Tagging with Movement: Somatic Strategies for Image Classification

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ABSTRACT
Movement researchers in HCI have begun to utilize theories from the field of Somatics to support their investigations into tangible, ubiquitous, and wearable computing systems. Despite recent advances in integrating movement theory within HCI, the practice of incorporating the associated Somatic methods and referencing this body-oriented epistemological perspective is often lacking from design ideation and development within movement interaction. The epistemological gap between somatic values and technological models of movement can constrain novel applications of somatic theories and their potential to inform embodied approaches to movement interaction. In this paper we discuss the value of Somatic epistemology and provide a case study exploring the use of movement to tag visual images. We describe a series of movement workshops structured to explore movement tagging of visual images, and illustrate the benefits of bridging Somatic theories and their associated methods to the design of novel movement applications.

Categories and Subject Descriptors
H5.2. [User Interfaces] Interaction Styles, Theory and Methods, User-centered Design

General Terms
Design; Theory

Keywords
Movement, Somatics, Kinesthetic Awareness, Felt Experience, Laban Movement Analysis, Image Classification

1. INTRODUCTION
As computers move ubiquitously into all aspects of people's lives, new lenses are needed to more fully understand computer use and to develop new forms of interaction. HCI has a history of incorporating multi-disciplinary lenses, often as research methods borrowed from the social sciences and humanities.

Movement has become a more common modality of interaction influenced by the development of ubiquitous, tangible, and wearable computing systems. These advances have in turn required new methods for interpreting and understanding the under-explored aspects of movement interaction including kinesthetic experience. HCI researchers have historically looked to existing frameworks from movement-based disciplines to inform their research. These frameworks are often based on theories of embodiment which posits that the body is the basis for the construction of conscious experience. In HCI, theories of embodied cognition have been heavily utilized to support research investigating movement interaction [6,22]. These theories, while explaining cognition, have inadvertently minimized the critical experiential, and phenomenological aspects of embodiment. Researchers interested in the lived experience of interaction have as an alternative turned to movement-based disciplines for theoretical insight and support [26].

One framework in particular that has been given a great deal of attention by movement-researchers interested in embodied experience is *Laban Movement Analysis*. Laban Movement Analysis (LMA) is an analytical system developed by Rudolph Laban to allow for the systematic description, analysis, interpretation, and representation of human movement. LMA was developed within the discipline of Somatics, a field dedicated to investigating the kinesthetic potential of the body, straddling the spectrum from health to artistic performance.

Concepts derived from Somatic practice, such as those encompassed by LMA, are based on experiential practice and rely on the cultivation of awareness of the moving body. Their application within HCI, however, is often removed from practice, reducing the concepts to theories disconnected form direct experience. This usage of somatic concepts creates an epistemological gap that misplaces the value of somatic knowledge by separating theories from the methods and practices used to develop them. Our approach of using Somatic theories such as LMA in conjunction with their associated methods provides new opportunities for understanding the role of movement as a component of interaction and user experience.

LMA was selected as a framework for our research because it accounts for both experiential and formal models of movement representation. Using LMA enables us to link the constructs of movement and meaning in order to consider technological interaction from both linguistic and embodied perspectives. This approach facilitates the exploration of movement as a tool for accessing, describing, and conveying personal meaning. Considered as a language, movement can be described through its formal semantic properties (required for computational modeling); however movement also needs to be described through its embodied properties which provide access to experiential, ephemeral, and expressive qualities. We are interested in developing movement interaction that explores technology design within this epistemological gap between movement description and movement experience.

In this paper we discuss the design of an ongoing study investigating the use of movement for tagging visual content. Our premise is that semantic descriptors used to categorize data taxonomies have been limited primarily to text; yet the growth of multi-media data types including visual, auditory and kinesthetic data suggest new opportunities for developing rich data tagging ontologies. We focus on movement interaction as a novel

Conference'10, Month 1–2, 2010, City, State, Country.

approach to tagging data. We are interested in how movement languages, such as LMA can be used to both explore the experience of describing or tagging data, as well as provide for semantic descriptors to support the formalization of tagging.

