, far more is happening:

- Recalling drink recipes and ingredient combinations.
- Adapting recipes based on available supplies.
- Intuitively experimenting with new drink ideas.
- Educating customers and making recommendations.
- Assessing customer reactions and optimizing future drinks.
- Entertaining interesting conversations with people at the bar.

Identifying the bartender's cocktail-preparation job only scratches the surface. It exposes little about how the bartender actually mobilizes knowledge, improvises recipes, interacts with customers, or uses recall and precision to learn from experience. These Cognitive Jobs represent some of the ripest opportunities for AI augmentation. Unfortunately, JTBD's narrow concept of the "job" misses them.

Consider how an AI-augmented product could use anticipated traffic and sell patterns to proactively notify the bartender when products will run out. It could provide a list of daily conversation topics to explore with the bar's patrons, or even suggest new drinks based on what's popular at other bars around the world.

Limitation 3: Job vs. Solution Focus

A core tenet of JTBD is to focus on the job, separate from any solutions. Researchers are advised not to ask, "What do you need?" but rather, "What are you trying to accomplish?" In theory, this strategy prevents solutions from limiting ideas about what jobs users might want done.

However, in the context of AI, separating a job from its solutions can constrain the creative process. For some fields and problem spaces, the optimal solution is derived through broad exploration. This broad exploration of often alternative or opposing ideas may be limited by a single human's finite capacity. AI-assisted exploration can help remove biases, broaden perspectives, and avoid premature focus on a single solution.

We have already witnessed the rapid advancement of numerous AI models that generate quicker, higher-quality solutions, thereby outperforming our human ability to go broad. Thanks to this efficiency of scale, we're now seeing the process of hidden cognitive functions — like

“brainstorming” — being outsourced to AI models across a variety of mediums and applications. We find opportunities not by removing AI from the picture, but imagining how AI could assist the user in new ways.

For instance, asking a designer about their job without considering AI may not uncover Cognitive Jobs like:

- Enhancing imagination through rapidly visualizing new concepts.
- Uncovering new data, patterns, or anomalies, which could lead to “insights” that prompt strategic shifts.
- Discovering novel design elements and compositions using AI.
- Gaining feedback by using AI to critique designs and suggest improvements.

Combining human creativity with generative AI diffusion makes certain Cognitive Jobs invisible — unless we connect the dots between jobs and solutions. This requires us to expose all elements of the creative problem-solving process as jobs unto themselves, for which AI is becoming increasingly well suited. JTBD’s strict insistence that researchers should separate the two is why it often overlooks opportunities for how generative AI could collaborate with the user.

Limitation 4: Threat to Identity and Assumed Roles

Jobs to Be Done focuses on the functional tasks and activities that people perform in set roles and careers. However, our identities are largely tied to socially constructed notions of our professional roles.

We can better understand how humans perceive their jobs, and the tasks within those jobs, by looking at the historical context upon which they’re based. Generational and familial knowledge is both explicitly and implicitly passed on to the next generation through a variety of mechanisms.

All of us grew up familiar with the long-established archetypes of the proverbial family business. The shoemaker, whose father was a shoemaker, and whose father’s father was a shoemaker — and so forth and so on. Every apprenticeship brings the knowledge, tools, biases, and methods of the previous generation. And then comes technology.

By using jobs and surface behaviors to create a narrow definition of people, JTBD misses the macro-socioeconomic and technological shifts that are constantly at play. Furthermore, JTBD theory can threaten personal identity when an event or technology forces a job to either adapt or face obsolescence. A person’s sense of purpose and meaning is intertwined with their assumed role and career identity.

For example, clerical workers who managed physical documents in mailrooms found their purpose questioned when digitization caused those jobs to vanish. Their predefined role was to manage paper. When that core job disappeared, identity-related anxiety arose.

As AI transforms roles by automating certain tasks, the limitations of JTBD become clear. It is solely focused on functional jobs, but without acknowledging the cognitive and emotional impacts on identity.

In contrast, Cognitive Design provides a more holistic view by encompassing our inner human needs for purpose, self-worth, and actualization.

Cognitive Design mitigates threats to identity by elevating jobs into more meaningful callings that align with human cognition. It makes it possible for people to use AI to augment their roles, rather than be replaced. This cognitive perspective also uses a human-centric foundation to navigate complex job transitions. The aforementioned mailroom clerk is no longer just managing documents — they are leveraging AI to manage corporate knowledge.

Re-Introducing Cognitive Jobs

When we talk about Cognitive Jobs, we are talking about a refined perspective on human tasks. It shifts the emphasis from surface-level behaviors to the often-overlooked cognitive processes, or thought processes, which occur within the user's mind.

