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A Scoping Review

Peng, Zhuochao; Desmet, Pieter M.A.; Xue, Haian

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Zhuochao Peng
Pieter M. A. Desmet
Haian Xue

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ZHUOCHAO PENG
Faculty of Industrial Design Engineering, Delft University of Technology, the Netherlands
z.peng@tudelft.nl

PIETER M. A. DESMET
Faculty of Industrial Design Engineering, Delft University of Technology, the Netherlands
p.m.a.desmet@tudelft.nl

HAIAN XUE
Faculty of Industrial Design Engineering, Delft University of Technology, the Netherlands
h.xue@tudelft.nl

Abstract
This article presents a comprehensive review of existing literature covering the topic of mood-focused design. It delves into how designers and design researchers currently address mood in the context of experience-driven design. Using a scoping review methodology, we identified and thematically analyzed sixty-six highly relevant articles. Our findings are categorized into four themes: (1) diverse features and impacts of mood that have been comprehended and explored in design; (2) mood-focused design innovations that support mood monitoring, expression, and regulation; (3) potential issues and considerations related to mood-focused design; and (4) methodological resources that support empathizing and ideation within a mood-focused design process. This scoping review advances our understanding of mood as a distinct facet of human experience in design and outlines the current state of mood-focused design as an emerging field. To facilitate progress in the field, we propose four avenues for further exploration, underscoring the need to expand mood-centric theoretical understanding, artifact creation, opinion sharing, and method development.

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Introduction

Human experience is inherently multifaceted and diverse. Whether shedding tears over a poignant film, feeling content with a hot tea on a chilly day, or becoming frustrated by traffic, our daily experiences are characterized by a complex interplay of subtle yet profound ups and downs. Designers and design researchers have long been intrigued by these human experiences, recognizing their potential for design innovation. The late 1990s marked the start of the design discipline shifting its focus from object to human experience, providing people with an overall pleasant experience when using products or technology.[1] As this field matured, its research evolved to explore more specific and nuanced aspects of human experience.[2] Aesthetic experience,[3] experience of meaning,[4] and emotions,[5] have all been deeply studied, forming foundations for the ongoing progression of experience design.[6]

More recently, human mood, another unique facet of human experience, has attracted scholarly attention.[7] In academia, mood is recognized as a crucial phenomenon in design for (at least) two reasons. First, as moods are temporary dispositions,[8] they can serve as a foundation for dynamic user profiling that considers the temporal and conditional characteristics of users, i.e., mood-stimulated thought and action tendencies.[9] This can supplement traditional user profiling techniques like persona or usage scenarios, which rely on static traits. Zhao et al., for instance, used mood in a dynamic profiling model for smartphone users to improve user experience.[10] Second, moods significantly affect health and well-being,[11] a fact highlighted during the Covid-19 pandemic.[12] This realization has ignited a renewed sense of urgency in design research to study mood, sparking interest in developing design interventions that alleviate negative moods and enhance positive ones.[13] One example is a smartphone-based game by Dietvorst et al., which monitors negative moods and provides advice to strengthen mood resilience.[14]

Emphasis on mood in design research is relatively recent, but it has long been a source of inspiration in design practice. A well-known example is the Philips Hue smart lighting system, which enables users to modulate light settings, inducing different moods for different occasions—peacefulness after a working day or jubilation at a family gathering.[15] Another example is NetEase Cloud Music, a social music platform where users share personal anecdotes linked to song choices. Many of the stories shared were gloomy, and in response, NetEase launched a "healing clinic," offering free online consultations with licensed psychologists.[16]

Though research and practice in mood-focused design are expanding, conducting a systematic investigation into mood is inherently more challenging when compared to other aspects of experience like aesthetics or emotion. First, the concept of mood is ambiguous. In everyday conversation, terms like "feelings," "emotions," and "moods" are used interchangeably. Similarly, in scientific research, "mood" is often studied under the names of "emotion" and "affect,"[17] obscuring its unique role in human-design interactions.[18] Second, mood is elusive. It subtly influences how people tend to feel, think, and act over a period,[19] often below conscious awareness.[20] Hence, capturing and articulating one's current mood is more

1 For instance, Patrick W. Jordan, "Human Factors for Pleasure in Product Use," *Applied Ergonomics* 29, no. 1 (1998): 25–33, https://doi.org/10.1016/S0003-6870(97)00022-7; Don Norman, Jim Miller, and Austin Henderson, "What You See, Some of What's in the Future, and How We Go about Doing It: HI at Apple Computer," in *CHI '95: Proceedings of the Conference Companion on Human Factors in Computing Systems*, ed. Jim Miller et al. (New York: ACM, 1995), 155, https://doi.org/10.1145/223355.223477.

2 Virpi Roto et al., "Mapping Experience Research across Disciplines: Who, Where, When," *Quality and User Experience* 6 (September 2021): article no. 7, p. 16, https://doi.org/10.1007/s41233-021-00047-4.

3 Paul Hekkert and Helmut Leder, "Product Aesthetics," in *Product Experience*, ed. Hendrik N. J. Schifferstein and Paul Hekkert (San Diego: Elsevier, 2008), 259–85, https://doi.org/10.1016/B978-008045089-6.50013-7.

4 Marc Hassenzahl et al., "Designing Moments of Meaning and Pleasure. Experience Design and Happiness," *International Journal of Design* 7, no. 3 (2013): 21–31, http://www.ijdesign.org/index.php/IJDesign/article/view/1480/589.

5 Pieter M. A. Desmet et al., "Emotion-Driven Product Design," in *Emotion Measurement*, 2nd ed., ed. Herbert L. Meiselman (Oxford: Woodhead Publishing, 2021), 645–70, https://doi.org/10.1016/B978-0-12-821124-3.00020-X.

6 Pieter Desmet and Paul Hekkert, "Framework of Product Experience," *International Journal of Design* 1, no. 1 (2007): 57–66, http://www.ijdesign.org/index.php/IJDesign/article/view/66/15.

