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From human-centred to humanity-ecosystem centred design. How can we dialogue with AI?

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Abstract

With the swift entry of artificial intelligence (AI) into everyday life, human-product interactions are becoming increasingly complex. We suggest an ecosystem-minded, humanity-centered design approach to better understand this complexity. Simultaneously with the development of interaction types, discussions and developments on theories of mental models are crucial to understanding and improving the nature of these interactions. In this paper, we address the gap in mental model theories and extend Norman's conceptual model at three dialogue levels: dialogue in language, mind, and use.

Keywords: artificial intelligence (AI), interaction design, humanity-centered design, mental model

1. Introduction

We live in a world full of interdependent, complex relationships. The world has never been that unified and connected before. Through globalization, societies are getting more and more integrated and getting more complex as they converge. With the advent of the invention of the internet and developments in computer technologies, not only societies but also minds started to integrate when exposed to the same news, information, and knowledge. These changes in the mind alter the way we perceive technology; from the way we produce technology to the way we use it. From minds to societies, connecting everything reveals new relationships and complexity. In coping with this new object-human complexity and creating meaningful flow, design plays a crucial role. Design can bring a diversified understanding to wicked problems emerged by increasing complexity (Prinen and others, 2022). Design on the other hand not only deals with this increasing complexity but also makes it understandable or meaningful to someone. Products semantics focus on the distinction between what an object is and what that object means in the cognitive and social contexts of their use (Krippendorff, 1989). The role of language on the other hand plays a crucial role in design in shaping this meaning. According to Krippendorff, language is part of a world that is in the process of being made, for this reason, as designers attempt to change the world, they must learn to use language creatively (Krippendorff, 2006). "The fate of all artifacts is decided in language" (Krippendorff, 2006). For this reason, it can not be wrong to conclude that all the changes and developments in design also happen in language and with language therefore, we as designers should know how to approach language.

Today, one of the most important developments in technology is probably "Artificial Intelligence " which has entered our lives swiftly. With objects equipped with AI technology, human-object interactions have evolved. This new interaction brought new challenges, like making the role of AI legible to the user in a meaningful way (Lindley and others, 2020). Therefore, designers need to learn how to manage the growing complexity that we face through the development of artificial intelligence (Buchanan, 2019). Design, on the other hand, needs a more comprehensive approach to making sense

of this sort of complexity and ordering the interaction between humans and AI in a desirable way. Accordingly, we discuss design as a dialogue between human and non-human agents. And we suggest an ecosystem-minded, humanity-centred design approach to understand the relationship between humans and AI. Then, the main purpose of the paper will be to understand the system model of AI from a dialogue perspective. Because a comprehensive understanding of AI technology does not always lead to a comprehensive understanding of how an AI system will behave (Gero and others, 2020). For this purpose, we expanded Norman's (2002) conceptual model by including human-AI interaction. Understanding the AI's system model can help designers create desired flows between humans and AI and prevent unexpected communication errors. According to this purpose, we suggest three levels of AI-human dialogue; dialogue in language, dialogue in mind and dialogue in use. All together, they create the mindset of the system model of AI and determine the quality of human-AI interaction.