This exploratory research illustrates how somatic theory and practice can be combined to investigate computational design solutions for novel movement applications. By directly incorporating LMA-based somatic exercises into a workshop exploring movement tagging we are increasing our understanding of how people embody memory and experience, and the ways in which they are enacted using expressive, full-body movement. This strategy supports the consideration of movement as a component of interaction in ways that are different from traditional approaches, and can lead to both new knowledge and new interaction techniques within HCI.

2. BACKGROUND

Movement as a form of interaction with computational devices has seen slow public adoption outside the field of gaming. Yet movement has the potential to overcome numerous challenges and to provide new approaches to interaction that can support ameliorative and adaptive user experiences.

Despite enormous advances in portability, smart phones and tablets differ little from their desktop counterparts with their reliance on text-based communication and limited support for full-body sensory engagement [19]. Current mainstream interface designs maintain the primacy of the screen during interaction, borrowing from desktop computing models that overlook the body's role in communication and experience. Smart phone technology has the potential to extend interaction beyond the screen, yet designers continue to develop applications that prioritize visual and aural content over other forms of sensory communication. This dependence on visual modes of input and output relies heavily on a user's attention, presenting problems for performing common tasks such as walking or driving. In order to support human-to-human communication and interaction in complex social and physical environments, mobile computing must move beyond a reliance on visual and auditory modes of communication and expand to include embodied forms of communication including movement. Researchers working in the areas of tangible and ubiquitous computing are exploring a wide range of interfaces to overcome these limitations and to expand interaction onto the body. This includes investigating gestures that better align with human cognitive processes, and developing wearable interfaces that take advantage of tactile and haptic interaction.

There has also been an increase in the number of gestural interfaces being developed with the availability of depth cameras such as the Microsoft Kinect©. Depth cameras are capable of tracking users and objects in three dimensions, facilitating unencumbered movement interaction limited only by the camera's line-of-sight. To date these movement tracking systems have been used almost exclusively to track easily detectable movements rather than focusing on the complex and subtle range of actions used by people in their daily lives. This omission is largely due to past limitations of the technology, requiring designers to utilize those gestures which were easily detectable; this focus on detectability reflects a technology-driven design process that is counter to the human-centered design practices espoused by contemporary HCI practitioners.

Gestural interfaces also largely ignore the kinesthetic experience of the user. For example, the use of the arms or hands for deictic tasks such as pointing emphasizes the communicative and semiotic aspects of movement while prioritizing the observer's perspective. The kinesthetic experience of the mover becomes subservient to the communicative task resulting in the experience of an "absent body" [18]. This omission neglects a primary characteristic of the human sensory experience that supports knowledge recall and human cognition.

3. EMBODIMENT

A concept that is particularly useful for investigating kinesthetic experience is *embodiment*. Over the last twenty years, theories of embodiment have become central to research investigations in a variety of disciplines including cognitive science, media studies, dance, performance, interactive art, and philosophy. Historically, the concept of embodiment developed as a critical alternative to the long-standing Cartesian separation of the mind and body in which the mind or brain is given primacy in the construction of experience and cognition. A central tenant of all theories of embodiment is that the body is the basis for the construction of conscious experience. Theories of embodiment do not dismiss the role of the brain in cognition, but rather view it as one of the many organs that comprise the body [23]. Researchers in a variety of disciplines have identified myriad ways in which embodiment supports human cognitive [16], emotional [5,6], and social development [1].

3.1 RESEARCH APPROACHES

Most embodiment research conducted within the scientific community investigates embodied cognition, a specific area of research emphasizing the role of the body in the development and support of human thought processes. This approach toward the study of embodiment is also the most often utilized within the field of Human-Computer Interaction (HCI) due to its cognitive science origins. An alternate and less common approach to understanding embodiment is to examine the role that the body plays in the construction of lived experience. Rather than reducing the scope of investigation, the latter perspective expands it to include elements of experience that are typically considered less research worthy within the scientific paradigm. Instead of solely focusing on the body's contribution to linguistic, mathematical, or conceptual thinking, this approach emphasizes sensory and tacit knowledge directly, to better understand how the body informs aspects of lived experience.