Although the concept of cognitive work is already intrinsic to human experience, this approach encourages a deliberate focus on the intricacies of how users think. In other words, it pushes us beyond a traditional understanding of "jobs."

The distinction is evident in the new set of nuanced questions we can use to uncover Cognitive Jobs:

- What mental models do users form to understand concepts in this domain?
- How do users mentally frame and reframe problems?
- When do users experience cognitive overload? What information gets filtered out?
- How might an AI agent enhance human reasoning and learning?
- What cognitive biases creep into human judgment in this area?

Cognitive Jobs broadens the idea of a "job." It views jobs not just as progress and task completion, but as discovery, curiosity, creativity, and the many other dimensions of cognitive experience. AI offers possibilities not only to work faster or better, but to think differently.

This approach reveals avenues that surface-level JTBD has ignored, especially opportunities for:

1. **AI that enhances working memory.** Holding intermediate results, filtering noise, and spotlighting relevant signals to reduce cognitive load.
2. **AI that strengthens mental model building.** Acting as a simulation engine to help construct new mental frameworks.
3. **AI that expands creativity.** Providing prompts and selections to widen creative possibilities.
4. **AI that fills cognitive gaps.** Supplying key information tailored to individual knowledge domains.
5. **AI that explains its reasoning.** Clarifying connections and revealing the reasoning behind its outputs, which makes AI more transparent.
6. **AI pattern recognition.** Surfacing patterns that a human cannot detect.
7. **AI rapid solutioning.** Feeding the thought pattern through rapid exploration of what-if scenarios.
8. **Multimodal.** Incorporating multiple modes of interaction (visual, auditory, tactile) to cater to diverse cognitive styles and abilities.

The Deep Roots of Cognitive Jobs

Cognitive Jobs is a new concept, but it's rooted in established methodologies:

- **Cognitive Task Analysis.** Originating in human factors research, cognitive task analysis seeks to construct detailed models of "knowledge, thought processes, and goal structures" used to perform complex tasks. It elucidates the key cognitive elements required for skilled performance.
- **Cognitive Work Analysis.** A framework for analyzing complex sociotechnical systems, emphasizing the interplay of cognitive work within broader organizational contexts. It aims to inform system design to better support cognitive work.
- **Cognitive Systems Engineering.** A discipline focused on designing technology to augment human cognitive abilities and help overcome biases, rather than replace people. The goal is to create "cognitive prostheses."
- **Cognitive Computing.** Software systems that can adapt and learn as they interact with humans, employing techniques like machine learning and neural networks to enhance decision-making. The emphasis is on systems that feel natural to the user.

Cognitive Jobs synthesizes elements from the above approaches into a practical framework for using AI to design cognitive augmentation. It balances an understanding of core cognition with a vision of using AI assistance to enhance thinking.

Cognitive Jobs in Practice

How does Cognitive Jobs differ, in practice, from traditional JTBD? Below are a few examples that demonstrate the contrast between these distinct approaches:

Legal Terms & Conditions Management App

- **Surface JTBD:** Centrally manage and one-way publish a business's numerous legal terms and conditions (e.g., privacy policy) across multiple channels and countries.
- **Cognitive Jobs:** Centrally manage and publish the business's legal terms and conditions, using translation models to personally translate them for each country and each individual customer. Use real-time feedback from customers, case laws, and regulations to auto-update and recommend grammar and structure improvements to the underlying source language of the legal terms.

Fitness Tracker

- **Surface JTBD:** Monitor exercise activity levels to hit daily fitness goals.
- **Cognitive Jobs:** Use data to internalize knowledge of how different exercises impact the body. Develop personalized mental models, rituals, and goals around fitness. Receive real-time prompts during workouts.

Creative Writing Aid

- **Surface JTBD:** Help authors brainstorm ideas and write faster with fewer blocks.
- **Cognitive Jobs:** Rapidly iterate plot concepts through AI simulations. Visually map stories to grasp pacing and structure. Receive tailored suggestions to enrich descriptions and deepen narrative voice based on writing samples.

Medical Diagnosis App

- **Surface JTBD:** Provide accurate medical diagnoses based on patient symptoms and health data.
- **Cognitive Jobs:** Construct an explanatory mental model to explain health conditions and treatment options when speaking with the patient. Personalize the explanation of each diagnosis, and provide social connection options to relevant support groups, to build patient knowledge and trust.

The above examples illustrate potential Cognitive Jobs. Having said that, they would still need validation from real users through research techniques like interviews and usability testing.

In each case, the cognitive perspective uncovers new opportunities to craft AI that feels like an extension of the user's mind. But this requires research methods that dig below the surface and expose the invisible cognitive work involved.