2. Design as dialogue

What is meant by design can change according to the context in which the word is used (Lopes, 2006). Although the roots of design go back to the dawn of humanity, design as a discipline emerged because of the need for mass produce products and associated with shaping the material. The focus of design was function-oriented and problem-solving. Design as problem solving involved less complexity. Users could reach the function of the product and the aim of the designer simply by observing the visual form of the products. Therefore, relationships with these objects were less complex. And the interaction was mostly physical. Within technology and digitalization products turned into black boxes (Boltz, 2000). And mental interaction came to the fore. It's difficult to understand things when we can't observe how they work. In order to make sense of these new relationships, design began to consider products in the cognitive, behavioural, and social context of the user. As a result, certain aspect of design shifted to more abstract, immaterial areas like user experience and interaction design. Today, we are at the doorstep of a new sort of object-user relationship. Within the development of AI, new and more complex object-user relationships are emerging. Designers should decide beforehand on the form of communication, role of AI and the boundaries between AI-human relationships. To understand all these areas, it is crucial to consider design from a more comprehensive approach. From this point of view, we express design as designing dialogue between human and non-human agents. Dialogue experts William Isaacs (1999), mention dialogue as a key factor to solve complex problems of global societies. According to him, dialogue is being aware of the flow and the meaning of the flow. Lopez (2006), point out 'dialogue' in design as a communication process between all participants and elements of design. Lloyd (2022), explained human-AI collaboration from a dialogue perspective. By the term 'dialogue' we mean creating meaningful flows between all human and non-human actors. Creating dialogue involves material, non-material, physical, emotional, visual, or tacit interactions of all kinds. The quality of the dialogue is directly related to the value of the object. In this aspect design as dialogue provide a comprehensive approach as presented in Figure 1. Just as Isaacs (1999) mentioned, dialogue can be defined as a meaningful flow between the object and the user. During this flow objects transmit pre-coded messages (Demirbilek and Sener, 2001). We define this kind of flow as proactive interaction. Proactive interactions deliver the predetermined specific messages to the user and during the flow meaning of the message cannot be changed by the object itself. But in the matter of AI-human interaction, the situation is different than object-human interaction. During the flow, AI does not just transmit pre-coded messages; it also makes decisions at the same time. Due to the learning capacity and adaptation ability of AI, it has the ability to change the message during the flow. We define this sort of flow between human-AI as active interaction. Since designers are not much familiar with designing active interactions, designing dialogue between AI and human can be considered as a new area. In this paper, we approach human-AI dialogue from an ecosystem-minded, humanity-centred design perspective. Thus, we believe that by addressing the issue from a more inclusive perspective, designers will not miss any interaction during the design process.