4. THE FIELD OF SOMATICS

The field of Somatics presents as being particularly beneficial in the study of kinesthetic experience and provides methods for investigating the phenomenological aspects of movement interaction that can support research in HCI. Somatics developed in the late 19th and early 20th century with roots in the Delsarte method as well as eastern philosophical traditions [25]. The term *Somatics* was coined by Thomas Hannah in 1976 to describe the collection of disciplines exploring embodiment and sensory awareness. One of the earliest works on the subject, *The Use of the Self*, was published by F. Mathias Alexander in 1932 [2]. Numerous other practitioners have contributed to the canon since then, including Elsa Gindler, Moshe Feldenkrais, and Rudolph Laban [9, 10, 15]. Unlike other body-based practices, Somatics does not focus on externally viewing the body, but rather is concerned with understanding the soma, the experience of the body perceived from within. This orientation provides a unique outlook that differentiates Somatics from other body-based practices [11].

Somatics is a practice-based field. Whether one is a dancer utilizing somatic techniques to improve their craft or a therapist assisting a patient improving their gait, the techniques provide a way to increase awareness of the way in which the body moves. Unlike physical therapy where the clinician manipulates the patient's body and prescribes exercises to improve strength or

flexibility, in Somatic therapies the patient is guided through movement patterns with the aim of becoming aware of the experience of moving. This awareness allows them to transform their relationship with their body and to improve overall functioning. Somatic methods are epitomized by their ability to expand awareness of kinesthetic experience.

The techniques utilized in the field of Somatics function as unique and valuable research methods, providing a way to gather empirical data that are of a first-person nature. Through the cultivation of awareness, skilled somatic practitioners extend their ability to perceive the body, enhancing awareness of each limb's position and motion as well as the sensations relayed through nerves, joints, muscles, tendons, and the skin [11]. This type of first-person inquiry provides a unique approach to understanding the body and its role in structuring human experience. Additionally, it highlights the role of an active body and of movement in embodied experience.

Somatic techniques provide multiple benefits to research in HCI. First, they can be utilized by technology system designers as research techniques by facilitating the identification and exploration of facets of bodily awareness that are applicable to technology design. They also provide models for how somatic awareness can be utilized in the development of new modes of interaction by emphasizing bodily experience, embodied cognition, and the incorporation of full body movement. Finally, Somatic techniques lend themselves to the investigations of user experience as it relates to gestural, tangible, and movement-based interaction in general, an area that needs to be better understood by researchers and practitioners alike.

5. LABAN MOVEMENT ANALYSIS

One Somatic framework that has been widely applied within HCI is Laban Movement Analysis (LMA). LMA is a comprehensive somatically derived system developed by Rudolph Laban beginning in the early 20th century to support the observation and analysis of movement providing documentation and evaluation techniques.

While Labanotion is often understood as equivalent to LMA, it is important to differentiate between them. Labanotation is a specific use of detailed notation that describes movement at the body level and applies overarching principles of LMA within it. Labanotation is a subsidiary system within LMA and provides a method for documenting and annotating sequences of movement. This system is similar to musical notation and provides a way for choreographers to document, distribute, and archive their work.

Laban Movement Analysis (LMA) is a comprehensive system for describing movement, including its higher-level over-arching themes and its specific attributes such as phrasing, encompassing qualitative characteristics and the subjective experience of movement. LMA takes a holistic view of movement by connecting outward movements with people's inner attitudes. Unlike other models of movement that approached analysis from a purely functional and efficiency-driven model, LMA considers the both the mind and body [3] thereby synthesizing function and expression. LMA describes movement as based on four primary components: Body, Effort, Shape and Space, which is referred to as BESS. The LMA system understands the dynamics of movement as encapsulating multiple perspectives. For example, the observational perspective enables a characterization of defining movement characteristics based on visual cues and kinesthetic empathy. The somatic perspective references the felt experience of movement – the awareness of muscle, bone, organs, tissue and the other proprioceptive and physiological elements, which make movement possible. The somatic perspective requires a different lens than visual observation necessitating proximal techniques (such as touch), and is more fundamentally experienced by the mover herself, through directed attention and awareness. Another perspective is the inner attitude that generates expressive quality of the movement conveying the mover's inner experience -- her intent and emotional state [3]. Within LMA there are overarching themes that link multiple perspectives for observation and analysis, and that link theory with practice to describe experience.