Uncovering Hidden Cognitive Jobs

Traditional Jobs to Be Done heavily depends on ethnographic interviews that concern the customer's circumstances, actions, and motivations.

However, Cognitive Design calls for deeper analysis to uncover the user's thoughts, feelings, hopes, and anxieties with empathy and compassion. Ethnographic interviews must aim for a thorough understanding of the user's thought processes, while also building rapport, trust, and care for their vulnerabilities. Cognitive Jobs demands new techniques to reveal the cognitive models, reasoning patterns, and mental workflows in users' minds.

The following are research approaches that will help us uncover which Cognitive Jobs are ripe for human-AI collaboration.

Cognitive Interviews

Cognitive interviews ask users deep questions to map their thought processes:

- How do you mentally frame or model this type of problem?
- Walk me through your step-by-step reasoning when evaluating options or making a decision.
- Which factors receive most of your mental focus? Which ones do you tend to gloss over?
- What knowledge or past experiences inform your thinking in this scenario?
- Where do you feel unsure about the right way to think through this problem?
- How might your thinking change if you had perfect information or memory?

Follow-up probes dig further into the nuances of cognition:

- What data would help strengthen your models and reasoning here?
- When do you feel cognitively taxed or overwhelmed?
- What connections and insights feel just beyond your grasp?
- How might you think through this problem differently if you had an AI agent that could assist?

By asking the user about mental models, reasoning flows, uncertainties, and bottlenecks, we can identify opportunities for AI augmentation. We can also identify when non-AI or ML solutions are better and easier to use.

Concept Mapping

Concept mapping is a powerful qualitative technique. It elicits the user's mental models of a domain by asking them to create visual diagrams of key concepts and relationships. By

externalizing their internal knowledge structures into tangible mind maps, it also reveals gaps, inconsistencies, and opportunities for AI augmentation.

Using the concept mapping process, the user illustrates the core ideas in a subject area. They connect them based on perceived relationships and organize them into higher-level clusters and hierarchies. A comparative analysis of these spatial maps versus expert models can surface mismatches and areas for improvement. Concept mapping uses visual expression to tap into mental models, thereby unlocking insights into user cognition for designing compatible AI assistance.

Key benefits and processes of concept mapping include:

- Asking the user to create visual maps of key concepts and relationships within a domain.
- Externalizing the user's mental models into tangible diagrams.
- Surfacing gaps, incorrect connections, and misconceptions in the user's knowledge.
- Identifying opportunities where AI could:
    - Explain concepts that the user incorrectly maps.
    - Recommend relationships that are missing from the user's maps.
    - Restructure information to match the user's mental models.

Process:

- User creates a diagram of core concepts in a domain.
- User connects concepts with lines or arrows to represent relationships.
- Concepts can be organized into hierarchies or clusters.
- User explains their rationale for each connection.

Analysis:

- Compare user concept maps to expert maps to find mismatches.
- Identify areas where knowledge is weakest, based on missing or incorrect connections.
- Assess evolution of maps over time as understanding deepens.

The value of concept mapping is clear. It externalizes hidden mental models into concrete artifacts, surfaces gaps where AI explanations would be beneficial, reveals how AI could restructure data to match user thinking, and models a domain through the cognitive lens of the user.

Behavioral Experiments

Behavioral experiments assess how the user performs when executing carefully designed tasks that map to real-world Cognitive Jobs.

The following list contains examples of actions that the user could be asked to take, as well as examples of the potential learning that could arise when observing those actions.

- **Elaborate on example tasks:**
    - Image classification could involve the identification of conveyed abstract concepts or emotional sentiments, among other qualifiers.
    - Data pattern detection could focus on trends, outliers, and correlations.
    - Simulated system prediction could allow the modeling of cause-and-effect.
    - Creative option generation could include divergent thinking or conceptual blending.
    - Decision-making could assess bias, heuristics, and risk tolerance.
    - Summarization could test abstraction to identify key ideas.
- **Describe how factors are modulated, in order to:**
    - Increase information volume and consider more data points and features.
    - Understand conceptual difficulty, by drawing from different knowledge domains.
    - Understand how working memory is challenged, by imposing concurrent tasks and distractions.
- **Explain how performance is measured, in order to:**
    - Understand accuracy, response time, recall, and problem-solving approach.
    - Leverage eye-tracking and think-aloud protocols to gather qualitative data.
    - Compare individual versus collaborative performance with AI.
- **Discuss bias-mitigation strategies:**
    - How balanced, representative data sampling is used to mitigate bias.
    - How they would conduct careful pilot testing to remove confounds.
    - Leverage analytics to detect outliers or flawed study design.
- **Provide examples of real-world insights, in order to:**
    - Identify misalignment between the user's mental models and AI outputs.
    - Pinpoint moments of cognitive overload where AI could assist.
    - Capture biases for or against certain types of decisions or data.
- **Emphasize the value for AI design to:**
    - Isolate opportunities for reducing cognitive friction.
    - Model factors that impact human reasoning.
    - Inform AI explanation, collaboration, and transparency.