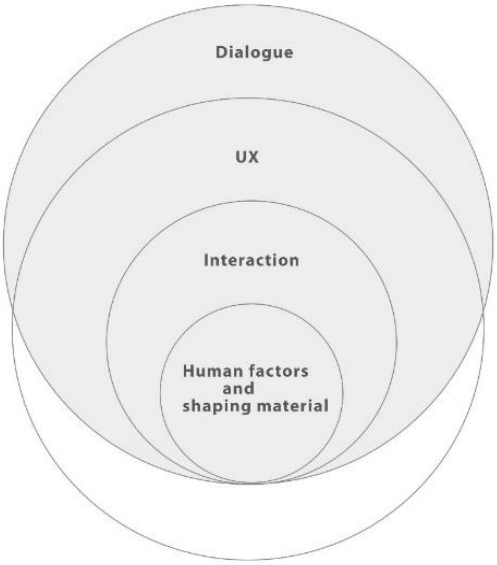

Figure 1. Design as dialogue

3. Ecosystem minded more than human centred design

Many traditional design approaches are dominated by human centred methods. Because there is a strong belief that design will never exist without the user. (Lee and others, 2020; Kazmierczak, 2003). User or human-oriented approaches centre the human and cultivate empathy with human needs, expectations and behaviours (Ideo, 2018). However, over time, user-oriented approaches began to fall short of understanding the needs of complex societies or envisioning the future. On the other hand, as the main focus of user-oriented approaches is the pleasure of the interaction, always prioritize the next level of the experience. This approach has the potential to lead to unsatisfied users. But how long can this situation last? Facing the consequences of our actions, let us realize that we are living in a world of interdependencies among living organisms, and the sources are not limited. The need for more inclusive approaches to address this new complexity requires community-centred approaches rather than individual-centred ones (in terms of design perspective). On the other hand, within the recent developments of technology like the Internet of Things or AI, the contribution of non-human actors in our lives has been significant. But human-centred design wasn't sufficient to deal with these new agents (Rosen, 2022). These trajectories refer to the transformation from human-centred design to humanity-oriented design (Donelli, 2017). To broaden the scope and include the other agents, design studies also began to use post-human concepts, and more than human studies emerged in the field of human-computer interaction HCI (Rosen, 2022). Studies that focus on the contribution of non-human agents include object-oriented ontologies like actor network theory (Gurpınar, 2022; Lindley, 2020; Matthews, 2019). Object-oriented and human-oriented studies share a common perspective by centring the human or object at the centre of the process. But to better understand the collaboration between human and AI we need a non-hierarchical method. We centre the human, human needs, behaviour, and cognition in the design process to create better products in object-human relationships since most of the time objects adapt to humans. But in AI-human interaction, not only AI but also humans adapt to AI. So just like humans, AI can actively contribute to the process; which is why we refer to this process as active interaction. Active interactions are complex situations because they involve dynamic relationships. Therefore, centring something in the centre may lead designers to miss some interactions (Rodriguez and others, 2018). In order to comprehend these relationships, we suggest an ecosystem minded humanity centred approach. The linguistic definition of ecosystem refers to a system formed by a complex community in which agents of the system interact with each other (Oxford, 2023). Ecosystem Thinking is referred to as a method of examining complex systems and their components (Dunn, 1994). Each agent in the design process together creates the system, and ecosystem-minded theory tries to explore relationships between these agents, how they affect and interact with each other, and how they

operate as a whole (Dunn, 1994; Rodriguez and Zepeda, 2018). Ecosystem minded approach can be considered a system thinking approach but they differ from each other in certain points. First of all, system thinking approach is a rule based, problem-oriented approach. This may lead designers to miss some information and cause interaction gaps between AI and human (Rodriguez and Zepeda, 2018). On the other hand, ecosystem-minded approach is more dynamic and innovative, while system-thinking is passive and pragmatic. Ecosystem thinking try to see the big picture. For these reasons, we refer to an ecosystem-minded approach as a 'world view', which is a holistic and interconnected perspective. Therefore, when we consider the learning ability of AI, the system thinking approach may be inadequate to understand the relationships between AI and humans.

4. Transformation of conceptual model

As seen in Figure 2, AI-human interaction is a dynamic structure that involves many complex relationships. Ecosystem-minded perspective can help us to make sense of these relationships. Each participant in the ecosystem contributes to interaction through their unique properties. While each sphere represents organic systems that include a group of interacting or interrelated elements that act according to a set of rules, when these systems come together, they form the ecosystem. The organic nature of systems is related to the adaptability of the structure to change through interaction. Mental model theories can be used to understand the relationships in which systems interact. Norman's conceptual model, for instance, tries to understand how users make sense of things when they interact with objects. However, since Norman's model does not include AI, we extended Norman's conceptual model by taking AI into account and proposing a new model (see Figure 4).

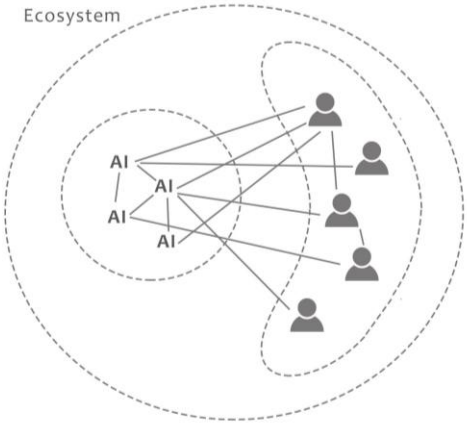

Figure 2. Human-AI ecosystem

Mental model theory was first mentioned by Johnson-Laird (1980), but even before him, the concept had been discussed. Kenneth Craik (1944), suggested "small-scale models" to explain how the mind predicts occurrences. Forrester's (1971) work on 'mental image' mentions the link between cognitive models in the mind and our decisions. The same topic has been studied in design literature by Don Norman (2002), in his book The Design of Everyday Things. Norman describes agents of design as the designer, user, and the system (see Figure 2). According to Norman, the user's mental model interacts with the system image that represents the designer's conceptual model. The conceptual model of a design process represents the designer's mental model. And the mental model of a designer is about how the designer comprehends the product. Designers interact with users indirectly through the system images. Through objects, designers expect the user's mental model to be identical to the design model (Norman, 2002). The user's mental model determines how people interact with the things and the mental model forms through experience, training, or instruction. And finally, the mental model of the device or object is formed by perceived actions. Norman refers this visible structure of the device and perceived actions as system image (Norman, 2002). When users interact with the system image, they try to make sense of it through their mental models. Errors can occur when the mental models of the user and the conceptual model of the designer do not match.