6. LMA AND HCI

LMA is a commonly referenced somatic framework within HCI; however, its usage is frequently presented without reference to its Somatic roots or their accompanying methods. Various researchers using LMA emphasize the use of Labanotation as a research instrument to aid in the transcribing of users' movement patterns. This includes Astrid Larssen, et al who focused on using the notation system as a tool for designing input into interactive systems [17] and Mads Vedel Jensen who used Labanotation as a means of transcribing movement data during ethnographic field work. [13]. Tom Djajadiningrat expanded on Jensen's research by exploring ways to characterize movement in terms of its expressive and emotional qualities rather than solely on its functional contributions to interactions [7].

Other researchers utilize elements from LMA as lenses through which to understand interaction, incorporating concepts such as the Effort-shape factors. Michael Bacigalupi integrated LMA using Dewey's aesthetic theory to investigate the role of aesthetics in constructing an interactive experience [4]. W.N.W. Hashim et al used LMA themes in the development of the Graceful Interaction concept, a framework for designing desktop interfaces for more effective, enjoyable, easy use [12]. Ana Paiva et al used LMA concepts to inform the development of the movement in their exploration of a *sympathetic interface*, a particular type of affective controller that responds to user's emotional gestures and touch [21]. [21]. And Petra Sundström, and Kristina Höök use LMA concepts to inform the design of their project *FriendSense*, a movement-based system that enables friends to share the physical sensation of emotional closeness [27].

7. EPISTEMOLOGICAL MISALIGNMENT

HCI's multi-disciplinary nature is beneficial as it allows for the expansion of the scope of the discipline. The incorporation of ethnography as a lens for understanding users, for example, brought with it both a new theoretical perspective as well as associated research methods. Coupling theory and method allowed ethnographic inquiry to gain widespread acceptance and utilization within the HCI community.

The use of Somatic concepts – those from LMA in particular – has similarly demonstrated the significance of interdisciplinary movement-based scholarship. The prevalent use of somatic theories, however, has not seen a corresponding utilization of somatic techniques. It is the incorporation of Somatic methods that articulate specific repeatable techniques for creating affordances for awareness that offer the greatest potential for researching and developing new movement-based interaction models.

While the use of LMA concepts, a specific Somatic approach, has provided insight for researchers investigating movement, the lack of reference to their origins in Somatics is problematic since it neglects the process oriented and action-centered basis of knowledge in the discipline and creates an epistemological conflict. This misalignment does not precluded the utilization of LMA concepts, however it severely limits their usefulness by removing them from the context within which they were developed creating a paradigmatic mismatch. The research

examples presented above do not take full advantage of the benefits of LMA because they have separated the theory from the methods used to produce it.

To fully understand this misalignment it is necessary to consider the origins of the techniques used by Somatic Practitioners; in particular, the central role of movement as a means of cultivating awareness in the development of Somatic theories. First-person somatic techniques, such as those used in LMA were developed as practice-based instruments in direct dialogue with the theories that they embody. The application of the frameworks and underlying theoretical perspective is predicated on the facilitation of personal body-awareness as exemplified in Schiphorst's notion of *somatic connoisseurship* [24].

8. CASE STUDY: MOVEMENT TAGGING

To illustrate the integration of somatic theory with somatic practice we describe an ongoing research project exploring how somatically-based workshops can inform technology design and aid in the development of novel movement applications. This case study demonstrates several ways in which somatic techniques can assist in research investigations: First, by providing an alternate approach to considering the role of movement in interactions by facilitating the recall of embodied knowledge; second, as a tool for priming participants in order to engage their kinesthetic intelligence; and finally as a method for motivating real time discussions of movement experience.

Our research investigates the use of movement metadata for tagging visual content. Semantic tags to describe data taxonomies have been limited to textual descriptors, yet the growth of multi-media data-types including visual, auditory and kinesthetic modalities suggest the possibility of rich data tagging ontologies. We focus on movement interaction as a novel approach to tagging data. Our research objectives our twofold: first, we are interested in how movement languages, such as LMA, can be used to both explore the experiential 'descriptions' of data and provide semantic descriptors to support computational models for tagging. Second, by incorporating LMA-based somatic exercises into a workshop exploring movement tagging we are increasing our understanding of how people embody memory and experience, and the ways in which they are enacted using expressive, full-body movement.