By modulating factors like information volume, conceptual difficulty, and working memory demands, we can isolate cognitive obstacles and biases. We also gain profound insights into how we could harness AI to reduce cognitive load, highlight connections, or enhance reasoning.

Emotion Detection

Emotion detection is the use of inputs like voice, text, or facial expressions to identify human emotions. This can uncover Cognitive Jobs related to the user's affective states, feelings, and sentiment.

Key techniques include:

- Facial expression analysis using computer vision and deep-learning models trained on labeled facial images.
- Voice analysis through prosody, spectral methods, and deep learning to discern emotions from vocal signals.
- Text analysis via sentiment analysis, NLP, and neural network word embeddings to detect emotions in written language.
- Behavioral analysis via computer vision to observe and analyze patterns in human behavior, such as gestures or posture, to provide insights into emotional states.

Emotion detection can surface emotional cues and sentiments that go beyond rational thought patterns to provide another lens into Cognitive Jobs. In order to design empathetic AI, it is critical to understand emotional needs.

Cognitive Walkthroughs: Uncovering Hidden Thought Flows

A cognitive walkthrough is a qualitative technique that reveals the user's invisible thought processes when completing tasks. In these sessions, the user vocalizes their thinking in detail while navigating representative scenarios. Researchers prompt the user with questions at critical decision points to elicit deeper explanations.

Sessions are recorded and transcribed for analysis. Key insights include:

- Mental models that the user forms based on how they frame problems (e.g., their conceptualization of medical diagnosis).
- Strategies for seeking, evaluating, and integrating information (e.g., narrow versus broad search approaches).
- Moments of confusion that indicate gaps or misconceptions (e.g., confusion over a technical concept).
- Biases that shape how the user interprets information (e.g., confirmation bias).

Researchers use techniques, such as protocol coding and process mapping, to detect themes and patterns in the user's verbalized thoughts. Pauses, repetitions, and changes in direction can quantify signs of cognitive friction.

Cognitive walkthroughs open a window to the hidden workflows of the mind. By modeling thought flows in realistic contexts, they can pinpoint breakdowns in understanding as well as obstacles to goals. These friction points inform the design of AI systems that are compatible with human cognition.

Examples of discoveries that cognitive walkthroughs have uncovered include:

- Users lacking expected domain knowledge (e.g., unaware of medical best practices).
- Ineffective information foraging and synthesis methods (e.g., difficulty contextualizing data).
- Misinterpreting outputs from an AI system (e.g., incorrect mental model of recommendations).

Cognitive walkthroughs reveal the invisible, underlying cognitive work behind a task. This think-aloud data reveals cognitive friction points, as well as "a-ha!" moments in which concepts click and understanding crystallizes.

Longitudinal Studies: Tracking Changes Over Time

Longitudinal studies take an extended timeline approach to studying the user, following them over weeks, months, or even years rather than at isolated moments. This empowers researchers to identify how Cognitive Jobs evolve as the user gains more knowledge and experience within a domain over time.

In longitudinal studies, researchers use interventions like surveys, interviews, and cognitive assessments to periodically check in with the user. They may also use ethnographic observation techniques to study the user across different contexts as their expertise grows. Artifacts created over time, such as concept maps, reveal shifts in mental models.

Analysis techniques involve statistical modeling to measure changes over time, qualitative coding to capture evolving cognitive stages, and mapping to document growth in capabilities.

Key insights that longitudinal studies have uncovered include:

- Novice users tend to focus Cognitive Jobs on comprehension, skill building, and the construction of mental models. As they gain experience, these jobs transition to rapid recall, nuanced judgment calls, and quick pattern recognition.
- Users' priorities often shift from learning facts and textbook concepts to contextualized decision-making grounded in practical wisdom.
- Expertise may create new biases in users, such as overconfidence in their intuition.

By tracing how cognition can change over a period of years rather than days, longitudinal studies unveil higher-level Cognitive Jobs that transcend basic tasks. This data guides the design of AI systems that will adapt to the user's evolving needs and changing mental models over time.

Static, one-off studies fail to capture the deep insights that longitudinal mapping can discover. Longitudinal mapping empowers the design of AI that continuously aligns with the user's ever-growing cognition.