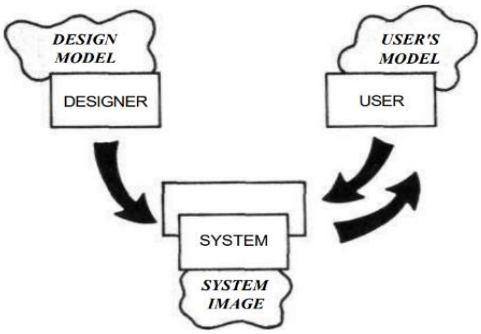

Figure 3. Norman's conceptual model

In this study, we extended Norman's conceptual model by taking AI into account and proposing a new model (see Figure 4). Some characteristics of AI, such as problem-solving, deep learning, and adaptation ability, position it in a different category from objects. Therefore, we define agents of the design process as designer, user, system and AI. System, refers the designed things in general. We prefer to use the word 'system' instead of product or object because designers do not just design tangible objects. They also design the action, function, meaning, emotion and visual quality of the product. All of these together create a system. And the system delivers the designer's conceptual model to the user through its discoverable features. We named these discoverable features, system images just as Norman did (Norman, 2002). In a linguistic way, the word 'system image' is a good way to explain the interaction between product and human. Because 'images' deliver the frozen moments and refer to instant interactions. When people interact with an image, they can receive the message the way it was designed, or they can create their own meaning, which may have unexpected consequences. Accordingly, consistency between the designer's conceptual model and the user's mental model is critical. Designer's conceptual model regulates the system image and system model of AI. It represents how designer comprehend the world. We mentioned the user's mental model just as Norman explained it in his book (Norman, 2002). In a broader sense, the user's mental model is about how people reason about knowledge in the world. And finally, as we mentioned before some characteristics of AI distinguish it from the objects. Therefore, we define AI as another agent of the design process. Users interact with AI through the system model of AI. System model can combine large data sets with intuitive processing algorithms, then it can manipulate these algorithms by learning behaviour patterns within the data set (Wilson, 2023). Therefore, AI' system model, in contrast to the system image, does not just deliver to the user pre-coded 'freeze' messages. Thus, AI has an organic and dynamic relationship with the user. AI system model refers to how AI interacts with the user. The system model of artificial intelligence is a structure that processes inputs and transforms them into outputs with interrelated algorithms. The way it processes these inputs determines its interaction with humans. We explained these interaction between AI and Human in dialogue perspective. Hence, in following we explained three levels of dialogue.

