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Novel design research tools for emotional appraisal: a diary study on emotional appraisal and core relational themes

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Abstract

Much HCI research has explored user experience and, in particular, emotional ones, reflected in the increasing interest in well-being and affective health technologies. While much such research has focused on emotional awareness and regulation, less work has explored how to design for emotional appraisal. We report a 2-week diary study informed by the conceptual model of Lazarus's appraisal theory to explore emotional appraisal in the wild by proposing two novel design research methods: the Emotional Appraisal Kit and the Emotional Appraisal Diary. Findings indicate that these tools support this shifting in paradigm by providing a holistic method that considers emotional, physical, and computational elements. Findings also highlight the value of such tools in capturing the emotional process, going beyond emotional recognition to provide a deeper insights into what triggers emotions.

RESEARCH HIGHLIGHTS

- This research shifts the focus of HCI toward designing for emotional appraisal.
- We introduce two novel design research methods: the Emotional Appraisal Kit and the Emotional Appraisal Diary, grounded in Lazarus's appraisal theory.
- Findings show that these tools offer a holistic framework integrating emotional, physical, and computational elements.
- By moving beyond simple emotion recognition and regulation, this work provides a deeper insight into investigating emotional appraisal in real-world settings and explores how to design for it within HCI.

Keywords emotional appraisal, core relational themes, diary study, design research tools, affective interfaces

The growing body of HCI research on affective technologies has predominantly focused on those supporting users to perceive and recognize emotions (Lane & Smith, 2021), to strengthen emotional awareness (Ghandeharioun & Picard, 2017; Khut, 2016; Sas et al., 2015; Umair et al., 2019; Vidyarthi & Riecke, 2013) or emotional regulation (Azevedo et al., 2017; Costa & Adams, 2016; Costa et al., 2016; Ji et al., 2025; Miri et al., 2018; Slovak et al., 2023), as the ability to control emotions in response to specific events (Gross, 1998). Additional work has focused on affective technologies supporting reflection on emotions (McDuff et al., 2012; Sas et al., 2015; Ståhl et al., 2009; Umair et al., 2019), aimed at helping users explore their emotional experiences in order to understand them (Rosenberg, 1990).

Emotional reflection and emotional appraisal are closely related, yet distinct. Reflection is a deliberate process focused on present or past emotional states, aimed at understanding why one experiences particular emotions and what these emotions reveal to the individual, thereby supporting self-awareness and self-development (Silvia, 2002). In contrast, emotional appraisal can be both deliberate and automatic and focuses on present or anticipated emotional events in order to evaluate their emotional significance for an individual, such as whether an event is threatening or beneficial and whether one can cope with it; this evaluation increases the likelihood of experiencing the immediate emotion most congruent with the event and shapes anticipatory emotional expectations for similar future situations (Scherer & Moors, 2019). Affective technologies primarily focus on emotional identification and emotional regulation, which help manage emotions (Boden & Berenbaum, 2011; Boden & Thompson, 2015). However, limited work has explicitly supported an understanding of emotional causes, i.e., emotional appraisal.

Emotional understanding is supported by appraisal theories, which suggest that emotions are triggered and recognized based on an evaluation of the personal significance of an event and its impact on one's well-being (Bippus & Young, 2012; De Rivera, 1977; Lazarus, 1991; Lazarus & Smith, 1988). A key appraisal theory is Lazarus's, who introduced a set of core relational themes, one for each specific discrete emotion, to capture its triggering, its evaluation

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process, and the inclination to react to the perceived harm or benefit of emotional events (Lazarus & Folkman, 1987). For example, the core relational theme for anger is "a demeaning offense against me and mine," and for hope is "fearing the worst but yearning for the better" (Lazarus, 1993, 14).

Appraisal theory has been applied in various contexts and for different purposes to explore emotional experiences connected to user experiences, in computerized tasks (Jokinen, 2015), with mobile phones (Arlinghaus & Ollermann, 2021), website design (Jokinen et al., 2018), and e-commerce (Lim & Kim, 2020). Lazarus's appraisal was implemented to examine how computerized tasks are perceived as either techno-competence or techno-frustration, based on the successful completion of tasks (Jokinen, 2015).

Despite the importance of core relational themes, limited HCI work has explored them and investigated their value in guiding the design of affective interfaces for emotional appraisal. To address this, we present a 2-week diary study with 18 participants, focusing on the following research questions:

- How can appraisal theory help in creating a tool to capture appraising real-life emotional experiences?
- How can users be supported in appraising their daily emotional experiences?
- What value does such a tool provide, and how do users perceive their value in assisting emotional appraisal?

Our contribution is threefold. Firstly, we present a novel Emotional Appraisal Kit, a cultural probe pack, and an Emotional Appraisal Diary, both explored designing for emotional appraisal in everyday life. Secondly, we discuss users' subtle assessment of appraisal experiences. Finally, we discuss design implications for affective interfaces that may support emotional appraisal. This paper extends our previous work (Alsubhi & Sas, 2024) on exploring and designing a bespoke probe called the Emotional Appraisal Kit, which described the kit's materials, a 1-week diary study, and participants' feedback on them.

Related work

We draw from HCI research on affective technologies, particularly those focusing on supporting emotional experiences, as well as the emerging work on emotional appraisal.

HCI research on affective technologies

Affective interfaces in HCI are gaining attention in designing technologies that have focused primarily on supporting emotional awareness (Ghandeharioun & Picard, 2017; Khut, 2016; Sas et al., 2015; Umair et al., 2019; Vidyarthi & Riecke, 2013), along with reflection (Azevedo et al., 2017; Costa & Adams, 2016; Costa et al., 2016; Miri et al., 2018) and regulation (McDuff et al., 2012; Sas et al., 2015; Ståhl et al., 2009; Umair et al., 2019).

For instance, Affective Health (Sanches et al., 2019) is a skin conductance measurement system that uses sensors and GSR for measuring real-time sensed data. The system was designed to analyze and understand how users reflect and regulate emotions depending on their own ambiguous interpretations of biodata. The researchers used a research through design approach with 23 participants, including weekly interviews. AffectAura (McDuff et al., 2012) is a desktop-based dynamic interface for presenting feedback on users' emotions over long periods. The interface presents multimodal sensing data (audio, visual, physiological, and contextual) for users to review emotional patterns over time. A short in-the-wild study was conducted to evaluate the tool's usability in addressing the difficulty of reflecting on and recalling past emotional experiences. Findings indicated that the interface allows users to reflect on their daily experiences and helps them regulate their emotional states.

Affective Diary (Ståhl et al., 2009) is a system that uses body sensors to track and present users' physical activities. The study deployed a user-centered approach to extend the traditional diary into an affective diary that captures bodily aspects of experienced emotions and combines them with other mobile phone materials to create anthropomorphic silhouette figures that change shape based on the level of movement and their color, presenting the level of arousal. Findings indicate that users of the system were able to reflect on past experiences, understand themselves, and even take steps to change their behaviors. Ripple (Howell et al., 2018) is a shirt that changes its color based on users' emotions or physiological states. It has three thermochromic threads that change their colors when exposed to different temperatures. Participants in the study were asked to wear the shirt for 2 days in daily life. Then, they were interviewed to collect their feedback on the probe. Although it is unclear what causes the color change, the ambiguous feedback led participants to actively interpret and question their bodily and emotional states.

Emotional appraisal in HCI

Human–computer interaction (HCI) research, especially work that links emotional experiences to user experience (UX) quality, has gained considerable momentum, largely driven by advances in interactive technologies that significantly expand how users interact with computers (Kheder, 2023). To investigate the appraisal process itself by checking whether participants emotionally react to computer-generated facial expressions as they do to real human faces, a laboratory experiment was conducted with fNIRS to measure brain activities for participants (Zhao et al., 2020). Outcomes validated the use of computer-generated facial expressions in affective HCI, virtual agents, and social interfaces as they elicit measurable neural markers of emotional appraisal. The relationships between mobile phone usage and users' emotional states were examined through an online survey and statistical analyses to test hypotheses linking use frequency and emotional appraisal (Arlinghaus & Ollermann, 2021). Findings showed a correlation between positive emotional states and mobile phone usage.

A user-centered approach to designing better content moderation tools was implemented (Jhaver et al., 2023). The researchers interviewed social media users and employed four personal moderation interfaces as interactive probes during interviews to elicit users' emotional judgments, mental models, and perceptions of responsibility and labor around content moderation. Although emotional appraisal is not explicitly adopted in the study, it provided rich evidence about how users appraised the effort and outcomes of content moderation settings and how these appraisals shaped their feelings. Moreover, a user study was carried out exploring how users appraised and emotionally reacted to technology problems during interactions (Jokinen, 2015). Participants in the study engaged in a one-time lab session, and they filled out online questionnaires before, during, and after the session. The study proposed a conceptual model of emotional user experience, explaining how interaction events, goal congruency,

and user traits lead to emotional reaction during technology interactions. Similarly, a laboratory experiment was performed in which participants appraised web pages, while researchers controlled experimental procedures. The study showed that targeted visual design can systematically shape users' esthetic experience (Jokinen et al., 2018). They presented a conceptual model based on appraisal theories and testable hypotheses to address the gap between vague UX goals and specific visual design choices.