Interactive Feedback Loops

Interactive feedback loops describe ongoing cycles in which the user provides input to an AI system. In response to the user's input, the system generates adapted output and the user gives feedback to recursively improve alignment with human needs. This fosters collaborative assistance between human and machine.

Key aspects include:

- **Human Touch.** The user shares reactions, thoughts, and feelings to infuse AI with emotional intelligence and empathy. This grounds the system in genuine human needs.
- **Context Sharing.** The user provides broader context about their circumstances, knowledge, and objectives to guide AI reasoning. This anchors it to real-world relevance.
- **Prompt Engineering.** The user suggests ways to fine-tune the AI's prompts and outputs so that interactions feel more natural. This helps AI communication resonate.
- **Adaptability.** The AI dynamically adjusts its responses and interface based on user feedback. This flexibility enables fluid cooperation.
- **Metacognition.** The user can engage AI feedback to reflect on their own thought processes and biases. This self-awareness leads to growth.

These loops arise throughout the creative research and design processes. For example:

1) **Preparing for interviews and research.** Providing information about initial needs and ideas in order to "prime" the AI. This sets the tone, as well as refines the questions and approaches.
2) **Conducting interviews and research.** AI-assisted note capture, sentiment analysis, and summarization can accelerate otherwise time-intensive tasks.
3) **Interaction design.** AI-assisted design systems can help to quickly scaffold interactions for testing, reducing iteration time.

By using recursive feedback exchanges to close the loop between human and AI, we can craft systems that intuitively adapt to the user's evolving cognitive needs and contexts. The human touch provides grounding, while AI provides endless customization.

Designing AI for Cognitive Augmentation

When designing AI to augment human cognition, we must recognize that humans offer irreplaceable strengths.

True cognitive augmentation uses AI to assist human capabilities. It is not about humans versus AI. Rather, it is about how we can work together to thrive. With this spirit of collaboration in mind, let us explore key principles in which human abilities can elevate AI design.

Once we have mapped Cognitive Jobs, how do we design AI so that it feels like a natural enhancement to human thinking? Below is an overview of the principles and patterns that ensure fluid cooperation between AI and the user's cognition.

Support Working Memory

Working memory is the mind's capacity to temporarily hold information while manipulating it. It is severely limited, because people can simultaneously retain only 7 +/- 2 items on average.

We can employ AI to support working memory and lighten the load of cognition. Key techniques include:

- **Caching.** Providing rapid access to previously viewed or generated information, removing the user's need to hold details in fragile working memory.
- **Chunking.** Grouping individual pieces of information into higher-order clusters and concepts that are easier to retain.
- **Filtering.** Reducing demands on working memory by curating only the most necessary and salient information for the task at hand.
- **Summarizing.** Distilling concepts to their essences, allowing users to offload lower-level details.

AI can support working memory by caching details, as well as by summarizing and filtering information. Humans provide the discernment to judge what information is most relevant and worthy of retention. By combining human discernment with AI memory storage, we create a system greater than the sum of its parts.

Structure Information

A human's working memory falters when it attempts to process unstructured information.

AI can dynamically organize information for easier comprehension in the following ways:

- **Diagramming.** Illustrate entities and the relationships between them. For example, a concept graph.
- **Categorizing.** Use text tags or similarity metrics to group entities into hierarchical categories or clusters.
- **Ordering.** Sequence information based on chronology, importance, relevance, or other meaningful patterns.
- **Summarizing.** Generate high-level overviews and key takeaways when absorbing large information sets.

Humans possess an intuitive sense of meaningful organization schemes. We also have the creativity to detect non-obvious connections across disciplines. AI offers computational

categorization, diagramming, and sequencing, while humans determine the most resonant structures tailored to the problem.

In short, we can use AI's dynamic organization capabilities to find new ways to support the working memory of humans.

Enable Mental Model Building

Mental models are conceptual frameworks that users form to make sense of complex systems. AI can accelerate this model-building process. Techniques include:

- **Simulating.** Allow users to tweak parameters and rerun simulations for faster, interactive model-building.
- **Visualizing.** Transform abstract relationships into concrete visuals and animations based on user needs.
- **Explaining.** Generate plain language descriptions of model dynamics, connections between components, and causal mechanisms.
- **Predicting.** Given a set of assumptions, allow users to test hypotheticals by computing expected outcomes.

Humans contribute invaluable intuitions and adaptability when iteratively developing and refining conceptual models of complex systems. And where AI provides ample computational power for running simulations and scenario testing, human intuition anchors those models in reality.

However, we must design AI systems with patience, encouragement, and support for human learning and growth. AI feedback and guidance should be delivered in a constructive and compassionate manner, with care for protecting human confidence and emotional needs.