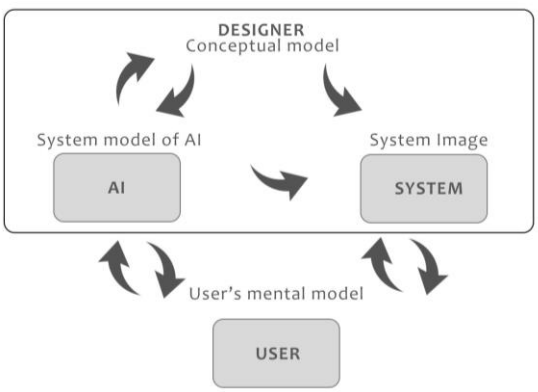

Figure 4. Transformation of conceptual model

5. Three levels of dialogue

We have claimed that withing the recent developments in technology like AI, human-computer interaction evolving to more complex relationships than ever, but we have not yet said what AI is. The concept of AI is a very complex, dynamic, and evolving field. McCarthy (2007), defines AI as the science and engineering of making human-like intelligent machines. 'Artificial', in the most basic sense, is something made or produced by humans rather than occurring naturally. However, the word ‘intelligence’ comes to the fore regarding what artificial intelligence is and what is expected from it. Intelligence is an abstract concept. There are varying viewpoints in literature as to what exactly constitutes intelligence. While some view intelligence as an internal process and characteristic of thoughts, others consider it as an exterior behavioral characteristic (Russell and Norvig, 2021). Intelligence can also be perceived as doing the right thing at the right time. However, Russell and Norvig (2021) point out that human decisions are not always mathematically perfect. Therefore, they mention that while some consider intelligence a rational and logical process, others define it as a fidelity to human performance. In its simple form, Artificial intelligence is a type of learning and evolving system that uses artificial neural networks and various artificial intelligence algorithms to produce action-based rational outputs. We propose that every relationship between AI and human interaction is built on three levels: trust, understanding, and acceptance. We refer to them as pillars of the dialogue, and AI has to face this process of engaging. We argue that the system model of AI is generated by the interaction of dialogue in language, dialogue in the mind, and dialogue in usage. In this paper, we will try to understand how users interact with the system mind of AI through the pillars of the dialogue.

5.1. Dialogue in language

French philosopher Emmanuel Mounier differentiates between tools and machines by stating that while machines are an extension of our language, tools are an extension of our organs (Aydoğan, 2017 p:111). Because of this clear distinction, it is meaningful to consider artificial intelligence and human interaction from the perspective of dialogue. Language undoubtedly forms the basis of dialogue. But language is not just a tool for communication. Because language does not just transmit knowledge; it also expresses emotions and plays a huge role in sharing culture and beliefs. Therefore, we are not considering language as an informative process of cognitive science. We believe that we can approach language in a more comprehensive way. For example, verbal language is mostly associated with transmitting knowledge and information. It's a cognitive process, and there is mostly a goal to achieve. On the other hand, body language is more about expression, gestures, and interpretations. In interaction with body language, emotions are involved, and we can assume how a person is feeling. It is both a conscious and subconscious activity. It's open to interpretation. Therefore, language should not be reduced to an information transfer method. Or it should not be perceived as purely practical.

Through dialogue in language, we also refer to the relationship between language and the mind. According to the linguistic relativity hypothesis, language shapes our behaviours by developing its own mindset (Kay & Kempton, 1984). Heidegger refers to the mentality of technology as a computational mindset. Beyond serving as a tool for communication, language gives the subject the ability to position herself/himself within the context of the world. This refers to the symbiotic relationship between language and thought (Vygotsky, 1986). In this case, we can conclude that the human being born into the world of meaning formed by machine language perceives the world according to the characteristics of that language. Therefore, when users interact with the language of AI, they also communicate with the mindset of AI. Language may have an impact on our lives more than we realize. For instance, we associate emotional characters with language. While languages like French are considered romantic languages, some languages like German or Russian are considered serious languages. Of course, this situation depends on who is receiving this language, and that makes language interpretable. But what causes this classification? Is it caused by the sound that occurs when certain letters are used consecutively, or can be other reasons? Can we find a link between the characteristic of the language and characteristic of the society that using that language? In this case, can we generalize that Germans as a society are more serious than French? The relationship between mind and language can also influence design language. Nowadays, when German design is mentioned, durable, functional 'serious'

products come to mind. From this perspective, the fact that while Philippe Starck is French, Dieter Rams is German is not be very surprising. We only mentioned a very few languages here, and maybe it is difficult to categorize every single language, but there may be a link between language and the characters and behaviours of societies. When we get back to the matter of AI, since it is a new area for us, the language of artificial intelligence is not yet fully defined. Language can help us better understand the mental models between humans and AI. What we mean by dialogue in the language is about the things that create the mindset and characteristic of AI. Although artificial intelligence does not yet have a mind that can process information like a human, it would not be wrong to say that there is a mentality here, as algorithms produce outputs according to a certain understanding. Users can perceive the characteristics of language through the tacit and explicit features of AI. From visual features like shape, colour, material, and sound to the way AI delivers its function. But not from an engineering point of view; it's more about an emotional and psychological point of view. Thus, every decision that a designer makes creates characteristics of the design language. And all these decisions that designers make together create the sense and feelings of the interaction. Dialogue in language is a holistic perspective of interaction, and it covers all processes of interaction (see Figure 5). It influences the emotional state of the user. Therefore, it has a direct relationship with building trust. People do not try to understand or use things that they do not trust. Following the establishment of trust between the user and the AI, users will be eager to understand more about the AI.