7 For instance, Pieter M. A. Desmet, "Design for Mood: Twenty Activity-Based Opportunities to Design for Mood Regulation," *International Journal of Design* 9, no. 2 (2015): 1–19, http://www.ijdesign.org/index.php/IJDesign/article/view/2167/691; Frank Spillers, "Getting in the Mood: The Role of Mood in Product Design and Interaction," in *Proceedings of the 7th International Conference on Design and Emotion (D&E 2010)*, ed. Judith Gregory, Keiichi Sato, and Pieter M. A. Desmet (Chicago: IIT Institute of Design, 2010), 1–9, https://doi.org/10.5281/zenodo.2596753.

8 Matthias Siemer, "Mood-Congruent Cognitions Constitute Mood Experience," *Emotion* 5, no. 3 (2005): 296, https://doi.org/10.1037/1528-3542.5.3.296; Matthias Siemer, "Mood Experience: Implications of a Dispositional Theory of Moods,"

difficult compared to other affective experiences like emotion. Unsurprisingly, the terminological ambiguity and elusive nature of mood have led to fragmentation in academic and practical efforts in mood-focused design, hindering progress. Design researchers struggle to gain a comprehensive understanding of the field, missing potential areas for further exploration. Practitioners find it challenging to innovate based on systematic mood-related design knowledge, relying instead on technology-driven or intuition-based approaches that can limit the effectiveness of their mood-focused designs. We propose that a comparative synthesis of existing scholarly work can address these challenges, laying a foundation for advancements in the field.

To our knowledge, only two synthesis studies have explored design and mood. Highlighting mood as a design objective, Spillers identified mood-sensitive products that can detect, indicate, or induce mood.[21] Desmet scrutinized mood-focused technologies in interaction design, which measure, express, adapt to, or influence mood.[22] Although these studies offered initial insights into the landscape of mood-focused design, they did not fully capture the breadth and depth of the field. To bridge this gap, we conducted a comprehensive literature review, delving into how mood is currently addressed by designers and design researchers in the context of experience-driven design. Our aim was twofold: (1) to advance our understanding of mood as a distinct facet of human experience in design; (2) to outline the current state of mood-focused design as an emerging field.

This manuscript presents our working definition of mood, followed by our review process and methods. We then report and interpret our findings and discuss their implications. In the final section, we reflect on key findings and propose avenues for future research, while also acknowledging the limitations of our review.

Defining Mood

The term "mood" is frequently used in everyday conversations, such as when we say, "You're in a good mood today," or "I'm not in the mood for a party." These expressions convey a shared understanding: moods relate to good or bad feelings and reflect a particular mindset that favors (or prefers to avoid) certain activities or occasions.[23]

To gain a deeper grasp of mood, it is useful to compare it with emotion. Both mood and emotion are subjective experiences—pleasant or unpleasant. They can be expressed, are associated with physiological responses, can reflect and influence people's evaluations of what is happening, and can be subject to regulation.[24] However, there are essential distinctions between the two, delineated by eight key qualities (Table 1).[25]

For this review, we adopt Morris's definition, stating that **moods are low-intensity, diffuse (pleasant or unpleasant) feeling states that typically last for hours or days**.[26] This definition, aligning with the eight distinguishing qualities noted above, has enabled us to select and analyze mood-related design literature.

Emotion Review 1, no. 3 (2009): 257–58, https://doi.org/10.1177/1754073909103594.

9 Pieter M. A. Desmet, Haian Xue, and Steven F. Fokkinga, "The Same Person Is Never the Same: Introducing Mood-Stimulated Thought/Action Tendencies for User-Centered Design," *She Ji: The Journal of Design, Economics, and Innovation* 5, no. 3 (2019): 179, https://doi.org/10.1016/j.sheji.2019.07.001.

10 Sha Zhao et al., "User Profiling from Their Use of Smartphone Applications: A Survey," *Pervasive and Mobile Computing* 59 (October 2019): 101052, p. 6–7, https://doi.org/10.1016/j.pmcj.2019.101052.

11 William N. Morris, "The Mood System," in *Well-Being: The Foundations of Hedonic Psychology*, ed. Daniel Kahneman, Ed Diener, and Norbert Schwarz (New York: Russell Sage Foundation, 1999), 169, https://psycnet.apa.org/record/1999-02842-009; Frenk Peeters et al., "Diurnal Mood Variation in Major Depressive Disorder," *Emotion* 6, no. 3 (2006): 383, https://doi.org/10.1037/1528-3542.6.3.383.

12 For discussions, see Zoran Đogaš et al., "The Effect of Covid-19 Lockdown on Lifestyle and Mood in Croatian General Population: A Cross-Sectional Study," *Croatian Medical Journal* 61, no. 4 (2020): 314, https://doi.org/10.3325/cmj.2020.61.309; Ziggi Ivan Santini and Ai Koyanagi, "Loneliness and Its Association with Depressed Mood, Anxiety Symptoms, and Sleep Problems in Europe During the Covid-19 Pandemic," *Acta Neuropsychiatrica* 33, no. 3 (2021): 161–62, https://doi.org/10.1017/neu.2020.48; Weiwei Zhang et al., "How Does Social Distancing during Covid-19 Affect Negative Moods and Memory?," *Memory* 29, no. 1 (2021): 94–96, https://doi.org/10.1080/09658211.2020.1857774.

13 Mariluz Soto, Haian Xue, and Emmanuel Tsekleves, "Diseño para el equilibrio: bienestar y salud [Design for Balance: Wellness and Health]," *Base Diseño e Innovación* 7, no. 6 (2022): 6–7, https://doi.org/10.52611/bdi.num6.2022.786.

14 Evelien Dietvorst et al., "A Smartphone Serious Game for Adolescents (Grow It! App): Development, Feasibility, and Acceptance Study," *JMIR Formative Research* 6, no. 3 (2022): e29832, https://doi.org/10.2196/29832.