Authors in (Lim & Kim, 2020) examined how shoppers' emotional intelligence shaped their online shopping behavior based on the cognation–affection–conation framework, and incorporated emotional intelligence as an influencing factor. They built their hypotheses and tested them by adapting questionnaire items from several prior validated scales. Findings indicated that emotional intelligence influences online shopping behavior by forming shoppers' cognition and affection, which affect their behavioral intentions. EmotiNet (Balahur et al., 2012) is a knowledge base, based on the appraisal theory model, which aims to tackle limitations of surface-based, word-level emotion detection. Appraisal is implemented by representing situations as structured sequences of action with ontological relations. These representations enable reasoning about goals and event outcomes, which are used to infer corresponding emotions from the knowledge base.

Emotional appraisal was conceptually implemented by adapting the OCC emotion model within the personality module of the robot architecture (Konstantopoulos et al., 2008). They introduced a system architecture aiming to provide a framework representing robot personality to support more natural human–robot interaction. Along similar lines, an emotion–cognition model was built and plugged into a reinforcement learning algorithm to tackle robots' inability to respond with appropriate emotions in human–computer interaction (Yang & Zhang, 2022). The model was mainly tested in a virtual setting, with no real-world robot or large-scale user study. Also, a narrow emotional context was utilized in the study by using only facial expression images as input. Appraisal theory was also applied as a computational model to continuously predict and track users' emotional state during interaction with tasks (Zhang et al., 2024). The model included a task, a learning agent, appraisal calculators, and an emotion-mapping stage. Users rated their feelings during the task using a self-report to compare them with the predicted emotions, and results from the study showed partial matches. Finally, emotional appraisal was adapted during a real-time interactive game to address the limitation of static emotion labels in virtual characters (Courgeon et al., 2009). The key outcome was an appraisal module that translated game events into emotions, which in turn drove MARC's facial expressions.

In conclusion, affective computing has mainly relied on ambiguous interpretations of collected data to infer users' emotional states. While previous work on affective representations indicates that such ambiguity can invite active interpretation (Gaver et al., 2003; Sanches et al., 2010). It also poses considerable challenges when the mapping lacks clarity (Howell et al., 2018). Emotional appraisal theory proposes a structural model to represent emotional states, and it has primarily been employed to develop conceptual models for enhancing human–computer interaction or to retrospectively describe user experience across different interaction platforms. However, there is limited empirical work that focuses on informing users about their own emotional appraisal processes or on translating appraisal theory into an interactive tool that enables users to capture and reflect on these processes. Moreover, the user-perceived value of such tools in supporting emotional appraisal remains largely unexplored, highlighting a clear gap in user-centered research within this domain.

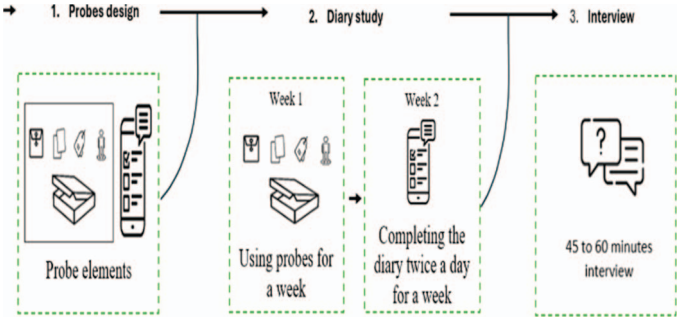

Figure 1 Study phases including the design of cultural probes, their use in a 2-week diary study, and follow-up interviews. Icons source: Flaticon. Accessed via https://www.flaticon.com/

Methods

To address the research questions, we drew on appraisal theory by presenting its main components and showing how these components were implemented in the design of our emotional appraisal tools. Then, we conducted a 2-week diary study in which participants regularly engaged with the bespoke probes to appraise their everyday emotional experiences. Finally, the collected data were analyzed to investigate the value of such tools. The study was authorized by Institutional Ethics Approval.

Participants

The study sample comprised 10 males and 8 females, aged 20–40 years (M = 29.5). Participants came from different academic levels, including 3 postdoctoral researchers, 10 PhD students, and 5 MSc students. They represented diverse disciplines such as management, biomedical sciences, marine sciences, and computing. None had social disorders or other mental health conditions, which was important for ensuring that the results were both dependable and broadly applicable.

Procedure

We aimed to explore emotional appraisal in real-life emotional events through a diary study. This study consisted of 2 weeks during which participants engaged in the first week with a cultural probes pack, and in the second week, they interacted with an online diary followed by interviews (Figure 1). Then, qualitative data were collected from the probes and interviews, as well as quantitative data from the online diary.

Materials: emotional appraisal kit

Emotions are not simply elicited from actual events but from cognitive processing of them, as suggested by emotional appraisal (Bippus & Young, 2012). There are two types of emotional appraisal in Lazarus' theory: primary and secondary (Lazarus & Folkman, 1987). While the primary one assesses if stimuli impact individuals' well-being, the secondary one evaluates their coping abilities (Smith & Lazarus, 1993). According to Lazarus (Smith et al., 1993), the components of primary and secondary appraisal are motivational relevancy and

Table 1 Appraisal components and their meaning, as well as how each component was articulated in a question on each token.

Tokens: appraisal component	Component meaning (Smith & Blons, 2000; Lazarus, 1993; Smith et al., 1993)	Component representation as token
Token 1: motivational relevance	The extent to which the situation is linked to personal goals or concerns.	
Token 2: motivational congruence/incongruence	The extent to which the situation matches or conflicts with personal goals or desires.	
Token 3: accountability	Identifying the source of the situation, giving credit if it is motivational congruence and blame if it is motivational incongruence.	
Token 4: problem-focused coping	Personal capability to alter the situation to match, or preserve, personal desire.	
Token 5: emotion-focused coping	The perceived chance of emotionally adjusting to the event by revising personal perceptions, desires, or beliefs.	
Token 6: future expectancy	Potential changes to the situation, actually or emotionally, that alter how it seems more or less aligned with personal motivations.	

motivational congruence/incongruence; accountability; problem and emotion-focused coping potentials; and future expectancy. Appraisal components have a set of possible values (Ellsworth & Scherer, 2003). These values are combined with summaries of cognition called core relational themes. Values of these core relational themes vary depending on how the different components of appraisal are combined (Lazarus, 1991a,b). The Lazarus model (Table A1) expresses emotions as a link between cognitive reactions and coping strategies (Roseman et al., 1996).

We explored previous emotional appraisal work to draw inspiration and to investigate methods used for eliciting emotions, such as vignettes (Robinson et al., 2001), emotional words (Carbia et al., 2020), or images (Stella et al., 2022). We also utilized cultural probes in designing our Emotional Appraisal Kit (Gaver et al., 1999; Riekhoff, 2008). For the first week of the study, the kit was iteratively designed, focusing on 15 discrete emotions: happiness, sadness, hope, pride, shame, guilt, anger, anxiety, disgust, relief, jealousy, envy, compassion, fright, and love (Lazarus, 1993). We had 15 different emotional packs, one for each emotion. Participants were instructed to engage in the kit activities by completing at least two daily emotion packs to accomplish all emotions.

Participants were instructed that if they experienced any of the 15 emotions, they should complete the emotion pack corresponding to that emotion. For completing emotion packs, they should first add situational details for the experienced emotion, respond to appraisal components, capture bodily sensations related to that specific emotion, and add its core relational theme. We used appraisal theory (Lazarus & Folkman, 1987; Smith & Lazarus, 1993) as a foundation for our work. Therefore, to capture the framework of this theory, we designed six tokens to represent the components of primary and secondary appraisals, each token representing one component (Smith et al., 1993). We articulated appraisal components as six questions and presented them in a way inspired by previous work (Matos et al., 2022). Each question represented one corresponding component (Table 1). To complete tokens, participants were instructed to respond to each question by writing one to three sentences on the back of each token. Responding to tokens provided an evaluation of emotional experience. Although data were collected using tokens for all 15 emotions, only nine could be directly compared with Lazarus's model, as full appraisal breakdowns were defined only for these emotions (Table A1) (Blons, 2000; Smith et al., 1993).

Then, participants were advised to examine the next set of probes, 15 cards. Each card reflected a core relational theme associated with each emotion. Lazarus provided a brief sentence describing the core relational theme for each of the 15 emotions (Lazarus, 1993) (Table A2). After examining cards and choosing the core relational theme card that matched the experienced emotion, participants were asked to place the card in the respective emotion pack. The placed card could not be used again, as each card was intended to be chosen once. This activity provided an awareness of core relational themes and how they could be linked to discrete emotions.

Body maps have been adopted in HCI to express emotions and illustrate complex body sensations (Núñez-pacheco & Loke, 2016). Therefore, along with tokens and cards, the kit also contained 15 body maps, one in each emotion pack. We aimed to provide nonverbal, more embodied ways for participants to express their feelings. We designed gender-specified body maps, including full-body dual views. Completing body maps required participants to choose a color that represents the feeling, draw areas on the body where they felt the emotion, and describe the feeling in verbal depictions.

Materials: emotional appraisal diary

This probe aimed to help participants appraise emotional events using a validated tool. A bespoke webform allowed participants to reflect on 10 key emotions: anger, guilt, fear, anxiety, sadness, joy, happiness, hope, pride, and relief, with each emotion being captured a maximum of two times. Participants were asked to complete this online diary 14 times in total, twice per day, as soon as possible after those emotional events occurred. Reminder messages were scheduled for the morning and evening to prompt diary completion.