5.2. Dialogue in mind

Once trust is established with AI, users will be willing to learn more about it. Dialogue in the mind is about understanding and reasoning with AI, so it is a sense-making process. According to the mental model theory, our interactions with the outside world are influenced by the mental models we have in our minds (Gero and others, 2020). Every day, people develop their mental models quickly and often unconsciously and engage with their mental models to make sense of the world (Gero and others, 2020). Thus, users develop mental models that guide them in reasoning about these technologies and use their mental models to make sense of AI systems and act on them. AI, on the other hand, creates its own system model to interact with people. Since AI is constantly fed by user feedback, system models develop continuously. However, designers play a huge role in creating meaningful flows between AI and users. They shape system models through their decisions. If the system model of AI is perceived by the user's mental models, dialogue flows in the mind. Otherwise, problems may occur. Because people understand things that they can perceive.

5.3. Dialogue in use

People integrate AI into their daily lives after building trust and understanding it. Dialogue in use mostly involves several tasks to solve, so it may be considered a problem-solving process. In the design process, there are so many ways to solve a problem. The quality of dialogue in use has a strong relationship with how easy it is to understand the task and how to solve it. Due to the fact that people keep use things that make sense to them. Designers design usage dialogs with their decisions, and users try to solve them with their conscious minds. Communication of the usage is also part of the design language and, therefore, the personality and mentality of the AI (see Figure 5). The way AI performs its function conveys various messages to the user in many respects. For instance, solving a problem in an unexpected yet easy way may deliver the message of well-thought-out expertise, and that experience can satisfy the user in a positive way. Therefore, the messages that AI delivers to the user must be consistent at every step of the dialogue. AI, on the other hand, has the potential to solve many things that people can or cannot do in order to provide a much more comfortable life for people. However, decisions here should be carefully considered. Just because AI can perform a task does not mean that it has to do it. While we are trying to make people's lives easier, making the wrong decisions may lead people to feel worthless. Therefore, designers should decide beforehand the boundaries of the dialogue in use.

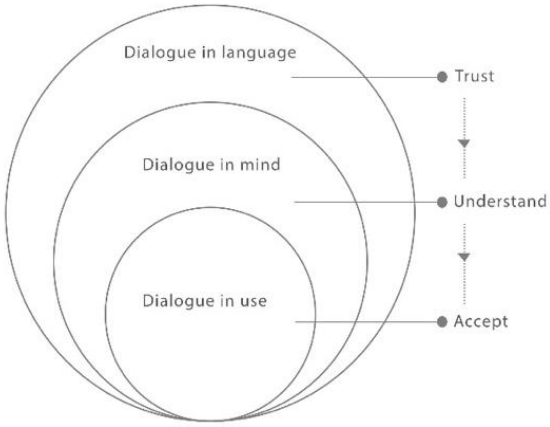

Figure 5. Three pillars of dialogue

6. Discussion and conclusion

Design needs more holistic and comprehensive approaches to making sense of human-computer interaction, which is becoming increasingly complex with technological developments. Ecosystem-minded humanity-centred design can provide designers with a comprehensive understanding of what they deal with. We believe that an ecosystem mindset approaches all design agents's equal way. Through this non-hierarchical mindset, all the agents can contribute to the system with their unique properties.