15 "Smart Mood Lighting Made for You," Philips, accessed August 20, 2023, https://www.philips-hue.com/en-us/products/promotions/ambiance-indoor-lp.

16 Emily Riddell, "NetEase Cloud Music Provides a Supportive Outlet for China's Post-00s," Dao, July 8, 2021, https://daoinsights.com/works/netease-cloud-music-provides-a-supportive-outlet-for-chinas-post-00s/.

Table 1 **Eight distinctions between mood and emotion.**

No.	Quality	Emotion	Mood
1	Duration	Emotions are typically brief, lasting only seconds or minutes.	Moods can persist for hours, days, or even weeks.
2	Timing	Emotions have a clear beginning and end.	Moods are continuous, always present, gradually changing, and sometimes lingering in the background of our consciousness.
3	Intensity	Emotions are usually more intense than moods.	Moods can be experienced as weaker or milder versions of certain emotions. For example, an irritable mood can be a diluted version of the stronger emotion of anger.
4	Intentionality	Emotions are directed towards someone or something specific (i.e., they are intentional).	Moods are not directed at anything in particular but at the world as a whole, reflecting more global and diffuse states or conditions.
5	Cause	Emotions are evoked by an explicit event.	Moods build up because of cumulative events, making their origins harder to discern.
6	Function	Emotion signals the state of the world, directing our attention to environmental demands.	Mood signals the state of the self, signifying whether our personal resources are sufficient or lacking to meet these demands.
7	Consequence	Emotions disrupt current thoughts and behaviors with emotion-specific action tendencies, like flight or approach, to neutralize threats or seize opportunities.	Moods subtly color our cognitive and perceptual processes and influence our general (dis)inclination to undertake actions.
8	Expression	Basic emotions are associated with distinct facial expressions.	Moods are typically conveyed through physical gestures, postures, or vocal cues, although moods might be discerned through mild emotional expressions (e.g., subtle signs of anger in an irritable mood).

17 Christopher Beedie, Peter Terry, and Andrew Lane, "Distinctions between Emotion and Mood," *Cognition & Emotion* 19, no. 6 (2005): 847–50, https://doi.org/10.1080/02699930541000057.

18 For discussion, see Haian Xue, Pieter M. A. Desmet, and Steven F. Fokkinga, "Mood Granularity for Design: Introducing a Holistic Typology of 20 Mood States," *International Journal of Design* 14, no. 1 (2020): 2–3, http://www.ijdesign.org/index.php/IJDesign/article/view/3578/891.

19 Siemer, "Mood-Congruent Cognitions," 296; Siemer, "Mood Experience," 257.

20 Hubert L. Dreyfus, *Being-in-the-World: A Commentary on Heidegger's Being in Time, Division I* (Cambridge: MIT Press, 1991), 173–74.

Methodology

For this study, we opted for a scoping review due to two reasons: our inquiry was broad and exploratory, and our aim was to comprehensively survey the current state of an emerging field.[27] Grounded in Arksey and O'Malley's methodological framework,[28] our review process included three stages: (1) formulating research questions; (2) identifying and selecting literature; and (3) analyzing data. To enhance our methodology, we incorporated recommendations from two additional guidance articles,[29] which are further explained in subsequent sections.

Stage 1: Formulating Research Questions

Although a scoping review is inherently broad,[30] it is recommended to articulate the specific areas of interest from the outset.[31] Our focus was on how

designers and design researchers address mood in the context of experience-driven design. To specify what we mean by "address mood," we formulated four research questions:

1. Considering that mood is an elusive phenomenon, what **facets of mood** have been comprehended and explored by designers and design researchers?
2. Given that mood is not an alien concept in design, what **mood-focused design innovations** have been developed and documented in the literature?
3. In the practice of mood-focused design, what **potential issues and considerations** have been identified and reflected on in the literature?
4. When undertaking mood-focused design, what **methods, tools, or techniques** are available that can facilitate the design process?

Stage 2: Identifying and Selecting Literature

For literature identification, we used multiple search methods to ensure comprehensiveness.[32] Initially, we conducted searches in three databases: Scopus, Web of Science, and the ACM Digital Library. As mood is often studied under the names of emotion and affect, we used the terms "mood," "emotion," and "affect" in conjunction with "design," constituting our search string: (mood* OR emotion* OR affect*) AND (design*). To acquire a manageable volume of literature, we focused on article titles, limited the documents to English articles from journals and conference proceedings, and restricted the timeframe to 1999 onwards.[33] Recognizing that not all design-related studies include "design" in their titles, we searched twenty journals and nine conference proceedings in the design field (see Appendix A). Our search strategy was that at least one affect-related term (e.g., "mood," "emotion," "affect," or their derivatives) should appear in the article title. This search was done via Scopus, Google Scholar, and other specific search engines like the DRS Digital Library. In total, we identified 6,687 articles—5,555 from electronic databases and 1,132 from electronic journals and conference proceedings. Appendix A details our search strategies and results. After the removal of 2,350 duplicates, we had an initial dataset of 4,337 articles.

For literature selection, we chose articles that reported experience-driven design research in the domain of interaction design, particularly those that explore user or customer mood. Table 2 outlines four criteria that guided our screening activities.[34] To reduce bias, three researchers (i.e., the authors) were involved.[35] We began by screening the 4,337 articles based on title and abstract. Using Rayyan,[36] Zhuochao Peng (ZP) excluded clearly irrelevant articles such as medical studies and those on the mood expressions of robots. Then, Haian Xue (HX) screened articles that ZP had approved or left undecided, using blind screening mode on Rayyan. Disagreements were discussed until consensus was reached. In this phase, we eliminated 4,080 articles out of the initial 4,337. Of these, 2,034 were not design research, 538 were not in the domain of interaction design, 1,216 did not focus on mood, and 292 did not address user mood.