In this tool, we used two main scales based on Lazarus' appraisal theory: the appraisal components and core relational themes scales. After selecting the experienced emotion from a list, participants answered general questions about the emotional event, and then they rated the scales. This step was intended to help them recall and structure information about the event. Attaching a photo was optional, in case participants preferred not to share images related to their

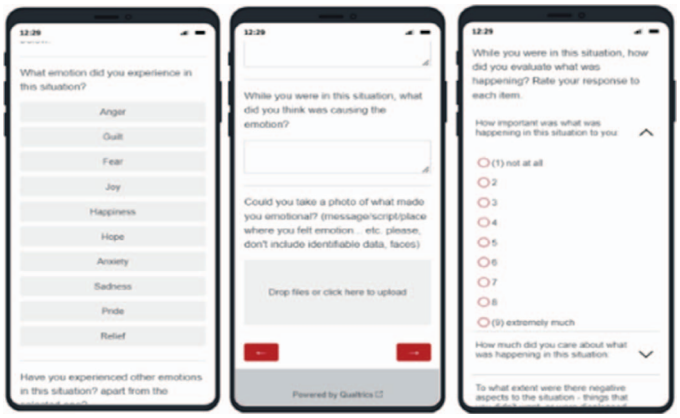

Figure 2 Emotional appraisal diary recording screens.

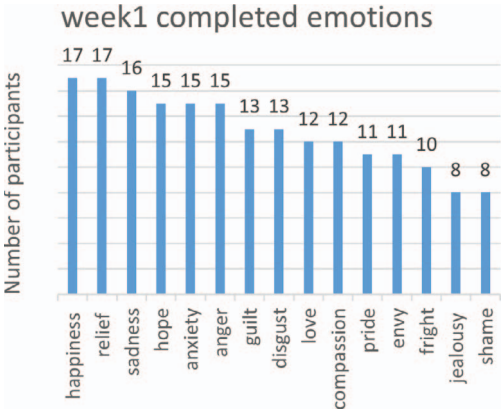

Figure 3 Week 1 emotions and the number of participants who completed them.

emotional experiences. Participants then completed the validated Likert scales by rating the scale statements from 1 to 9 (Figure 2).

Many scales with multiple dimensions have been used in the literature, such as causal attributions, categorical attributions, dimensional attributions, emotions, appraisal components, and core relational themes (Blons, 2000; Smith & Lazarus, 1993; Smith et al., 1993; Jamieson et al., 2018; Folkman & Lazarus, 1985). We aimed to ensure that the webform would not be overwhelming. Therefore, we used the most important scales in appraisal theory. According to Lazarus (Smith & Lazarus, 1993; Smith et al., 1993), emotional identification and comprehension depend mainly on appraisal components and core relational themes.

Interviews

We conducted individual, semistructured interviews, enquiring about participants' understanding of the appraisal process and their perceptions of the process components. They were asked about the way they interacted with the study's materials and accomplished its activities. We also collected their feedback on the overall impacts and the challenges they encountered with the materials. Interviews were conducted online over Microsoft Teams, lasted between 45 and 60 min and were audio-recorded.

Data analysis

In this study, data were collected from three sources: (a) qualitative data provided by participants through the kit, (b) data from the online diary, which included both qualitative and quantitative data, with the present analysis focusing on the quantitative one, and (c) qualitative data obtained from semistructured interviews. Data collected from the probes and interviews were anonymized and transcribed. To analyze the data, a hybrid approach for thematic analysis (Fereday & Muir-Cochrane, 2006) was used. Such an approach combined deductively generated codes (Crabtree & Miller, 1992), informed by research on appraisal theory, with inductively generated, data-driven codes (Boyatzis, 1998). This combination aligns with the research objectives, allowing themes to emerge naturally from the data.

The coding scheme was developed iteratively, drawing on research in appraisal theory and Affective interfaces. Deductively generated codes included a framework and concepts relevant to appraisal theory, such as appraisal process grasping, identification of process components, appraisal components from tokens, core relational themes from cards (Blons, 2000; Smith et al., 1993; Smith & Lazarus, 1993) and impacts of the probes on emotional understanding, awareness, regulation and reflection (McDuff et al., 2012; Saariluomaand & Jokinen, 2014; Sas et al., 2020; Turmo Vidal et al., 2023). Inductively generated codes captured data collected from body maps and emotion bags such as body parts, emotion color, feeling description, and situational details. Inductively generated codes, also from interviews, were generated to capture participants' overall experiences with probes, challenges, factors impacting perceiving emotions, and improvement suggestions to the probes. The analysis was conducted using Atlas.ti (Friese, 2019).

Data collected from the online diary was exported and accumulated in a spreadsheet for analysis. Then, the data were analyzed using the methodology outlined in the corresponding theoretical framework (Blons, 2000; Smith et al., 1993; Smith & Lazarus, 1993). Mean scores were calculated for the appraisal components and core relational themes across emotions. In the literature, validity and reliability are repeatedly tested to ensure that a measurement tool is accurate and consistent. For the former test, correlation analysis was used (Blons, 2000; Smith et al., 1993; Smith & Lazarus, 1993). We are not aiming to assess the tool's reliability, as it has already been validated (Blons, 2000; Smith & Lazarus, 1993). The data captured in the online diary were analyzed using R software (Crawley, 2014).

Results

Engagement with probes

Although we aimed for all 18 participants to complete the 15 emotions in the kit, only four participants completed the full set. Figure 3 shows emotions included in the first week and the number of participants who completed each emotion. By the study design, we expected that each participant would contribute one entry per emotion. Even so, none of the 15 emotions was completed by all participants, with happiness and relief having the highest engagement, as 17 participants completed them.

For the online diary, we expected a total of 252 completed diary entries, 14 per participant. However, the total completed entries were 171, and the number of entries per emotion varied across participants. Figure 4 presents emotions included in the second week, the number of completed entries per emotion, and the number of participants who completed them. Although anxiety had the highest number of

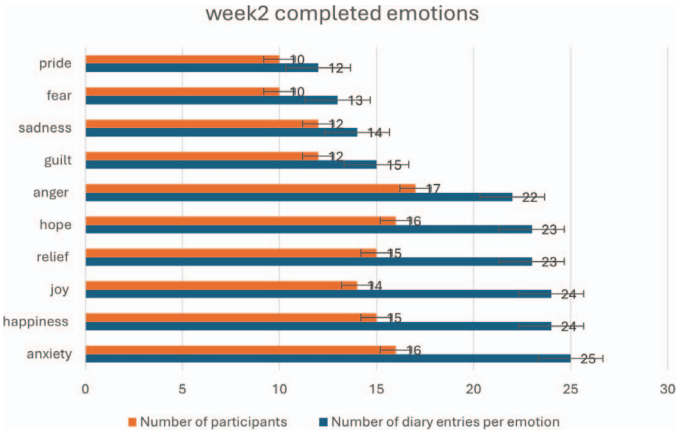

Figure 4 Week 2 emotions and the number of participants who completed each emotion, as well as the number of diary entries recorded per emotion.

completed entries, 25 entries by 16 participants, the next four most completed emotions were all positive.

Participants gave justifications for their inability to capture all emotions in the kit or completed the total number of entries in the diary (Table 2). Nearly half the participants (8/18) agreed that having a stable lifestyle or routine caused them to experience fewer emotions. For instance, P17 found that his intensive research work led him to a lifestyle with limited social interaction: "I spend most of my day in the department or office, often from morning until 10:00 PM. Some emotions are difficult to experience, as they are more closely tied to interactions with others." The lack of triggers for specific emotions prevented experiencing them (5/18). P13 stated that although he understands what jealousy means, he is unsure whether he has experienced it: "While I may feel envy at times, I do not think I have ever experienced jealousy, as I lack situations that trigger it." Participants (7/18) also emphasized that having to experience multiple emotions within a limited time frame hinders their ability to cover the entire list of emotions.

Appraisal process: grasping and identification

Since the study's core concept was not explicitly explained to participants, the probes and activities were designed to assess whether participants could be informed about emotional appraisal experiences. An important finding is that participants grasped many perspectives on this process, and they defined it in different expressions as emotional awareness (13/18), understanding (10/18), regulation (2/18), and reflection (6/18). Moreover, they referred to this process as evaluating events and personal attitude (6/18), interacting with emotions (4/18), and noticing physiological and behavioral aspects of emotions (4/18) (Table 2). One participant expressed her understanding of the emotional appraisal in a way that captures the cognitive process, as thinking of emotions as a process related to different life aspects, such as goals.

Moreover, to deeply investigate the effectiveness of the probes in informing participants about the process, we asked them to describe their understanding of its components. As shown in Table 1, their responses included the appraisal components included in the theoretical model. Participants stated that motivational relevance was an important factor in the process (16/18). The alignment of goals or beliefs with the situation was reflected as a factor by (10/18) participants. Accountability (10/18), coping (5/18), and the future impact (1/18) of the situation were mentioned as components in the process.

While coping potentials are theoretically represented by two components, emotion and problem, and are similarly captured in our probes, participants were unable to distinguish between them. Future research that follows the structural model of this study could explore this point and investigate better designs of appraisal components to help users distinguish between them.

Impact of the probes

This section outlines the most significant impacts perceived during the engagement with the probes (Table 3).