Cultivate Discovery and Creativity

Cognitive Jobs approach highlights the many ways that AI can spark creativity. For example:

- **Idea Generation.** Use techniques like conceptual blending to produce novel concepts and thought-starters beyond human imagination.
- **Unusual Associations.** Surface atypical connections between disparate concepts to inspire new creative linkages.
- **Perspective Shifting.** Offer alternative interpretive lenses and metaphorical viewpoints to solve problems.
- **Recommendation.** Suggest selections from a vast space based on patterns in user taste and preferences.

Creativity resonates with humans because of our capacity for individuality, emotional expressiveness, and socio-cultural awareness. AI can rapidly generate novel connections and

ideas based on patterns, while humans use deeper meaning and value to curate which possibilities to pursue.

Adapt to Expertise Level

Different users will hold different levels of baseline knowledge. AI should personalize its assistance to close these knowledge gaps. Here are some examples:

- **Diagnosing.** Through conversation and tasks, assess a user's conceptual vocabulary, skills, and knowledge.
- **Filling Knowledge Gaps.** Explain key terms, ideas, and background context missing from the user's expertise profile.
- **Adjusting Language.** Modify the vocabulary, as well as the conceptual complexity of the explanations and feedback that are tailored to the individual.
- **Visualizing Complex Concepts.** For low-knowledge users, transform sophisticated concepts into interactive visual metaphors and demos.

Human social skills and empathy encourage a sensitive approach to teaching that adapts to the learner's gaps and strengths. Combined with AI's capabilities for knowledge diagnosis and visualization, this fosters personalized learning journeys tailored to the individual.

Make Reasoning Transparent

For users to trust and effectively cooperate with AI, they must grasp how it makes decisions:

- **Explainability.** Translate opaque AI logic, like neural network weights, into interpretable reasons using techniques like LIME.
- **Uncertainty Communication.** Convey confidence judgments and uncertainty metrics in clear terms. For example, percent chances instead of raw probability scores.
- **Reasoning Tracing.** Allow users to inspect the step-by-step logic behind any output, highlighting connections between input data, model layers, and results.
- **Reasoning Comparison.** Contrast the AI's logic with an estimate of how humans might reason through the same problem.

Nuanced human communication builds understanding and relatability when explaining reasoning. AI offers invaluable tools to translate opaque models into interpretable terms and surface key drivers, which humans can then convey to others with clarity and wisdom.

Mitigate Cognitive Biases

AI has the potential to act as a counterbalance to biases and blind spots in human cognition:

- **Bias Identification.** Monitor user behavior and judgments for signs of bias, like confirmation bias or the affect heuristic.

- **Perspective Tuning.** Gently bring to light different viewpoints and interpretations that the user may be ignoring or discounting.
- **Logical Deconstruction.** Analyze and pinpoint flaws in reasoning, like false premises or hasty generalizations.
- **Data Insights.** Highlight patterns in data that may disconfirm faulty assumptions and challenge biased mental models.
- **Nudge and Feedback.** Use carefully timed prompts to encourage reflection on judgments and openness to alternatives grounded in evidence.

Human self-awareness, empathy, and cognitive flexibility are indispensable tools for challenging entrenched perspectives and biases. AI can systematically identify potential biases through user monitoring and data-driven insights. Humans make the call on which biases need to be addressed to create a more just system.

Promote Long-Term Learning

AI can fulfill Cognitive Jobs related to knowledge accumulation:

- **Identifying Knowledge Gaps.** Diagnose areas in which the user's mental models could be expanded or enriched based on collaborative dialogues and task performance.
- **Linking to Existing Knowledge.** Explain new concepts by relating them to knowledge and experience that the user already possesses.
- **Scaffolding Challenges.** Introduce new problems that stretch just beyond the user's comfort zone, using practice to expand capabilities.
- **Reviewing and Quizzing.** Periodically resurface old information to strengthen recall and retention of knowledge over time.
- **Tracking Growth.** Highlight improvements in understanding to build metacognition and confidence.
- **Sequencing Jobs Across Tools.** Execute and complete complex, cognitive-type jobs in order across an ever-growing spectrum of digital tools.

Fundamental human traits like curiosity, motivation, patience, and wisdom can sustain growth and enrichment over a lifetime. AI provides expansive diagnostics, quizzing, recommendations, and simulations to nurture this journey, while human guidance steers this knowledge accumulation toward meaning, ethics, and maturity.

Using a holistic design, AI can expand the frontiers of human potential. However, we must remember that AI is the means, and that it's humans who provide the purpose and direction. Humans light the path forward while AI expands the horizons of what's possible. Humans can also use our wisdom and values to guide the expanded capabilities that AI provides.