By using LMA as a starting point for our investigation, we conceived of using movement qualities rather than coded gestures for interaction. An LMA lens for describing movement quality enables us to observe and analyze how qualities of movement relate to subjective experience [20].These qualities of movement provide glimpses into the internal state of the mover, and are tightly connected with embodied and tacit knowledge. In LMA movement quality is divided into four *Effort Factors*, each representing a specific type of movement experience for an individual. The effort factors are described as *Flow*, *Weight*, *Space*, and *Time*. The movement qualities represented by combining these Effort factors are not mutually exclusive and normally occur in concurrent blends that vary fluently over time; however for the purposes of this investigation they are explored individually.

In this investigation Effort quality is not only enacted as a lived experience, but is used as a method of inquiry for observing experience. As a method, it frames experience in the context of real-world artifacts and facilitates decoding in a semantic framework that can be accessed by users in their relationships with images through meaningful properties such as memory, artifact, and metaphor.

Considering movement in this manner enabled us to conceptualize an exemplar research application to investigate how embodied meaning can be attributed to photographic content through the use of kinesthetic, or movement tagging. Digital tags, or metadata, are often used to classify and describe the contents within large databases of information in order to make them more easily indexable. Typically, metadata use language-based lexical units, providing textual labels that describe a characteristic of a particular piece of digital content. This research explores the use of full-body kinesthetic movement as a means of characterizing digital content. We consider movement and gesture as forms of human experience that can be richly and qualitatively described through the articulated theoretical semantics of LMA; however, rather than focusing on the semantic information as a separate, and non-embodied semiotic form that pre-defines experience, we utilize experience to shape the semiotic form and its underlying properties. In the application, users' movements are analyzed for the qualities they express which are encoded and linked to specific content, allowing user to search and sort their photographs using expressive movement. This tagging method differs from current approaches to using gestures for digital interaction which often mimic functional movement literally or metaphorically [14].

Our eight workshop participants were skilled movers workshop was held in a dance studio providing an environment conducive to moving. The goal was to explore various ways that people represent their experience of an image or images through the application of the LMA *Effort* factors. We devoted two hours to the investigation of each of the four *Efforts*.

Figure 1: Participants in the guided LMA warm-up

Each of the four phases began with a priming stage in which a Certified LMA expert conducted a 45 minute somatic-based movement exploration to enhance body awareness, tailored to embody the particular Effort Factor being investigated. These improvisations focused on self-observation of movement qualities with the participants responding to descriptors of images as they were experienced metaphorically (Figure 1).

Figure 2: Participant sorting images

Following the priming stage participants were given a set of 34 identical photos, which they were asked to sort based on the Effort qualities evoked by the image (Figure 2). For example, when investigating the *Flow* Effort they laid out the images on a continuum from *Bound Flow* to *Free Flow*. Participants selected an image from each side of the spectrum and created a short movement phrase of 3 to 5 seconds that embodied the

characteristics of the photographic image, emphasizing the particular Effort factor. Participants paired up and performed the short movements for their partner. Each group was given a Flip Camera® with which to record the movement and the ensuing partner discussion. This was followed by a group discussion in which the participants shared insights as movers and observers.

The use of the Flip Cameras® provided a method for capturing both movement sequences and discussions simultaneously without sacrificing the immediacy of the experience or compromising the participants' kinesthetic state. The cameras also enabled us to capture large quantities of data in a less formal and more natural manner (Figure 3).

Figure 3: Participants enacting images

8.1 Initial Findings

Our analysis of the workshop data focuses on the *strategies* used to embody the photographs, as well as a *thematic analysis* of the participants' discussion about their observations and analysis. We utilize a qualitative method involving coding transcripts from the workshop to identify thematic elements as well as correlations between movement experience and image categories such as memory, identity and social and familial structures.

Our analysis identified five high level strategy categories used by the participants in the process of interpreting and enacting the images. These were:

1. *Immediate Response/Reaction*
2. *Letting the Body Lead*
3. *Letting Emotion Lead*
4. *Letting the Image Lead*
5. *Relying on Metaphor or Abstraction*

The first category, *Immediate Response*, included any strategies that participants described as immediate, reactive, or occurring without conscious thought. Participants described some of these experiences as acting on impulse, letting the image wash over them, and responding to adjacent thoughts immediately before or after seeing the image. One participant commented, "I approached them like I'd seen them for the first time and I was letting them wash over me." Another participant related, "I found it quite easy to go with my first impulse, but I would get stuck because I thought…for a second."