Impact of the kit: tokens

Tokens were one of the probes provided in the kit, which had a great impact on participants' awareness (14/18), understanding (18/18), reflection (6/18), and regulation (10/18). This indicates the value of this probe in supporting emotional appraisal by not just reflection on goals and beliefs, but also in extracting the meaning of emotional situations by questioning feelings. This resulted in grasping a good understanding of emotions and raising awareness of similar situations. For instance, P8 indicated that during the first week of the study, he experienced pride in his sister's achievement of her personal goal and stated that: "Earlier, I would feel happiness or pride physically but would not label or acknowledge it. Negative emotions were always noticeable, but positive ones often passed without being fully perceived. This awareness enabled me to understand and name my emotions more clearly."

Token 3, accountability, promoted understanding of emotional triggers by reflecting on the cause of emotions, which in turn led to emotional coping. Tokens raised awareness of P7's habituation to anxiety and supported him in understanding sources for such emotion: "I am facing anxiety regularly, I had never noticed as I was habituated to it. After answering tokens, I gained awareness of the feeling and understood its reasons." Similarly, token 3 helped P4 be aware of sources of negativity in her daily life, people or places, and then she took steps to avoid such instances. Tokens 4, 5, and 6 increased emotional regulation and shaped responses to emotional events by avoiding reactive responses, raising awareness of emotional intensity, and critically thinking of ways to overcome negative situations. Three participants highlighted experiencing a therapeutic value in responding to tokens.

Impact of the kit: body maps

This probe was perceived as a reflective tool (16%) that developed participants' awareness (72%) and understanding (16%) of different bodily sensations related to emotions. Participants used body maps to differentiate emotions through physical signals, including internal bodily sensations such as warmth, coldness, vibration, and heaviness, as well as external states such as body posture, facial expressions, sweating, and muscle activation. They also highlighted the body parts affected by emotions and distinguished between different sensations when emotions involved a specific body part. Body maps further helped participants justify their bodily reactions to emotions. For example, P12 reported, "I can feel love in my chest area and also in my arms as a reaction to wanting to hug someone," while P15 experienced

Table 2 Themes identified regarding participants' understanding of the appraisal process and difficulties in completing emotion entries.

Category	Subcategory	Theme	n	%
Emotional appraisal process	**Identification of process components**	Motivational relevance	16	90%
		Goal & beliefs congruence/in congruence	10	55%
		Accountability	10	55%
		Coping	5	28%
		Future expectancy	1	5.5%
	Appraisal process grasping	Emotional awareness	13	72%
		Emotional understanding	10	55%
		Emotional reflection	6	33%
		Emotional regulation	2	11%
		Evaluating events & personal attitude	6	33%
		Interacting with emotions	4	22%
		Thinking of emotions as a process related to different aspects	1	5.5%
		Physiological and behavioural aspects of emotions	4	22%
Engagement with the probes	**Reasons for not completing all emotions/entries**	Time constraints and study duration	7	40%
		Lifestyle and contextual factors limiting emotional variety	8	44%
		Infrequency or lack of triggers for certain emotions	5	27.8%
		Emotional overlap and difficulty differentiating emotions	1	5.5%
		Conceptual misalignment with emotion categories	1	5.5%

Table 3 Themes describing the challenges and impacts of the probes reported by participants.

Probes	Challenges with the probes/activities						Impact of the probes			
Kit	Tokens	Appraisal components do not fit all emotional situations 8 44%	Repetition and overlap between tokens 5 28%	Complex and multilayered questions 4 22%	Emotional complexity 1 5.5%	Privacy concern 3 16%	Lack of clarity on how to respond 4 22%	Emotional strain during appraisal 3 16%	On emotional awareness 14 78%	On emotional understanding 18 100%	On emotional reflection 10 28%	On emotional regulation 6 28%
	Cards	Language and wording of the cards 3 16%		4 22%		3 16%	Mismatch between cards and personal definition of emotions		6 28%	6 28%	4 22%	
	Body maps	Difficulty in expressing bodily sensations visually 3 16%			1 5.5%		4 22%	Difficulty in differentiating physical reactions to different emotions	13 72%	3 16%	3 16%	
Online diary		Statements irrelevancy 4 22%		3 16%		Frequency, lengthy, and time-consuming			15 83%	12 66%	7 39%	8 44%

love as "a tingling sensation in the fingertips." Participants provided metaphorical expressions to describe emotions, which demonstrated a high level of awareness (Citron & Goldberg, 2014).

The key mechanism used in completing body maps was typically feeling an emotion first and then noticing the associated bodily sensations. However, two participants found that body maps directed their attention to these sensations, especially when the emotion was not strong, allowing them to notice emotions through bodily sensations. As reported by P16: "When I notice bodily signs, such as tense shoulders or a curled posture, I start questioning what they mean and whether I am feeling a specific emotion. These physical signals help me recognize the emotion and reflect on what triggered it."

On the body maps, participants expressed emotions through words and drawings. They used different shapes and linked those shapes with specific types of emotions. For instance, heart shapes were used mainly with love and sadness to represent different feelings, such as a broken heart for sadness and a heart with an arrow for love (Table 4, summary of anger representations on body maps). Therefore, body map findings indicate that to support the development of the HCI research, it is important to research tools for capturing bodily data (Daudén Roquet & Sas, 2020; Gayler et al., 2021; Sas et al., 2020) to guide design based on the body (Alfaras et al., 2020; Roquet & Sas, 2021).

Impact of the kit: cards

Cards, core relational themes, had the lowest overall impact compared to other kit materials, as 28% of participants reported that the cards had an impact on emotional awareness and understanding, whereas 22% noticed a reflective value. Two participants stated that these cards increased their awareness of identifying and distinguishing rare and closely related emotions. For instance, they made P11 build a personal understanding that helped her differentiate between envy and jealousy: "I became more aware of these two emotions. I am now differentiating them; from my perspective, I think of jealousy as having a more negative impact on me. On the other hand, envy is more about desire than negative emotions." Besides the envy and jealousy cards, the card representing love helped P1 understand and recognize the meaning of the emotion. It relieved him to know that love emotion is often mutual, but should not have to be: "Love card was participating in affection, usually, but it is not necessary to get it back. So that clarification was so satisfying to me when I saw that. Then I got to know I do love a lot of things like that."

Participants interacted with this probe by matching cards to emotion packs. Two participants noted that the limited impact of the cards was mainly due to the short duration of the interactions, [P18]: "I do not think the cards strongly impacted me, unlike the tokens, because I just had to match them." This highlights the importance of interaction duration and effort in shaping participants' overall feedback (Jhaver et al., 2023).

Impact of the online diary: emotional appraisal diary

The online diary had a notable impact on awareness of emotional states (15/18) (Table 2). The awareness was raised by rating emotional appraisal statements, such as "How important is what was happening in this situation to you?" Besides acknowledging the importance of emotional events, participants (12/18) stated that the online diary increased their understanding of emotional triggers. Additionally, one participant noted that it helped him recognize emotional patterns across different places and situational factors, [P9]: "In the second week, I started to see patterns in my emotions based on locations, and

Table 4 Body map representations of anger. Participants' qualitative body-map data. This table shows how participants experienced and expressed anger in the body through the shapes they drew, metaphorical descriptions, reported physical sensations, and referenced body parts. They mostly used red colour to draw.

Shapes	Internal states/signals	Physical sensations	Facial expressions	Body parts	Metaphorical descriptions
Arrow	Madness, irritated, rage, fuming, uncomfortable thoughts	Tight fist, burning hands	Frown	Head, face, limbs	Wanting to rip things
Circle	Activation of muscles	Shaky hands	Bulging eye	Chest, heart	Flash and flare of heat
Wavy, zigzag lines	Energy moving through the chest	Tight chest	Tense face	Neck, shoulders	Physical movement as a recoil to my actions
x sign	Cloudy judgment	Sweating	Tight lips, showing teeth		
Cloud	Pounding heart	Spinning, dizziness			

situations. At the gym, I often felt anger and fear, joy at home while eating specific foods, hope, anxiety, and a mix of other emotions in the office around specific people." Moreover, it helped P6 to reflect on situations from new perspectives, blaming others for emotional situations: "Rating statements such as, someone is taking advantage of me," or "I have been cheated or wronged, had a profound impact on my emotions, making the experience incredibly insightful. The awareness of these situations moved me to tears." The diary encouraged reflective thinking (7/18) by prompting self-questioning and influenced how to deal with similar situations over time: "I have also asked myself questions to complete the diary, which expanded my views and led to personal growth. Then, when similar situations occurred, those questions from the diary would arise to guide the feeling" [P7]. Reflecting on emotional situations from different perspectives, such as accountability for oneself or others, helped P1 discover more about these situations while completing the diary, in contrast to months of self-reflection using a reflection tool: "Filling in the diary helped me gain a better understanding of emotional events in one go compared to the months of self-analysis using a note-taking app I used to use."

Finally, the probe helped participants control their emotions (8/18) by promoting analytical thinking through a self-questioning approach. Such an approach increased awareness and then encouraged understanding of emotional experiences. According to P7, that may have a long-term value: "The online diary has many questions that I never thought I could ask myself to deal with situations. I feel that I can apply all those in the future." The diary prompted a new approach to regulating self-responses rather than controlling emotional triggers by shifting focus toward recognizing effective and ineffective reactions to emotional events: "The study helped me recognize my tendency to shout or behave badly when I am angry, so I learned to step away from situations or triggers and redirect my attention toward controlling my reaction" [P8].