By consciously incorporating our human strengths throughout the design process, we can create AI that feels like a natural extension of our capabilities. The future lies in the harmonious melding of human qualities and AI skills.

The design space for cognitive augmentation is vast. But principles like the ones we've described can transform abstract Cognitive Jobs into concrete AI capabilities that feel intuitive. These principles give us a compass to guide our design, but human-centered iteration and testing will be critical for refining the intuitive qualities and feel of AI.

The use of co-design, user testing, and iteration to augment human strengths is crucial to create AI that feels intuitively human-centered. We must design AI that complements, not replaces, the human spark.

Cognitive Design as a New Paradigm

Why is reimagining Jobs to Be Done so critical for the future of human-AI collaboration? What paradigm shifts does it enable?

Moving from Automation to Augmentation

For many jobs, modern AI tech — like other technologies — leans towards a vision of full autonomy.

The reality is that the spectrum between augmentation and automation is broad. Cognitive Design aims to augment select aspects of cognition, addressing human cognitive limits and struggles while keeping the human at the center of the process.

While this augmentation can be beneficial, it's crucial to be aware of the potential for cognitive atrophy or over-reliance on machines, which could impact long-term cognitive abilities. To mitigate this, safeguards can be integrated into AI systems. For instance, adaptive challenges can be built into the AI that recognize if a user has become overly reliant on the AI system. It can then prompt the user with tasks or questions that are designed to stimulate and challenge the user's cognition.

The system can also provide periodic feedback and self-assessments, allowing users to gauge and improve their cognitive engagement levels. By doing so, we can use augmentation to both assist and enhance human capabilities. Take, for example, an AI legal assistant: it could automate certain tasks but also prompt legal professionals with challenging cases or scenarios, ensuring they stay mentally engaged and sharp. This balanced approach not only feels more cooperative, but also actively promotes cognitive growth.

In another example, the AI legal assistant could take over leads and contract management completely. Or it could augment selective pain points, such as remembering previous terms, details, or references, while leaving top-level legal decisions and language to the user. The augmentation approach feels far more cooperative.

When we conceive of AI as a part-time collaborator that complements cognition, it moves us toward technology that enhances our lives. Automation alone often diminishes the human role. The crossover from automation to augmentation is where design becomes truly user-centric.

Balancing Data-Driven and Human-Centered AI

The rise of deep learning has made AI development highly data driven. But Cognitive Design brings human context back into focus by starting with the user's mental models before considering data and algorithms. This human-centered approach allows us to see opportunities for AI beyond what data dictates.

Big data reveals correlation patterns, but often fails to capture the user's needs for creativity, mental model building, and emotional resonance. Cognitive Design offers an ethical method to balance data-driven techniques with human priorities.

Crafting AI That Feels More Natural

JTBD tells us to separate "job" from "solution." But Cognitive Jobs has an intrinsic ability to blend with AI solutions. Certain cognitive needs only become visible with stimulation from a breadth of options. This interplay allows us to craft AI that meshes with human thinking in an organic way.

Natural user interfaces like voice assistants emulate human conversation patterns. In the same vein, Cognitive Design envisions AI that reflects human thought processes. This shifts our trajectory towards AI that is more than just functional — it's responsive and intuitive.

Making AI a Cognitive Assistant

Traditional design thinking primarily perceives technology as a tool for specific tasks. However, by focusing on Cognitive Jobs, we can collaborate with technology on a more profound level. While tools merely execute user instructions, cognitive assistants support and enhance our thinking processes.

This assistive model allows AI to adapt to the user's evolving knowledge and promotes meaningful, two-way interactions. With Cognitive Design, the goal is for AI to feel less like a passive device and more like a responsive aide to our intellectual endeavors.

Validating Cognitive Jobs with Human-Centered Testing

Although it is essential to uncover Cognitive Jobs, we must use real-world testing with humans to validate them. AI cannot fully predict the nuanced cognitive needs that emerge from human-AI interaction.

Approaches to validate and enrich Cognitive Jobs include:

- **Human-AI Assistance Testing.** Observe the user collaborating with prototype AI systems to reveal gaps in capability and cognition. Monitor when and where human-AI coordination breaks down.
- **Cognitive User Testing.** Ask representative users to complete tasks and simulations using think-aloud protocols. Assess their problem-solving approaches, misconceptions, and friction points.
- **Empathy Interviews.** Conduct open-ended interviews focused on the user's thoughts, feelings, hopes, and fears concerning AI augmentation. Uncover emotional and social needs.
- **Diverse Participant Recruiting.** Seek a broad range of cultures, backgrounds, personalities, and cognitive styles. Identify gaps for underserved populations.
- **Long-Term In Situ Testing.** Deploy long-term AI prototypes in real environments. Track changes in Cognitive Jobs as the user's knowledge grows.