The second category, *Letting the Body Lead*, included strategies that involved bodily awareness or sensation. This included focusing on breathing, the internalization of the LMA Effort qualities, and having a bodily or sensory reaction to an image. For example, one participant recalled, "something that helped was thinking …how does my breath respond to that image - like does it make it go faster slower, and then just going with that and just having the image be just part of that experience."

The third category, *Letting Emotion Lead*, included two primary sub-categories: experiencing a personal connection with the image, and responding emotionally to an aspect of the image. When personally connecting to the image participants included specific strategies including connecting with the action, people, animals, or subject depicted in the image. Some even had an emotional response to the faces of people depicted in the image, while others connected the images to personal experience that they had had in their own lives. One participant related her experience, "I could connect to the people because I have done those actions or I could imagine what they were feeling."

Those participants who had a more general emotional interpretation of the images described reacting emotionally to an image, associating an Effort Quality based on either liking or disliking the imagery, judging the image, and even experiencing fear while looking at the image. For example, one participant recalled her response to an image of a laughing woman saying, "To me that was the moment of something happening emotionally and that picture kind of encapsulated that moment – so I responded to the emotional quality and that was like a speeding up of time."

The fourth category, letting the image lead, included a number of sub-categories:

1. *Compositional Approach*
2. *Analytical Interpretation*
3. *Imagined Interaction*
4. *Creating a Narrative*
5. *Immersion Within the Image*
6. *Becoming the Image*
7. *Focus on Energy in the Image*

The first two strategies involved very distanced approaches to interpreting the imagery. Participants using the compositional approach focused on specific features relating to the layout, texture, or other formal property of the images such as the number of objects present. Participants who described using an analytical approach related using a distanced and objective observation in their interpretation. The remaining strategies in this category involved a much more involved interaction often based on the narrative quality of an image. These strategies included imagining ways to interact with the subject or objects depicted in an image, focusing on cause and effect, creating a narrative, imagining a scenario, experiencing immersion within the image, and in some cases becoming the image. One participant who experienced a strong sense of immersion recalled, "I found myself inside each image, each thing, each thing in the image." One participant also described an awareness of the energy within some images and used this to guide her interpretation.

The final category, *Relying on Metaphor or Abstraction*, included conceptual interpretations of the images. For example, when enacting an image of chains one participant related, "I thought about somebody being in chains, and like dying or being freed from that, so there was a sense of rising that came from that." Another participant commented that an image of lightning appeared to be "dabbing the sky" and this informed her interpretation and enactment of the image.

9. CONCLUSION

With the increasing ubiquity of depth cameras, and the availability of consumer-oriented wearable computing products, new design methods are needed to aid in the development of movement-based interaction methods that are human-centered and align with the role of the body in supporting cognition, and experience. Within HCI, designers and researchers are articulating a fuller range of such design practices that support embodied experience within computational interaction. Yet, despite the growing awareness that human cognition and behavior are dependent upon the experience of the body, techniques for invoking and modeling awareness of bodily experience as a design tool remain relatively sparse [19]. Somatic practices provide tools that can support HCI researchers and designers investigating bodily experience. Currently, researchers are utilizing theories that have evolved

through the use of somatic practices, but they generally neglect to incorporate these methods which are integrally connected and that could function as design tools. This trend significantly reduces the value, efficacy, and usefulness of any somatically-derived theory and potentially overlooks under-explored sensory capacities that could benefit movement interaction.

Somatic techniques function as unique research methods that are both empirically-based and provide a first-person perspective. This unusual combination makes them extremely valuable for investigating movement experience as it pertains to interaction. By exploring how theories of embodiment can be explicitly operationalized through rigorous somatic techniques of self-observation and self-reflection, HCI practitioners can re-conceptualize the role of movement during interaction. This transformation has the potential to aid in the development of novel movement-based interaction techniques, and provide better support for human cognition and emotional well-being.

Our study investigating the use of movement for tagging visual content illustrates how somatic theory and practice can be utilized together to explore computational design solutions. By directly incorporating LMA-based somatic exercises into a workshop exploring movement tagging we are increasing our understanding of how people embody memory and experience, and the ways in which they are enacted using expressive, full-body movement. While the direct application of our findings will go towards the development of a movement-tagging photo application, the results of our study have implications for understanding user context, emotional state, and psychological profile which can support a variety of other interactive strategies.

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