Challenges with probes

This section outlines the most significant challenges encountered during the engagement with the probes (Table 3).

Challenges with the kit: tokens

The challenges reported with tokens were related to their structure. Approximately 44% of participants reported that certain tokens did not fit all emotional situations. These mismatches occurred only in a few instances and did not involve the entire token set. Tokens were not designed to directly mirror components of Lazarus's model for each emotion. Instead, all six appraisal components (six tokens) were included in each emotion pack, allowing us to test whether the data collected from participants' interactions with the tokens would align with Lazarus's model. For instance, in positive situations, tokens 4 and 5 (coping abilities) did not align well, causing participant irritation, [P7]: "The tokens are good, but for some emotions, they do not always fit. For example, a question, such as 'How much control do you have to change the situation?', does not make sense in a happy moment."

Tokens were also reported as being repetitive and overlapping by 28% of participants. A couple of tokens appeared similar or repetitive: tokens 1 and 2, tokens 4 and 5. For example, even though P9 was aware that tokens 4 and 5 were different, he could not distinguish them: "I catch myself answering tokens 4 and 5 the same way. I see there are some sort of differences, but very naturally, when I was answering one token, I already wrote the answer for the next one."

Complexity and multilayered questions, as well as uncertainty about how to respond, were each reported by 22% of participants as constraining engagement with the tokens. Further challenges were reported by 16% of participants, including privacy concerns, especially when the situation involved other parties, and emotional strain during appraisal. For the latter, participants found responding to tokens made them reexperience the situations. For instance, [P15]: "I think this mostly happened with negative emotions. Reading the questions after the event made me reexperience the situation, so I avoided explaining too much to prevent the intensity of emotions."

While tokens enabled deep cognitive reflection, they also demanded effort, leading to partial responses. Such challenges could be refined in future versions of the tokens. They need to be reformulated in a simpler way that easily clarifies the differences between similar components.

Challenges with the kit: cards

Challenges with cards were mainly classified into three main categories: language and wording of the cards (16%), ambiguity and multiple possible matches (22%), and differences between card descriptions and participants' own understanding of emotions (16%). Participants noted that the cards' language was formal, academic, and negatively focused. Diverse first languages between participants may have caused a language barrier, as they came from different backgrounds. However, two out of the three participants who accurately paired all the completed emotions to their cards were non-native English speakers.

The greatest challenge was the ambiguity of the cards, which made them appear overlapping and applicable to multiple emotions. Interestingly, the same ambiguity led two participants to perceive the cards as a set that could be assigned to a single emotion. For example, the card representing shame was mismatched by two participants, highlighting its ambiguity, as each associated it with different emotions, [P11]: "Some cards seemed to belong to multiple emotions, for instance, having failed to live up to an ego ideal could reflect fear or anger," and [P18]: "Matching cards to emotions was difficult, especially at the end of the study when I had only a few cards left, which made me confused. For example, having failed to live up to an ego ideal made me think of both anxiety and fear."

The mismatch between the card descriptions and personal definitions of emotions led some participants to perceive a few cards as exaggerated and not reflective of their actual experiences. For instance, sadness for P8 seemed exaggerated: "They did not always encapsulate how I felt with that emotion. Sometimes, they seemed a bit more exaggerated." One participant highlighted that there was no clear purpose or outcome from matching the cards. This highlights that future work on these cards should support emotional literacy rather than just being about matching emotions to descriptions.

Challenges with the kit: body maps

Among the kit materials, this probe had the fewest observed challenges. These challenges involved difficulties in capturing emotions with limited bodily sensations (22%), expressing bodily sensations visually (16%), and differentiating physical reactions to different emotions (5.5%). They mostly reflected participants' experiences and perceptions rather than limitations of the probe. However, two challenges were related to the design of the probe itself. One participant reported difficulty in expressing complex sensations, such as vibrations, using a two-dimensional tool. The second challenge was presented as a suggestion to improve the probe: although color can represent emotional intensity, additional features may be needed to capture it more fully.

Challenges with the online diary

The online diary had the fewest challenges among the probes, primarily two. The most reported challenge was the appearance of irrelevant statements, with 22% of participants finding statements unrelated to the appraised emotion annoying. This issue arose because the diary was designed to compare participants' results against the theoretical framework, allowing us to evaluate them in a way similar to the tokens. This was reported by P5 to a specific part of the diary, the core relational themes: "The first two sections were generally fine and related to all emotions, which made them helpful. The third section, however, focused on classifying statements for specific emotions, and some questions didn't seem relevant to the target emotion. While I understand the rating system allowed flexibility, this felt a bit distracting and annoying." Challenges related to the number of interactions required with the diary were reported by 16% of participants, as they were asked to complete it twice per day. This challenge was largely due to the length of the diary, which consisted of three main parts that were time-consuming at the beginning. These issues became less significant as participants grew accustomed to the task.

Overall experiences with the probes

Overall experiences with the kit: tokens

Interacting with tokens was a positive engagement and had reflective benefits. They helped participants reflect on emotions, understand situations, and engage in deeper emotional processing. However, completing tokens was perceived as a difficult task due to the cognitive perspective of tokens, irrelevance, or difficulty linking emotions and goals (*Challenges with the kit: tokens* section). A few tokens were reported as repetitive, which could be both a challenge and a benefit. One participant noted that repetitive tokens allowed for a second reflection, [P16]: "Some tokens were quite similar, which was nice because it gave me a second chance to kind of rethink and then also articulate more." The formatting of tokens was reported positively by P1: "The format was good. The tokens were presented in a consistent order from 1 to 6, which made completing them easier as I became familiar with the process. Also, after finishing the first token, I switched it so I couldn't see the content, which helped me focus on the remaining ones."

Overall experiences with the kit: body maps

Body maps were the only probes that obtained totally positive feedback, as completing them was an enjoyable, colorful, simple, and expressive experience. It was an enjoyable experience to express emotions physically, as reported by P14*:* "I enjoyed creating the body maps and found it a helpful and useful activity to do something different by physically locating emotions in the body. For some emotions, I did not feel strong physical sensations, so there was less to add to the map." In a similar line, P13 found body maps enjoyable, and this was driven by his perspective on emotions*:* "I look at emotions as the different concentrations of different hormones in my body."

Two participants reported that including a blank text space on the body map to describe feelings in words was useful, particularly in cases where emotions were difficult to express visually. The

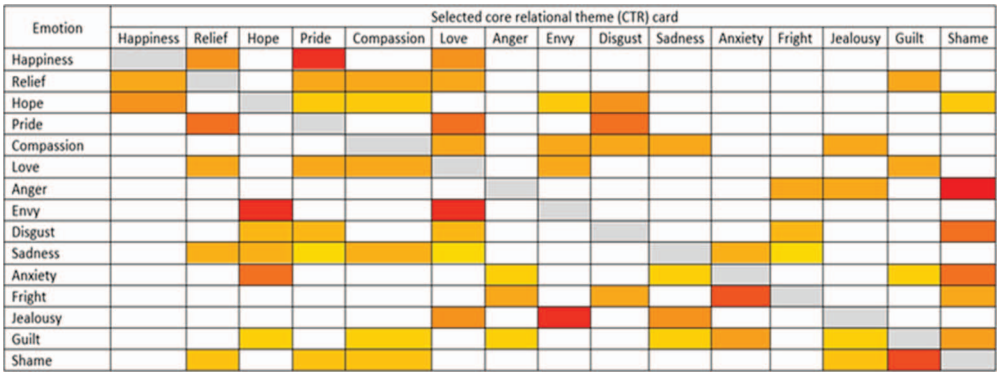

Figure 5 Normalized confusion matrix is visualized as a heatmap. Rows represent the emotion, and columns represent the selected core relational theme (CRT) card. Cell values indicate the proportion of incorrect matches for each emotion. Darker shading indicates stronger confusion. Gray cells indicate correct matches and were excluded from interpretation.

descriptive space was helpful for participants who reported difficulty expressing emotions through drawing. For example, P3 stated: "Some emotions were felt physically, while others were not obvious. The text area was helpful in those cases. Although I am not an artist, I tried to indicate as accurately as possible where I felt each emotion in my body and whether it was experienced as positive or negative." P6 described body maps as a tool to collect interoceptive data: "it is interoceptive data that makes me aware of my reactions to different emotions, and I find which parts of my body are impacted."

Overall experiences with the kit: cards

The cards received relatively less favorable feedback. Only 16.7% of participants correctly matched all emotions to the cards, while 11% incorrectly paired all of them. The remaining participants 72% had mixed results. Overall, the correct match rate between the core relational theme cards and their associated emotions was 53.4%, with accuracy for individual emotions ranging from 11% to 82%.

The lowest match rates were observed for guilt and shame, with only 23% and 11% of participants correctly matching these emotions, respectively. Anxiety, hope, and sadness were slightly better, with correct match rates ranging from 44% to 47%. Pride, disgust, fright, compassion, love, and jealousy were matched correctly between 50% and 64% of the time. The highest accuracy was found for envy, happiness, anger, and relief, with 71%–82% of participants correctly matching them. P18 described interacting with the cards as a quiz. While most participants found it difficult to match the cards, only four described the interaction as easy. One participant who incorrectly matched all the cards to the completed emotions described the interaction as straightforward.