Following the title and abstract screening, we screened the full text of the remaining 257 articles. EndNote was used to organize the articles and

21 Spillers, "Getting in the Mood," 2–3.
22 Desmet, "Design for Mood," 3–6.
23 Brian Parkinson et al., *Changing Moods: The Psychology of Mood and Mood Regulation* (Detroit: Longman, 1996), 2.
24 Randy J. Larsen, "Toward a Science of Mood Regulation," *Psychological Inquiry* 11, no. 3 (2000): 129–30, https://doi.org/10.1207/S15327965PLI1103_01; Parkinson et al., *Changing Moods*, 9.
25 We summarized the mood-emotion distinctions based on a compositive book on the nature of emotion edited by Ekman and Davidson, a book on the psychology of mood and mood regulation by Parkinson and colleagues, and a synthesis article on differences between emotion and mood by Beedie et al. See Beedie et al., "Distinctions between Emotion and Mood," 863–71; Paul Ekman and Richard J. Davidson, eds., *The Nature of Emotion: Fundamental Questions* (New York: Oxford University Press, 1994), 49–94; Parkinson et al., *Changing Moods*, 5–9.
26 William N. Morris, *Mood: The Frame of Mind* (New York: Springer, 1989), 1–3, https://doi.org/10.1007/978-1-4612-3648-1.
27 On how to choose between systematic reviews and scoping reviews, see Zachary Munn et al., "Systematic Review or Scoping Review? Guidance for Authors When Choosing between a Systematic or Scoping Review Approach," *BMC Medical Research Methodology* 18 (2018): article no. 143, p. 1–7, https://doi.org/10.1186/s12874-018-0611-x.
28 Arksey and O'Malley's methodological framework consists of five stages: (1) identifying the research question; (2) identifying relevant studies; (3) study selection; (4) charting the data; and (5) collating, summarizing, and reporting the results. We combined their second and third stages into one single stage as our process of literature identification and selection was not strictly linear. We also combined their fourth and fifth stages into one consolidated stage, aiming to streamline our analysis method. Hilary Arksey and Lisa O'Malley, "Scoping Studies: Towards a Methodological Framework," *International Journal of Social Research Methodology* 8, no. 1 (2005): 19–32, https://doi.org/10.1080/1364557032000119616.
29 Danielle Levac, Heather Colquhoun, and Kelly K. O'Brien, "Scoping Studies: Advancing the Methodology," *Implementation Science* 5 (2010): article no. 69, https://doi.org/10.1186/1748-5908-5-69; Micah D. J. Peters et al., "Updated Methodological Guidance for the Conduct of Scoping Reviews," *JBI Evidence Synthesis*

Table 2 **Four selection criteria.**

No.	Criterion	Note	Example
1	The article presents design research.	Mainstream design research includes research for design, research through design, research is design, and design methodology research.[a]	We excluded articles discussing medical solutions for affective disorders or course designs considering students' affective experiences, as these fall under medical and educational research respectively.
2	The article presents experience-driven design research in the domain of interaction design.	Interaction design is the activity of designing interactive products or services that facilitate the way people work and interact in their everyday lives.[b]	We excluded articles within the domain of architecture design, urban design, fashion design, communication design, or tourism design.
3	The article focuses on the phenomenon of mood.	Moods are low intensity, diffuse (pleasant or unpleasant) feeling states that typically last for hours or days. Mood differs from emotion in terms of duration, timing, intensity, intentionality, cause, function, consequence, and expression.	We only included articles aligning with the definition of mood as provided in the section of Defining Mood, regardless of the specific terminology used such as "mood," "emotion," "affect," "emotional state," or "affective experience."
4	The article focuses on user or customer mood.	"User or customer mood" emphasizes that we focus on moods that are experienced by human users and customers.	We excluded articles exploring the design of mood expressions in social robots or conversational agents.

[a] Pieter Jan Stappers and Elisa Giaccardi, "Research through Design," in *The Encyclopedia of Human-Computer Interaction*, 2nd ed., ed. Mads Soegaard and Friis Dam Rikke (Interaction Design Foundation, 2017), chapter 43, http://www.interaction-design.org/literature/book/the-encyclopedia-of-human-computer-interaction-2nd-ed/research-through-design.
[b] Helen Sharp, Yvonne Rogers, and Jennifer Preece, *Interaction Design: Beyond Human-Computer Interaction*, 5th ed. (2008; Chichester: John Wiley & Sons, 2019), 9–10.

18, no. 10 (2020): 2119–26, https://doi.org/10.11124/jbies-20-00167.

30 Arksey and O'Malley, "Scoping Studies," 23.

31 Levac et al., "Scoping Studies," 3.

32 Arksey and O'Malley, "Scoping Studies," 23.

33 In 1999, the International Design and Emotion Society was established, which demarcated emotion-focused design as an explicit research area. Pieter M. A. Desmet and Paul P. M. Hekkert, "Special Issue Editorial: Design & Emotion," *International Journal of Design* 3, no. 2 (2009): 1–6, http://www.ijdesign.org/index.php/IJDesign/article/view/626/255.

34 Arksey and O'Malley, "Scoping Studies," 25–26.

35 Levac et al., "Scoping Studies," 5–6; Peters et al., "Updated Methodological Guidance," 2124.

36 Rayyan is a web-based software for systematic and scoping reviews. It supports manually choosing to include,

monitor the process. ZP determined if the articles met our selection criteria. Articles deemed eligible or left undecided were then examined by HX. Disagreements and uncertainties were addressed with Pieter M. A. Desmet (PMAD). When multiple articles featured the same design case, we included one in our review to avoid overlap. This situation typically arises when researchers publish updated or revised journal articles that originated as conference papers. In such instances, we prioritized the journal articles. In this phase, 207 articles were excluded: 41 were not in the domain of interaction design, 161 did not focus on mood, and 5 were duplicate design cases. Thus, we distilled our collection down to 50 high-relevance articles.