Mental model theories, on the other hand, are largely discussed in design literature to create better interaction and a positive user experience. It is also one of the most discussed concepts in human-computer interaction, perhaps because the heart of what it means to design technology that is fit for human purpose lies here (Payne, 2003). As a result of AI's swift entry into our lives, human-product relationships have gained a new perspective. On the other hand, moving toward a new age in design with AI, mental model theories have not evolved. Due to the fact that AI has a system model, which includes the mindset of the AI, that gives it the ability to learn, reason, and make decisions, it forces mental model theories to evolve. Therefore, we extended Norman's conceptual model by including the involvement of artificial intelligence. According to the model provided in this paper, in user-AI interaction, users interact with the system model of AI, which is regulated by the designer. But due to the learning ability of AI from the user, the system's model is an organic structure that can also be constructed by AI itself. Designers also benefit from the data collected by artificial intelligence from users. This situation positions artificial intelligence as both a designed thing and a tool that plays a role in the designing process. This mutual relationship is shown in Figure 4.

The interaction between AI and humans goes beyond the physical. Given this, mental interactions stand out more, and we consider research on this subject to be crucial. Mental interactions are more complicated than physical ones. To define mental models, we should better understand the relationships, elements, and components of mental interactions. The aim of the research is to explain the mental interaction between AI and the user by expanding Norman’s conceptual model. In this research, we referred design as 'dialogue' and explained three levels of dialogue to better understand the interaction between AI and users.

Norman (2002) approaches interaction from a goal-oriented perspective. In his very famous book 'Design of Everyday Things', he explains his goal-oriented view through seven steps of 'action style' (Norman, 2002). According to him, the goal lead the interaction to act. The action-oriented view includes cognitive and physical user actions and device behaviours in response to user actions. As it is a goal-oriented approach, it focuses on the behaviour and the result. And all the components that we just mentioned serve to better understand user behaviour by mostly focusing on the action. Hence, explaining mental model theories through an goal-oriented approach is related to the behaviourist view in psychology. According to the behaviourist, the mind cannot be understood or measured directly. We can only make assumptions by observing human behaviour. Therefore, it focuses on actions and behaviours. In the literature, some studies focus on behaviour and the results to better understand the mental models. For example, Gero and others (2020) study the mental model from the perspective of

knowledge and behaviour. They suggest that the mental model of AI has three components, which are global behaviour, local behaviour, and knowledge distribution (Gero and others, 2020). According to this model, the knowledge that AI has and its behaviour at both large and small scales determine the conceptual model. The cognitive perspective is valuable because it provides a set of values that HCI can understand and commit to. But understanding the user as a behaving system actions is criticized as reducing the user to a machine. Therefore, contemporary approaches to interaction design shift from a pragmatic perspective to a hedonic perspective. They stress the emotional and interpretable side of interaction. We should embrace both cognitive and hedonic side of the interaction. For this purpose, studies in mental model theories may, rather than action itself, focus on relationships that shape the process in the mind. For example, in the literature of psychology, the structuralist view, opposite the behaviorist view, is interested in relationships rather than results. The structuralist view tries to understand the structure or characteristics of the mind. The approach focuses on understanding the conscious experience through a method called introspection. We assume that structuralists' interest in relationships rather than results and their emphasis on the link between parts and the whole have a similarity to explaining mental models from a dialogue perspective. In this study, similar to the structural perspective, we tried to create a relationship between the components of mental models. Therefore, by describing design as dialogue, we mentioned the link between language and the mind. We suggest that language is the key component of mental interaction. We explain language as not only a communication tool but also interpretational knowledge, which trigger the emotions and create the characteristics and mindset of AI. Philosopher of language and reasoning and developer of mental model theory, Johnson Laird's work focuses on the relationship between language and perception (1980). The study suggests that the mental model provides a way of mapping language to perception (Laird, 1980). In this study, we introduced three levels of dialogue and explained them in the engagement process between AI and the user. We suggest that through this process, if the user's mental model matches the system's, dialogue can flow. Otherwise, some communication errors can occur. But we need future work to better understand the link between language, the mind, and mental interactions. How language in design determines the behaviour, meaning, and emotional experience of the user.

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