The normalized confusion heatmap presented in Figure 5 indicated that participants did not rely on precise emotion labels when linking emotions to core relational theme cards. Instead, their responses formed systematic clusters that reflected broader experiential meanings. Self-conscious emotions (Bell & Song, 2005) (e.g., shame and guilt) were frequently confused with each other, whereas threat-related emotions (Reiss et al., 2021) (e.g., fright and anxiety) formed a common group. In contrast to anger, which appeared relatively more distinct, positive emotions showed substantial overlap. These patterns indicate that participants interpreted emotions primarily through situational and relational meaning rather than discrete vocabulary.

The heatmap also revealed asymmetric confusion patterns. For instance, while jealousy was mainly confused with envy, such confusion was not true for envy, as it was mainly confused with hope and love. According to Lazarus' core relational theme, envy is wanting what someone has, whereas jealousy involves a perceived threat to a valued relationship by a third party. In the matching process, participants frequently misidentified envy as hope and love, as both emotions include the desire aspect that envy has. This indicates that they understood the core meaning of envy. However, they did not fully understand the meaning of jealousy, as they simplified it to a specific form of social comparison captured by the concept of envy and ignored the threat dimension. This suggests that interaction should be designed around users' experiences (e.g., social evaluation, threat, loss, or accomplishment) and guided prompts, rather than requiring users to label emotional experiences.

Overall experiences with the online diary

The core relational themes in the online diary had the greatest value in the appraising process. While eight participants mentioned it when referring to the impacts of the diary on their emotional awareness, understanding, and coping, five participants specified the appraisal part. The rest of the participants did not specify any part of the diary. Two participants reported that completing the online diary had initial difficulty, but it decreased as participants became familiar with the structure and statements, [P11]: "At the beginning, the online diary seemed stressful, with too many statements. Definitely, but then slowly it was a breeze and handled."

One participant recognized the similarity between the appraisal scale used in the diary and the tokens, as stated by P6: "The initial pages were enjoyable as I reflected on situations and emotions. However, the questions were excessive and lengthy. I found a similarity between the second section in the diary and the tokens." The ease of accessibility to the diary made the appraisal process easy and suitable for in-the-moment reflection (7/18), [P3]: "It was easier complete and didn't take as much time as the kit, and I can access it very easily as it is online. So, the online diary was preferred over the first week because of its accessibility." Although the online diary was easily accessible and efficient, P12 noticed that it was less engaging and enjoyable than the physical kit: "I enjoyed the pen and paper format, as it was tangible, and I appreciated writing things down. However, it required more time to complete, whereas the online diary was quicker to fill out. So, I found the first week using the physical kit slightly more enjoyable."

Alignment of the analyzed data with the theoretical model

Alignment of tokens' results with the theoretical model

A summary of participants' responses to tokens is presented in Table 5. The alignment of results can be compared to the nine emotions presented in Table A1, as highlighted in *Materials: emotional appraisal kit* section. A noticeable finding was that data collected from tokens are mainly matched with Lazarus' model, except for a few instances: anger for accountability (token 3), anxiety for coping (token 5), and hope for the appraisal component's motivationally incongruent (token 2).

The anger emotion pack was completed by 83% of participants. Although a high percentage of them (53%) blamed others for their anger, which aligned with Lazarus' model, 47% assigned the blame to themselves. Lazarus (Smith & Lazarus, 1990a) distinguished between self-blame and self-directed anger. He stated that self-directed anger focuses on behavior, and it happens when individuals are angry at themselves. Therefore, self-directed anger includes questioning actions, whereas self-blame includes self-questioning and value. By examining the situational details attached to the data collected from participants who blamed themselves for the anger, it was found that the triggers were caused by their actions. For instance, situational triggers collected for these events were: lost a match due to a self-mistake, no progress in achieving a degree, or self-caused work plan disruption. Therefore, we can conclude that participants' responses to anger matched Lazarus' justification.

Tokens for Anxiety were completed by 83% of participants, 87% of them reported high emotional coping as responses to token 5. Lazarus' model associated low emotional coping with anxiety. This result mismatched the theoretical framework for this component. However, previous work indicates that when individuals experience high levels of anxiety and fear, they tend to understand and address potential threats, which leads to encouraging different ways of coping (So et al., 2016). For the hope emotion, 15 participants completed it, and all of them agreed that the reported situations were motivationally congruent, which conflicted with the theoretical model. This might be derived from the fact that hope is a positive emotion, and this might shape participants' goals and beliefs in a way that motivates them and encourages positive alignments. These misalignments showed the complexity of such a process and highlighted the value of considering factors beyond the theoretical model when working toward emotional appraisal tools.

Alignment of the online diary's results with the theoretical model

For the data extracted from the online diary, we focused on validity as we intended to test the accuracy of our findings with the framework by examining the relationship between emotions, appraisals, and core relational themes. As stated in section *Materials: emotional appraisal diary* section, no emotion scale was used to shorten the online diary. Therefore, emotion data was recorded as binary results that indicated if a certain emotion was experienced (1) or not (0). We employed point–biserial correlation analysis to assess associations between emotion, along with continuous appraisal and core relational theme variables. Except for a few specific variables related to pride and hope, the results for all emotions are consistent with the theoretical framework (Table 6).

The results for the motivational relevance correlation indicated that all negative emotions were negatively related to this item. This suggests that the situations were either insignificant or temporary and had no lasting impact on their long-term goals. This reflects the difficulty reported by a participant, who found it difficult to determine whether she would evaluate emotional events based on short-term or long-term goals. Also, as reported by a few participants (3/18), in certain cases, it was challenging to fit situations into the questions, as they appeared to be primarily goal-centric.

The appraisal component, motivational congruence in the online diary, was measured to reflect motivational incongruence. This means that emotions associated with motivational congruence should show a negative correlation, and vice versa. According to the theoretical framework, hope is linked to motivational incongruence. However, the observed correlation ($r = -0.1408$) indicates motivational congruence, aligning with the result for hope's token2 (motivational congruence) from the kit. Moreover, according to appraisal theory, hope should be associated with high (positive) future expectancy, but the observed negative correlation ($r = -0.0464$) indicates low future expectations. This is opposite to the result that came from token 6 (future expectancy) in the kit, which indicated high future expectancy. The core relational theme associated with hope should be effortful optimism; however, the correlation results show that easing of threat, the core relational theme of relief ($r = 0.2195$), had a slightly higher correlation than effortful optimism ($r = 0.1807$). This does not indicate a major contrast in their association since their difference (0.0388) is small.

The first part of the diary was about recording information such as blended emotions and situational and contextual factors to provide a framework for analyzing the results and understanding why mismatches occurred. Hope was recorded 23 times in the diary by 16 participants. Only seven of the 23 completed entries were not blended with any emotions. The rest of the entries were combined mostly with relief and happiness/joy. This explains the misalignment result of motivational incongruence, as these two emotions have motivational congruence, and the result of easing of threat is highly correlated. This may state that participants misinterpreted relief situations. According to Snyder et al. (1991), hope implies having determination and a plan toward achieving a goal. The key element of hope is the uncertainty of the result (Smith & Ellsworth, 1987; Lazarus, 1999) or possibilities of success, even though a current situation blocks/challenges one's goal (Smith & Lazarus, 1990a). Through observation of the situational contexts of hope's entries, they mostly described task completion or progress toward goals, which would provoke happiness or relief. Certain situations embody the essence of hope by involving challenges/blocks and yearning for better outcomes, such as: "Although my resume is being shortlisted, I am not receiving interview calls, but I remain hopeful for receiving one" [P10]. Although the situation described elicited hope, the participant appraised it inaccurately. This indicates that appraising real-time hope situations might require additional factors to distinguish hope from other positive emotions.

A total of 12 recordings were made for pride in the online diary by 10 participants. In four records, pride was not blended with any other emotions, while it was mostly combined with happiness or joy in the remaining entries. This explains the high correlation value of success ($r = 0.1586$), which is the core relational theme of happiness/joy. The appraisal component's accountability for pride was correlated with self-accountability ($r = 0.0581$) and other-accountability ($r = 0.1212$), while theoretically it is supposed to be associated only

Table 5 Summary of the qualitative data on tokens.