However, some relevant works, which we were aware of through previous research, were not included. Notable omissions included the stress-reduction products developed by Alonso et al.[37] and Maclean et al.[38] To rectify this and ensure that we did not omit other related articles, we performed a supplementary search using a backward and forward citation search method.[39] ZP checked the references and citations from the 50 articles, selecting those meeting our criteria. Selections were examined and verified by HX.

exclude, or postpone the decision on one article, while noting down the inclusion or exclusion reason(s) with tags. It also enables blind-mode screening among multiple reviewers, increasing research reliability. Mourad Ouzzani et al., "Rayyan — A Web and Mobile App for Systematic Reviews," *Systematic Reviews* 5 (2016): article no. 210, https://doi.org/10.1186/s13643-016-0384-4.

37 Miguel Bruns Alonso, David V. Keyson, and Caroline C. M. Hummels, "Squeeze, Rock, and Roll; Can Tangible Interaction with Affective Products Support Stress Reduction?," in *TEI '08: Proceedings of the 2nd International Conference on Tangible and Embedded Interaction*, ed. Albrecht Schmidt et al. (New York: ACM, 2008), 105–8, https://doi.org/10.1145/1347390.1347413.

38 Diana MacLean, Asta Roseway, and Mary Czerwinski, "MoodWings: A Wearable Biofeedback Device for Real-Time Stress Intervention," in *PETRA '15: Proceedings of the 8th ACM International Conference on PErvasive Technologies*

The process yielded 33 extra articles, raising our total to 83 highly relevant articles.

Because distinguishing between articles focusing on mood versus emotion proved challenging and susceptible to bias, we did a more meticulous second-round screening based on full text prior to the in-depth analysis. Guided by the mood definition and the eight mood-emotion distinctions noted earlier, we scrutinized whether the 83 articles focused on user moods instead of emotions. ZP undertook the task, HX examined the results, and disagreements were addressed with PMAD. In this phase, 15 articles were deemed not to focus on the mood phenomenon, and 2 duplicate design cases were found and excluded. This resulted in a final set of 66 articles (see Appendix B).

Our literature identification and selection process was not strictly linear,[40] especially when it involved a supplementary search after the initial full text screening. Figure 1 is an adapted PRISMA-ScR flow diagram,[41] outlining the whole process and indicating the number of articles at each phase.

Stage 3: Analyzing Data

We used thematic analysis on the 66 articles,[42] enabling a dual form of analysis that encompassed deductive and inductive techniques. While we

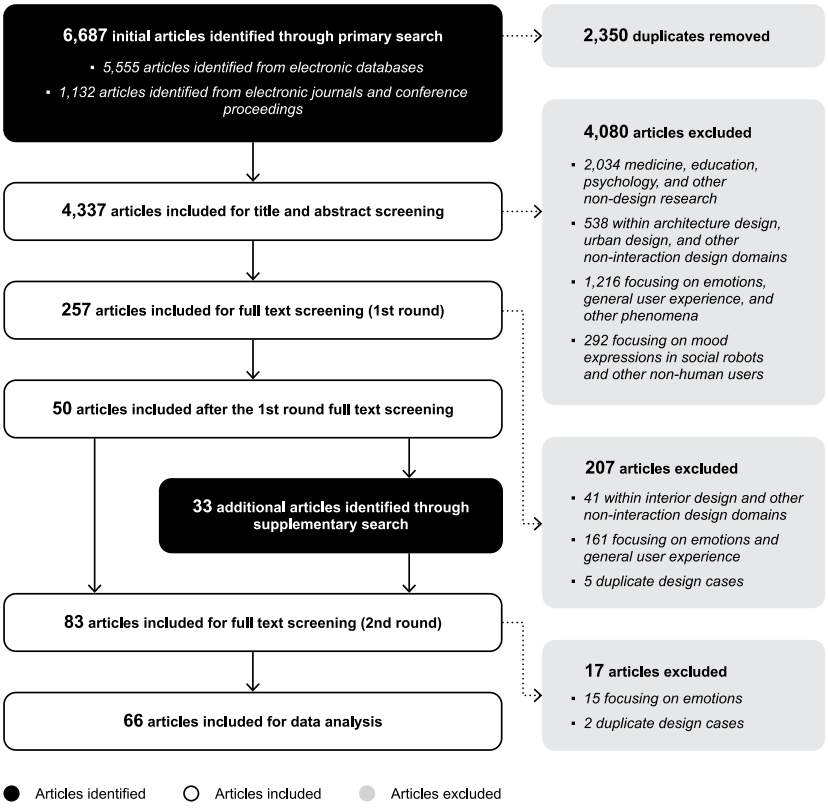

Figure 1
The process and results of literature identification and selection. © 2023 Zhuochao Peng, Pieter M. A. Desmet, and Haian Xue.

followed our predefined research questions, we also allowed ourselves the flexibility to discover recurring patterns of meaning within each thematic area.[43] Our process, guided by the framework outlined by Braun and Clarke,[44] involved the following steps: (1) familiarization; (2) coding; (3) generating initial themes; (4) reviewing and developing themes; (5) refining themes; and (6) reporting results.

Three researchers (i.e., the authors) collaborated on the analysis. ZP conducted the tasks of familiarization,[45] coding, and initial theme generation in ATLAS.ti, following Saldaña's suggestion to allow themes to naturally emerge from data.[46] For instance, after coding several design functionalities as "triggering mood-influencing conversations," "improving coping ability," and "offering strategies for mood management," the theme "providing mood-regulating interventions" emerged. During coding and initial thematization, the research team met to review ZP's results, with code and theme revisions made iteratively.[47] For instance, the aforementioned codes were revised to "mood-sensitive interactions," "competence development," and "recommendations," while the theme was refined to "(mechanisms for) supporting mood regulation." Additionally, new codes "self-awareness or self-reflection," "system adjustments," and "mood regulation technologies" were added.