The goal is rapid iteration informed by nuanced human feedback. Testing helps evolve Cognitive Jobs to resonate with how people truly think, learn, and interact with AI. This human-centered validation prevents blind spots in our designs, while forging a tighter bond between machine cognition and human life.

Expanding Design Thinking

For all its merits, design thinking has blind spots: focusing on visible jobs while ignoring hidden cognition, prioritizing progress over creativity, separating human and technology. Cognitive Design uses a holistic framework to address these gaps by creating deep connections between AI capabilities and human needs.

By focusing squarely on the cognitive perspective, we can create AI that feels like a true extension of the user. This next stage in the evolution of design thinking leads to AI that cognitively collaborates as an assistant, not just procedurally behaves as a tool.

Conclusion

In our pursuit to shape the future of AI, it's imperative to stand on the shoulders of giants. Traditional design thinking has paved the way while Cognitive Design aims to take the next steps hand in hand. Guided by compassion for human abilities and limitations, Cognitive Design also strives to create AI systems that are collaborative, responsive, and caring — elevating rather than diminishing our humanity. Combined, these methodologies promise a more intuitive, responsive, and beneficial AI-human interaction.

Jobs to Be Done continues to be a crucial framework during a period of rapid progression for AI. Yet, it needs to evolve beyond overt tasks. Jobs to Be Done must delve deeper into the intricate cognitive workings that are fundamental to human experiences. By reconceptualizing Jobs to

Be Done as Cognitive Jobs, we pave the way for AI that can harmoniously assist both human strengths and human limitations.

The Cognitive Design methodology offers guiding principles and tools that highlight vast opportunities to enhance memory, creativity, mental model formation, and learning. It unveils how we can shape AI that is not only intuitive and responsive, but also collaborative and engaging.

But this future is dependent on organizations embracing change rather than optimizing the status quo. The potential for cognitive augmentation is emerging, but capturing this opportunity necessitates embracing new perspectives when conceptualizing solutions. Design thinking must delve below surface jobs into the workings of the human mind. This creates technology that feels compatible with human life, because it works in concert with human thought processes. As with Henry Ford innovating the motor engine rather than incrementally improving the horse carriage, organizations should view Cognitive Design as an opportunity for transformational innovation over incremental gains.

We must use real-world user testing to validate the Cognitive Jobs that research reveals. This human-centered validation is key to uncovering nuanced human needs and guiding ethical, human-compatible AI design. As Cognitive Design evolves, proven user feedback will determine its success. However, it risks dilution if organizations do not fully embrace these processes to push boundaries. There is a danger that it could become a wasted opportunity to genuinely understand human cognition.

About the Authors

David Thomson, CEO of Momentum Design Lab, an HTEC Group company
David Thomson is the founder and CEO of Momentum Design Lab, an award-winning full-service digital product agency ranked #1 on Clutch since 2016. Thomson provides strategic vision and design leadership for industry-shaping innovations, staying at the forefront of technology breakthroughs across multiple industries such as financial services/fintech, martech, SaaS, HCLS, and others.

Sava Marinkovich, Head of Healthtech at HTEC Group
Sava Marinkovich is the Head of Healthtech at HTEC Group, a global product innovation and engineering services firm. Sava brought innovations to life at both Corporate and early-stage companies, founding 3 ventures in Consumer, Health, and Artificial Intelligence. Sava has multiple patents in consumer, medical, and AI fields, and uses his product experience to help Fortune 100 companies identify new opportunities to leverage AI and breakthrough technologies.

Joe Preston, Vice President of Product & Design at Intuit
Joe is hopelessly in love with design, and learning more about how little he knows each day. Prior to Intuit, Joe co-founded a product design agency, Momentum Design Lab, and worked with companies like Facebook, Microsoft, AT&T and Mastercard. Joe is a proud husband and father of daughters and lives in the San Francisco Bay Area.

This paper is the result of many discussions, including analysis and collaboration sessions, between David and Sava over several months about how to solve for designing products and solutions when both cognition and access to data approach a zero cost. It was synthesized by Google Bard, OpenAI GPT-4, and Anthropic Claude 2, with a re-summarization by Claude 2 and rewritten by the authors and contributors.

Additional contributions from and special thanks to:

- Denis Lacasse — COO Momentum Design Lab, an HTEC Group company.
- Mark Scrivener — Managing Director UK Momentum Design Lab, an HTEC Group company.
- Peter McNulty — Head of Design at Momentum Design Lab, an HTEC Group company.
- Jazmin Cabrera — VP of Client Services and Strategy at Momentum Design Lab, an HTEC Group company.