Emotion	*N* (18)	Token1: motivational relevance	Token2: motivationally congruent/incongruent	Token3: accountability	Token4: problem coping potential	Token5: emotion coping potential	Token6: future expectations
Happiness	17 94%	Relevant (*N* = 15 88%) not relevant (*N* = 3 16%)	Congruent (*N* = 17 94%)	Other-credit (*N* = 3 18%) self-credit (*N* = 12 70%) self and other (*N* = 2 12%)	No need to cope (*N* = 10 59%) high (*N* = 7 41%)	No need to cope (*N* = 10 59%) high (*N* = 7 41%)	High (*N* = 17 100%)
Relief	17 94%	Relevant (*N* = 15 88%) not relevant (*N* = 2 12%)	Congruent (*N* = 17 100%)	Self-credit (*N* = 11 65%) other-credit (*N* = 6 35%)	High (*N* = 11 65%) moderate (*N* = 2 12%) low (*N* = 4 23%)	High (*N* = 13 76%) low (*N* = 4 24%)	High (*N* = 17 100%)
Sadness	16 88%	Relevant (*N* = 15 94%) not relevant (*N* = 1 6%)	Incongruent (*N* = 16 100%)	Self-blame (*N* = 5 31%) other-blame (*N* = 3 19%) self and other (*N* = 3 19%) uncontrollable (*N* = 5 31%)	High (*N* = 2 12%) low (*N* = 14 88%)	Low (*N* = 5 31%) high (*N* = 11 69%)	Low (*N* = 12 75%) high (*N* = 4 25%)
Anger	15 83%	Relevant (*N* = 12 80%) not relevant (*N* = 3 20%)	Incongruent (*N* = 15 83%)	Other-blame (*N* = 8 53%) self-blame (*N* = 7 47%)	High (*N* = 10 67%) low (*N* = 5 33%)	High (*N* = 9 60%) low (*N* = 6 40%)	High (*N* = 13 87%) low (*N* = 2 13%)
Anxiety	15 83%	Relevant (*N* = 14 93%) not relevant (*N* = 1 7%)	Incongruent (*N* = 10 66%) partly congruent (*N* = 5 33%)	Self-blame (*N* = 9 60%) other-blame (*N* = 6 40%)	Low (*N* = 5 33%) high (*N* = 7 47%) moderate (*N* = 3 20%)	Low (*N* = 2 13%) high (*N* = 13 87%)	Low (*N* = 5 33%) high (*N* = 10 67%)
Hope	15 83%	Relevant (*N* = 15 100%)	Congruent (*N* = 15 100%)	Self-credit (*N* = 11 73%) other-credit (*N* = 4 27%)	High (*N* = 12 80%) low (*N* = 3 20%)	Low (*N* = 3 20%) high (*N* = 12 80%)	High (*N* = 15 100%)
Guilt	13 72%	Relevant (*N* = 11 85%) not relevant (*N* = 2 15%)	Incongruent (*N* = 11 85%) partly congruence (*N* = 2 15%)	Self-blame (*N* = 11 85%) other-blame (*N* = 2 15%)	No coping (*N* = 4 31%) high (*N* = 9 69%)	Low (*N* = 5 39%) high (*N* = 8 61%)	High (*N* = 13 100%)
Disgust	13 72%	Relevant (*N* = 9 69%) not relevant (*N* = 4 31%)	Incongruent (*N* = 13 100%)	Other-blame (*N* = 10 78%) self-blame (*N* = 3 23%)	Low (*N* = 5 39%) high (*N* = 8 61%)	No need to cope (*N* = 6 46%) low (*N* = 5 39%) high (*N* = 2 15%)	High (*N* = 8 61%) low (*N* = 5 39%)
Compassion	12 66%	Relevant (*N* = 12 100%)	Congruent (*N* = 6 50%) incongruent (*N* = 4 33%) no impact or change (*N* = 2 17%)	Self-credit (*N* = 4 33%) other-credit (*N* = 9 75%)	Low (*N* = 9 75%) high (*N* = 3 25%)	No need to cope (*N* = 6 50%) high (*N* = 6 50%)	High (*N* = 8 67%) low (*N* = 4 33%)
Love	12 66%	Relevant (*N* = 12 100%)	Congruent (*N* = 12 100%)	Other-credit (*N* = 4 33%) self and other (*N* = 8 67%)	No need to cope (*N* = 3 25%) high (*N* = 9 75%)	No need (*N* = 8 66%) high (*N* = 5 42%)	High (*N* = 12 66%)
Pride	11 61%	Relevant (*N* = 11 100%)	Congruent (*N* = 11 100%)	Self-credit (*N* = 9 82%) other-credit (*N* = 3 27%)	No need to cope (*N* = 2 18%) high (*N* = 9 82%)	No need (*N* = 4 36%) high (*N* = 6 54%)	High (*N* = 11 61%)
Envy	11 61%	Relevant (*N* = 11 100%)	Incongruent (*N* = 8 72%) neutral (*N* = 3 27%)	Self-blame (*N* = 9 82%) other-blame (*N* = 2 18%)	High (*N* = 7 64%) low (*N* = 4 36%)	High (*N* = 11 100%)	High (*N* = 10 91%) low (*N* = 1 9%)
Fright	10 55%	Relevant (*N* = 7 70%) not relevant (*N* = 3 30%)	Incongruent (*N* = 10 100%)	Other-blame (*N* = 3 30%) self-blame (*N* = 3 30%) external factor (*N* = 4 40%)	No need (*N* = 4 40%) high (*N* = 6 60%)	No need to cope (*N* = 4 40%) high (*N* = 6 60%)	Low (*N* = 2 20%) high (*N* = 8 80%)
Jealousy	8 44%	Relevant (*N* = 7 87%) not relevant (*N* = 1 13%)	Incongruent (*N* = 4 50%) congruent (*N* = 4 50%)	Other and self-blame (*N* = 8 100%)	High (*N* = 5 63%) low (*N* = 3 38%)	High (*N* = 6 75%) low (*N* = 2 25%)	High (*N* = 8 100%)
Shame	8 44%	Relevant (*N* = 8 100%)	Incongruent (*N* = 8 100%)	Self-blame (*N* = 8 100%)	High (*N* = 5 63%) low (*N* = 3 38%)	High (*N* = 7 88%) no need (*N* = 1 12%)	High (*N* = 8 100%)

Table 6 Correlation analysis result for the online diary.

Emotional appraisal items	Anxiety	Happiness	Sadness	Relief	Guilt	Joy	Anger	Hope	Pride	Fear
motivational_relevance	−0.0018	0.0369	−0.0486	0.0983	−0.1359	−0.0172	−0.1019	0.1535*	0.0822	−0.1035
motivational_incongruence [1]	0.1846**	−0.3217***	0.2598***	−0.0565	0.2295**	−0.2958***	0.2778***	−0.1408*	−0.2093**	0.1562*
self_accountability	0.0880	0.0321	−0.1701*	0.1419*	0.1344	−0.0384	−0.1043	0.0431	0.0581	−0.2400***
other_accountability	−0.1054	0.0001	0.1393	−0.1924**	−0.1579*	0.0666	0.0849	0.0614	0.1212	0.0229
problem_focused_potential [2]	−0.0357	0.1358	−0.3195***	0.1556*	0.0257	0.0492	−0.1799*	0.0012	0.2064**	−0.0659
emotion_focused_potential [2]	−0.1001	0.1449*	−0.1462*	0.1404	−0.0485	0.0281	−0.2155**	0.0912	0.1541*	−0.0651
future_expectancy [2]	0.1028	−0.0574	−0.0753	0.0626	0.0526	−0.0106	−0.0697	−0.0464	0.0156	0.0258
Core relational themes										
other_blame	−0.0060	−0.1004	0.0721	−0.0679	−0.1016	−0.1073	0.3199***	−0.0842	0.0134	0.0935
self_blame	0.1170	−0.1601*	0.0137	−0.0436	0.2837***	−0.1339	0.1241	−0.0969	−0.0506	−0.0136
Threat	0.1293	−0.1644*	0.0091	−0.0533	0.1010	−0.0957	0.1044	−0.1277	−0.0449	0.1967**
loss_helplessness	0.0931	−0.1729*	0.2049**	−0.1224	0.0836	−0.1628*	0.2072**	−0.0857	−0.0738	0.0933
valued_achievement	−0.1486*	0.1404	−0.2717***	0.2214**	−0.2408***	0.1441*	−0.1343	0.1530*	0.1917**	−0.1355
effortful_optimism	0.0050	−0.0388	−0.1967**	0.1285	0.0407	−0.0187	−0.1638*	0.1807*	0.0613	−0.0220
easing_of_threat	−0.1412*	0.1352	−0.2222**	0.2333**	−0.1465*	0.0998	−0.2070**	0.2195**	0.0738	−0.1278
Success	−0.1501*	0.2221**	−0.3003***	0.1928**	−0.2340***	0.2138**	−0.2263**	0.1640*	0.1586*	−0.1392

$*p < .10$, $**p < .05$, $***p < .01$ [1]A negative correlation means motivational congruence [2]A positive correlation means high coping abilities or positive future expectation *Note*: Important components for each emotion are highlighted for clarity.

with self-accountability. However, accountability for pride entries varied: self (3/10), others (3/10), and both (6/10). According to Williams & Davies (2017), individuals experience pride in their successes and others' achievements. They identified three types of this emotion: pride in one's achievements, pride in contributing to the group's achievements, and pride in others' achievements, which are defined as self-pride, group pride, and vicarious pride, respectively. The situational contexts of pride's entries in the online diary indicate that all these types of pride were experienced. For example, self-pride as P2: "I was able to complete 15,000 steps today," vicarious pride as [P14]: "I received a picture of my nieces starting school," and *g*roup pride as [P9]: "I finished a hard training session with my team, and our coach said we were well prepared for the competition." This suggests that the appraisal component's accountability might not significantly shape pride, and social or contextual factors could play a role in how this emotion is experienced.

A few participants expressed pride in self-achievement, but this pride was motivated by other responsibilities, such as praise or recognition from others, for instance, [P17]: "I was unaware of my PhD journey until someone remarked on my achievement, making me proud." In such cases, participants rated self-accountability and other accountability as responsible for events. Lazarus' appraisal theory focuses on who is responsible for an event rather than what caused it (Smith & Lazarus, 1990b). Since these instances were about self-achievements, participants appeared to have inaccurately appraised accountability.