Having created an initial collection of well-defined codes and themes, ZP and HX held a half-day refinement session. HX scrutinized all codes and themes along with their definitions and examples, placing paper cards on the wall for discussion. The codes and themes were then discussed, refined, and recategorized until we reached consensus. For instance, to improve thematic consistency, "detecting moods," "self-tracking moods," and "analyzing moods" were consolidated into "monitoring moods," while "displaying moods" and "sharing moods" merged into "expressing moods." The refined themes, including "supporting mood regulation," constituted a consistent set of themes for design functionalities. As a last step, PMAD verified and further refined the updated codes and themes. Appendix C provides our final collection of codes and themes, along with data exemplars and references.

Results and Discussion

Based on 66 articles, we investigated how mood has been addressed by designers and design researchers in the context of experience-driven design. In this section, we report the review results based on our research questions (see Table 3 for an overview), followed by our reflections on the findings and their implications.

RQ1: What Facets of Mood Have Been Comprehended and Explored?

Of the 66 articles, 10 (15%) explicitly claimed to focus on continuous moods rather than momentary emotions. Three articles (5%) acknowledged the distinction between mood and emotion, considering it irrelevant due to the applicability of their research to both. Fifteen articles (23%) focused on specific mood states, most commonly stress and relaxation. The remaining 57% used indirect expressions like "emotional climate" or "affective tone"

Related to Assistive Environments, ed. Fillia Makedon et al. (New York: ACM, 2013), article no. 66, https://doi.org/10.1145/2504335.2504406.

39 Simon Briscoe, Alison Bethel, and Morwenna Rogers, "Conduct and Reporting of Citation Searching in Cochrane Systematic Reviews: A Cross-Sectional Study," *Research Synthesis Methods* 11, no. 2 (2020): 170, https://doi.org/10.1002/jrsm.1355.

40 Literature identification and selection may be iterative in a scoping review. Levac et al., "Scoping Studies," 5–6.

41 PRISMA is an effective way to illustrate the literature identification and selection process and present results. Peters et al., "Updated Methodological Guidance," 2124; Andrea C. Tricco et al., "PRISMA Extension for Scoping Reviews (PRISMA-ScR): Checklist and Explanation," *Annals of Internal Medicine* 169, no. 7 (2018): 467–73, https://doi.org/10.7326/m18-0850.

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43 Virginia Braun and Victoria Clarke, "Can I Use TA? Should I Use TA? Should I Not Use TA? Comparing Reflexive Thematic Analysis and Other Pattern-Based Qualitative Analytic Approaches," *Counselling and Psychotherapy Research* 21, no. 1 (2021): 38–39, https://doi.org/10.1002/capr.12360.

44 Virginia Braun and Victoria Clarke, "Using Thematic Analysis in Psychology," *Qualitative Research in Psychology* 3, no. 2 (2006): 86–93, https://doi.org/10.1191/1478088706qp063oa.

45 In this study, the work of familiarization with the literature data was conducted simultaneously with the work of full-text screening in literature selection.

46 Johnny Saldaña, *The Coding Manual for Qualitative Researchers*, 3rd ed. (Thousand Oaks, CA: Sage, 2015), 9.

47 Thematic analysis is not a linear process, where movement back and forth is needed. Braun and Clarke, "Using Thematic Analysis," 86.

48 Desmet, "Design for Mood," 1; Desmet et al., "Mood-Stimulated Tendencies," 169; Pelin Esnaf-Uslu, Pieter M. A. Desmet, and Hendrik N. J. Schifferstein, "The Eye Inward and the Eye Outward: Introducing a Framework for Mood-Sensitive Service Encounters," *She Ji: The Journal of Design, Economics, and Innovation* 8, no. 1 (2022): 119, https://doi.org/10.1016/j.sheji.2021.12.002; Alina Huldtgren et

Table 3 **An overview of the review results.**

No.	Research Question	Key Finding
1	What facets of mood have been comprehended and explored?	Four features of mood have been comprehended and explored, including (1) long duration, (2) diffuseness, (3) dynamics, and (4) social relevance; three types of impacts of mood have been recognized and considered in design, including those on (1) health and subjective well-being, (2) individual and group performance, and (3) social relationships.
2	What mood-focused design innovations have been developed?	Three types of mood-focused design innovations have been reported, including those that can support (1) mood monitoring, (2) mood expression, and (3) mood regulation.
3	What issues related to mood-focused design have been discussed?	Eight issues have been discussed, distributed across three categories: (1) issues related to mood-monitoring designs (i.e., lack of reliability, lack of granularity, and system surveillance); (2) issues related to mood-expressing designs (i.e., misinterpretation and mood privacy); and (3) issues related to mood-regulating designs (i.e., negative effects of introspection, individual preferences, and system intrusiveness).
4	What methods for mood-focused design are available?	Two main types of methodological resources are available that can support (1) empathizing and (2) ideation respectively in a mood-focused experience design process.

interchangeably with "mood," "emotion," and "affect." Despite diverse terminology, multiple features and impacts of mood have been commonly comprehended and explored in design.

Features of Mood

Thirteen articles highlighted that moods are relatively long-lasting affects, persisting for hours or days.[48] Xue and Desmet et al. contended that people always start interactions with a pre-existing mood state, which could be favorable or unfavorable.[49] This explains why Esnaf-Uslu et al. found service providers consciously adjust their moods prior to professional work.[50] Several design researchers have worked with the enduring nature of moods, such as Yoon et al., who aimed to induce a "well-prepared" mood in flight attendants before serving passengers,[51] and Wu et al., who explored interventions to relieve drivers' stressful moods before long trips.[52] Mood duration is, however, relative to fleeting emotions. Compared to longer-lasting sentiments or dispositions, moods are temporary.[53] The term "momentary moods" has been used to articulate this.[54]