To conclude, unlike the limited impact of the core relational themes (cards) in the kit, the results of the correlation analysis indicate that they played a major role in the online diary, showing significant results for each emotion. While the appraisal components (six tokens) were important in the first week, in the online diary, their correlation results were not significant, except for motivational congruence/incongruence. However, their results largely conformed to the theoretical structure of most emotions. The alignment of the qualitative and quantitative data from the probes with the theoretical framework they were built on showed that they met the goal they were designed for and helped participants appraise real-life emotional experiences.

Discussion

In this section, we will focus on answering the initial research questions and exploring the importance of our findings. The results will be analyzed in terms of their contributions to different aspects of emotional processing: awareness, understanding, regulation, and appraisal. Finally, we will examine the implications for appraisal research, design, and tools.

Supporting emotional awareness, regulation, reflection, and appraisal

As reported by participants, the study appeared to influence their awareness of emotions, as it helped them categorize and differentiate between emotional experiences. This suggests that the bespoke probes encouraged participants' ability to identify and distinguish emotions. This ability primarily refers to emotional awareness (Boden & Berenbaum, 2011). Although this ability is important, it is not sufficient for successful emotional processing (Öhman & Soares, 1994), as other aspects of emotional processing are also required. This study

implemented an emotional appraisal theoretical framework. Therefore, it encouraged a more deliberate assessment of emotional experiences. Participants' responses collected from the bespoke probes generally aligned with the applied theoretical framework across both weeks. This suggests that engagement extended beyond awareness of emotional events, with participants demonstrating elements of emotional appraisal, although some instances showed limited appraisal.

The Lazarus appraisal model also includes other aspects of emotional processing, particularly emotional understanding and regulation. This indicates that embedding the appraisal framework within the probes supported participants in engaging with appraisal components through structured reflection. Determining the causes of emotions reflects emotional understanding (Boden & Berenbaum, 2011). The appraisal component, accountability, reflects awareness of who is responsible for receiving either credit or blame for emotional events. Participants reported that token 3 (accountability) and the accountability-related statements in the online diary both prompted reflection on the triggers of emotional events, indicating engagement with emotional understanding across both weeks.

According to Gross (1998), strategies for modifying situations are considered problem-focused coping, which was reflected in token 4. Responses related to token 4 and token 5 (coping potentials) suggest that participants considered possible strategies for dealing with specific emotional situations. Moreover, these coping-related components were also included in the appraisal statements used in the online diary, and participants reported greater awareness of how they might regulate their emotions after responding to the statements.

Reflection includes cognitive abilities such as understanding and evaluating emotions, behaviors, and thoughts (Rosenberg, 1990). When participants were asked about their understanding of the emotional process, several described it as a form of self-reflection, while their explanations also demonstrated awareness and understanding of their emotional experiences. Cognitive appraisal has been connected to reflective appraisal, which may occur both consciously and unconsciously (Kappas, 2006). Primary appraisal involves evaluating how events relate to personal goals or beliefs and their impact on well-being, whereas secondary appraisal involves reflection on coping abilities (Smith & Lazarus, 1993). As the bespoke probes were designed based on Lazarus' appraisal model, these types of reflections were prompted through both the tokens and the diary. Moreover, the body maps supported reflection on embodiment, including attention to bodily sensations and physical experiences. In addition to supporting emotional appraisal, engaging with the probes appeared to support multiple aspects of emotional processing, with reflection acting as a mechanism through which awareness, understanding, and regulation were expressed. Overall, the value of the probes was not limited to recording emotions; rather, participants perceived them as supporting their understanding of emotional experiences. By guiding participants to evaluate situations, identify causes, and consider coping responses, the probes functioned as a scaffold for emotional appraisal.

Theoretically informed emotional appraisal probes

The principles of emotional appraisal were translated into bespoke probes, which was a complex and demanding process. Previous emotional appraisal research has commonly used methods for provoking emotions, such as images (Stella et al., 2022), videos (Lindgren et al., 2018), motivational words (Carbia et al., 2020), or recalled experiences (Losh & Capps, 2006). In contrast, the probes in this study were designed to help users in appraising everyday emotional experiences by drawing on emotional appraisal theory (Smith & Lazarus, 1993; Lazarus & Smith, 1988) and material-centric design (Wiberg, 2014).

In responding to the first research question, we started by examining the key concepts of appraisal theory to identify its core components. These components were then translated into simple physical probes that participants could handle and engage with, as real-world artifacts can support richer engagement (Kuznetsov et al., 2014). For the online diary, an adapted appraisal instrument derived from a previously validated psychological measure based on Lazarus' theoretical framework was used. This instrument was adapted into a digital format to support appraisal of everyday emotional events. To reduce interaction time and effort, the online diary was shortened to include only key scales relevant to emotional appraisal. A pilot study was then conducted to evaluate the diary's usability and refine the design. This study demonstrated how appraisal theory can be operationalized into reflective interaction through both physical and digital materials. It also showed how appraisal theory could guide the design of probes that allowed participants to appraise events elicited by real-life emotional experiences rather than responding to emotions that were purposely induced.

Implications for appraisal research, design, and tools

The results from the probes largely aligned with the implemented appraisal model. This theory provides a structured framework for understanding emotions. However, findings suggest that some emotions are complex to appraise in real-time interactions and require greater self-evaluation and an understanding of accountability than more immediate emotions. For instance, self-conscious emotions such as shame and guilt are more difficult to appraise compared to anger (Smith & Lazarus, 1990b). Such emotions need further support to help users appraise them accurately. Furthermore, social emotions are elicited in response to relationships or social interactions, such as pride, jealousy, or compassion (Hareli & Parkinson, 2008). Although Lazarus' appraisal theory includes a social factor, other credit or blame, it conceptualizes pride primarily as self-credit and therefore does not explicitly represent other-oriented forms of pride (De Hooge & Van Osch, 2021). These observations suggest that examining emotional appraisal in everyday life makes the social and interpersonal aspects of emotions more visible than they appear in structured theoretical models. The findings also suggest that some emotions were difficult to distinguish using the appraisal components of the framework, particularly positive emotions such as hope and relief. Participants mainly overlapped these emotions, especially in appraising such emotional experiences in the online diary. This indicates that the current appraisal dimensions may not fully separate closely related positive emotions in daily life. Including additional appraisal dimensions, such as certainty associated with hope (Smith & Ellsworth, 1987), may help clarify these distinctions.

Relationships between appraisal and emotion can be described in a structured way. However, emotions are dynamic and change over time as people cope with situations. These changes lead to shifts in their emotional states, as their appraisals evolve (Folkman & Lazarus, 1988; Smith & Lazarus, 1990b). This suggests that reappraisal may be an important mechanism to consider when designing tools for emotional appraisal. Some participants reported difficulty documenting

certain situations because, by the time they reflected on them, the events had evolved, making it unclear at which stage they should record their experiences, either when responding to the diary prompts or interacting with the tokens.

Findings from interactions with the probes suggest that, when designing tools to capture real-life emotional appraisal, users should be guided through the appraisal process by prompting them to reflect on situations, causes, and consequences rather than requiring an immediate emotion label. This interpretation was also supported by participant feedback, as several participants recommended designing from a contextual perspective rather than an emotion-based one. Moreover, interaction duration, effort and clarity on the purpose of interaction were observed as important factors to consider when designing for emotional appraisal. Participants stated that while interacting with tokens required more effort than other probes, it had the most impactful value. In contrast, the cards' limited interaction time and unclear purpose diminished their effectiveness.

Findings introduced the value of involving users in designing emotional appraisal tools. Participants suggested several improvements to the probes, such as making the kit more portable and refining the body maps. Findings also highlighted that participants noticed patterns in their emotional episodes, linking certain emotions to specific situations, places, or social interactions. This suggests that such tools could help users recognize these patterns over time by considering aspects of their environments. For instance, this might involve capturing aspects about users' situations, such as location, activity, or changes in their surroundings, potentially through features like location tracking or activity sensing.

To conclude, we can learn more about ourselves by noticing our emotions, understanding them, helping regulate distress, staying focused, and maintaining positive relationships (Lazarus & Lazarus, 1994). Participants noticed that interacting with the probes helped them collect observations about themselves and understand the reasons behind their emotions, especially negative ones. For instance, for one participant who frequently experienced anxiety, the study facilitated a deeper understanding of the underlying causes of his persistent anxiety and helped him consider ways of responding to it. It also enabled participants to become more aware of their emotional episodes and anticipate how they might react in similar situations. The emotional awareness supported by the tools helped participants appreciate positive emotions more, especially after recording recurrent negative experiences, which demonstrated the future usefulness of such tools.

Conclusion

This study explored how users can be sensitized toward appraising emotional experiences across 15 emotions by transferring Lazarus' appraisal theory into real-world tools. These tools were implemented in both physical and digital formats. Our findings highlight the capability of these probes to support emotional appraisal and increase emotional awareness, understanding, reflection, and regulation. This suggests that implementing such tools to appraise everyday emotional events may have valuable benefits.

Supplementary material

Supplementary material is available at *Interacting with Computers* online.

Conflicts of interest

The authors declare no conflicts of interest.

Data availability

The data that support the findings of this study are not publicly available due to their containing information that could compromise the privacy of research participants.

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