In thirteen articles, moods were described as diffuse states that often lack a specific cause or trigger.[55] This diffuseness positions mood as a background element that underlies ongoing experiences and events.[56] Consequently, moods are complex to observe or measure.[57] To tackle this, researchers have adopted a componential approach to unpack the experiential qualities of mood, yielding typologies of individual moods[58] and group moods.[59] Spillers suggested a systemic approach to capture moods, factoring both internal and

al., "Design Considerations for Adaptive Lighting to Improve Seniors' Mood," in *Inclusive Smart Cities and e-Health*, ed. Antoine Geissbühler et al. (Cham: Springer, 2015), 19, https://doi.org/10.1007/978-3-319-19312-0_2; Joris H. Janssen, Egon L. van den Broek, and Joyce H. D. M. Westerink, "Tune in to Your Emotions: A Robust Personalized Affective Music Player," *User Modeling and User-Adapted Interaction* 22, no. 3 (2012): 259, https://doi.org/10.1007/s11257-011-9107-7; Robert LiKamWa et al., "MoodScope: Building a Mood Sensor from Smartphone Usage Patterns," in *MobiSys '13: Proceeding of the 11th Annual International Conference on Mobile Systems, Applications, and Services*, ed. Hao-Hua Chu et al. (New York: ACM, 2013), 390, https://doi.org/10.1145/2462456.2464449; Yuliya Lutchyn et al., "MoodTracker: Monitoring Collective Emotions in the Workplace," in *ACII '15: Proceedings of the 6th International Conference on Affective Computing and Intelligent Interaction*, ed. Roddy Cowie et al. (Washington: IEEE, 2015), 296, https://doi.org/10.1109/ACII.2015.7344586; Verónica Rivera-Pelayo et al., "Introducing Mood Self-Tracking at Work: Empirical Insights from Call Centers," *ACM Transactions on Computer-Human Interaction* 24, no. 1 (2017): article no. 3, p. 8, https://

external causes.[60] Some explored various contextual factors, like weather, location, sleep, diet, or past events, to enhance understanding of moods.[61]

Seventeen articles mentioned that moods are dynamic, changing from one type to another over time.[62] In addition to types, mood dynamics can manifest in varying intensities (e.g., mild, neutral, strong),[63] as seen in designs asking users to rate their mood strength.[64] In collective settings, Sönmez et al. found mood dynamics can also be denoted by the uniformity of group moods, indicating diverse moods can coexist within a group.[65] Moods constantly evolve without a clear beginning or end,[66] often unnoticed by individuals.[67] Considering this, Janssen et al. developed a music player that subtly alters music to induce or enhance user moods without disruption.[68] The dynamic nature of moods determines user characteristics—people in varying moods tend to have different motivations and preferences for interaction styles.[69] Desmet et al. proposed user profiling based on mood-stimulated tendencies,[70] and De Lera suggested designing interactions aligned with current user moods.[71]

Moods are considered socially relevant that can be experienced in both one-to-one interpersonal interactions[72] and group contexts.[73] Articles in our dataset explored mood in interactions between individuals and their close ones (e.g., partners, family, or friends),[74] strangers,[75] service providers and clients,[76] employees and managers,[77] and educators and students.[78] People can simultaneously experience multiple "layered" moods, like a personal and a professional mood in service provider-client interactions,[79] or a concealed and a shared mood in employee-manager interactions.[80] Beyond one-to-one interactions, design researchers also investigated mood in group activities like virtual meetings[81] and collaborative tasks,[82] and in group environments like online communities,[83] classrooms,[84] homes,[85] workspaces,[86] and other public spaces.[87] Mood contagion, where group members influence each other's moods, can occur in group contexts, such as the spread of cheerfulness or stress.[88]

Impacts of Mood

Moods are recognized to impact health and subjective well-being. Persistent negative moods can lead to mental health issues like depression and mood disorders[89] and physical health problems such as weakened immunity and increased heart disease risk.[90] Moods also directly impact subjective well-being, with positive moods promoting a focus on the brighter aspects of ambiguous situations, enhancing life satisfaction and fulfillment.[91] Design researchers have explored how to support individuals in maintaining "healthy" moods or recovering from "unhealthy" ones,[92] with designs like a laughing dress to cheer people up,[93] a smart pen to alleviate stress,[94] and a fit mirror to counter a lethargic morning mood.[95]

Moods are acknowledged to impact people's performance. Negative moods can impair individual perception and judgment,[96] motivation,[97] attitude,[98] attention,[99] decision-making,[100] creativity,[101] and productivity.[102] This can lead to poor performance in contexts such as work,[103] learning,[104] or onstage.[105] In groups, moods can affect individual cognitive and behavioral aspects, ultimately influencing group performance.[106] In addition, moods impact team communication flow, creativity, cohesion, and satisfaction—all crucial to effective group performance.[107] Due to the influence of moods on performance,

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50 Esnaf-Uslu et al., "Mood-Sensitive Service Encounters," 132.

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various design interventions have been explored. For example, a smart wristband that monitors driver stress levels to enhance driving performance,[108] and a virtual agent that moderates group member moods to improve overall group function and atmosphere.[109]

Moods are thought to impact social relationships in four ways. First, they affect people's motivation to interact with others[110]—people are more likely to socialize when cheerful rather than gloomy.[111] Second, moods influence interaction behaviors,[112] with positive moods fostering kinder, more generous behaviors.[113] Third, moods impact the quality and effectiveness of communication, affecting both what people communicate and interpretation and evaluation.[114] Last, moods often form a central topic in daily conversations, highlighting their roles in social relationships.[115] Recognizing these impacts, researchers have explored designs like a smart scarf that displays mood and triggers mood regulation during group communication,[116] and a web-based application for caregivers to track patient mood variations, improving communication and coping strategies.[117]

Summary and Discussion

Mood remains an elusive topic in design. Over half the literature we examined conflated emotion and other affective phenomena with mood. Our review identified four frequently recognized experiential features of mood in design literature: moods are long-lasting, diffuse, dynamic, and socially relevant. We also discerned three acknowledged impacts of mood: on health and subjective well-being, individual and group performance, and social relationships. These findings disclose the design field's current understanding of mood as a distinct aspect of human experience: (1) it is inherently multifaceted; (2) it impacts humans in multifarious aspects on individual, interpersonal, and collective levels. However, not all facets of mood are fully comprehended in design. For instance, mood functions as a system signaling the (in)sufficiency of personal resources to meet perceived environmental challenges,[118] which in turn directs self-regulatory behaviors like investing in, protecting, or replenishing these resources in response to external demands.[119] While Desmet introduced the knowledge of mood functionality to the design field,[120] its practical implications for design and research remain ambiguous.

Our review indicates that designers and design researchers have incorporated mood features into their work, such as products that adjust to user mood fluctuations (i.e., dynamics) or services that promote or mitigate mood contagion (i.e., social relevance). This suggests that mood features can inform certain design characteristics. We advocate that these mood features are viewed as opportunities for developing more effective mood-focused designs. For example, because moods tend to be long-lasting, designs that influence moods should focus on the overall cumulative effect of the entire human-design interaction journey, rather than momentary events within it. Our research also identified design endeavors aimed at alleviating negative moods or amplifying positive ones, with the goal of enhancing health and well-being, performance, and social relationships. We therefore view mood-focused design as a promising approach to advance the Positive Design initiative, which aims to facilitate human flourishing.[121]

Daniel McDuff et al., "AffectAura: An Intelligent System for Emotional Memory," in *CHI '12: Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, ed. Rebecca Grinter et al. (New York: ACM, 2012), 850, https://doi.org/10.1145/2207676.2208525; Roseway et al., "BioCrystal," 20; Xue and Desmet et al., "Mood Granularity," 3.

101 Cernea et al., "Group Affective Tone," 10; Janssen et al., "Affective Music Player," 256; Lutchyn et al., "MoodTracker," 295; MacLean et al., "MoodWings," 1; Rivera-Pelayo et al., "Mood Self-Tracking," 2; Sönmez et al., "Group Mood," 94.

102 Balaam et al., "Exploring Affective Technologies," 1623; Carneiro et al., "Collective Environments," 33; Cernea et al., "Group Affective Tone," 10.

103 Rivera-Pelayo et al., "Mood Self-Tracking," 2–3.

104 Balaam et al., "Exploring Affective Technologies," 1623–24.

105 De Luca et al., "Performers," 2423–24.

106 Benke et al., "Chatbot-Based Emotion Management," 2; Carneiro et al., "Collective Environments," 34; Lutchyn et al., "MoodTracker," 295; Sönmez et al., "Group Mood," 94; Xue and Liang et al., "AffectiveWall."

107 Benke et al., "Chatbot-Based Emotion Management," 2; Lutchyn et al., "MoodTracker," 295; Sönmez et al., "Group Mood," 94.

108 Wu et al., "Driver's Emotional Transitions," 126–36.

109 Benke et al., "Chatbot-Based Emotion Management."

110 Church et al., "MobiMood," 128; Desmet, "Design for Mood," 7; Xue and Desmet et al., "Mood Granularity," 2.

111 Desmet et al., "Mood-Stimulated Tendencies," 169.

112 Ashoori et al., "Creating the Mood," 2001; Roseway et al., "BioCrystal," 20; Stephan Wensveen, Kees Overbeeke, and Tom Djajadiningrat, "Push Me, Shove Me and I Show You How You Feel: Recognising Mood from Emotionally Rich Interaction," in *DIS '02: Proceedings of the 4th Conference on Designing Interactive Systems: Processes, Practices, Methods, and Techniques*, ed. Bill Verplank et al. (New York: ACM, 2002), 335, https://doi.org/10.1145/778712.778759.

113 Desmet, "Design for Mood," 1; Esnaf-Uslu et al., "Mood-Sensitive Service Encounters," 120; Rivera-Pelayo et al., "Mood Self-Tracking," 1.

114 Esnaf-Uslu et al., "Mood-Sensitive Service Encounters," 119.

115 Church et al., "MobiMood," 128.

116 Guo et al., "Designing a Smart Scarf."

117 Yamashita et al., "Changing Moods."

118 William N. Morris, "A Functional Analysis of the Role of Mood in Affective Systems," in *Emotion (The Review of Personality and Social Psychology)*, ed. Margaret S. Clark (Thousand Oaks, CA: Sage, 1992), 256, https://psycnet.apa.org/record/1992-97396-010.

119 Vincent Nowlis and Helen H. Nowlis, "The Description and Analysis of Mood," *Annals of the New York Academy of Sciences* 65, no. 4 (1956): 353, https://doi.org/10.1111/j.1749-6632.1956.tb49644.x; Robert E. Thayer, Robert J. Newman, and Tracey M. McClain, "Self-Regulation of Mood: Strategies for Changing a Bad Mood, Raising Energy, and Reducing Tension," *Journal of Personality and Social Psychology* 67, no. 5 (1994): 920–22, https://doi.org/10.1037/0022-3514.67.5.910.

120 Desmet, "Design for Mood," 7.

121 Pieter M. A. Desmet and Anna E. Pohlmeyer, "Positive Design: An Introduction to Design for Subjective Well-Being," *International Journal of Design* 7, no. 3 (2013): 5–19, http://www.ijdesign.org/index.php/IJDesign/article/view/1666/595; Anna E. Pohlmeyer, "How Design Can (Not) Support Human Flourishing," in *Positive Psychology Interventions in Practice*, ed. Carmel Proctor (Cham: Springer, 2017), 235–55, https://doi.org/10.1007/978-3-319-51787-2_14.

Figure 2
Pearl monitors user mood variations over time using sentiment analysis of their tweets. Source: Jian Zhao et al., "Pearl: An Interactive Visual Analytic Tool for Understanding Personal Emotion Style Derived from Social Media," in *Proceedings of the 9th IEEE Conference on Visual Analytics Science and Technology (VAST 2014)*, ed. Min Chen, David Ebert, and Chris North (Washington: IEEE, 2014), 203, figure 1, http://doi.org/10.1109/VAST.2014.7042496.

RQ2: What Mood-Focused Design Innovations Have Been Developed?

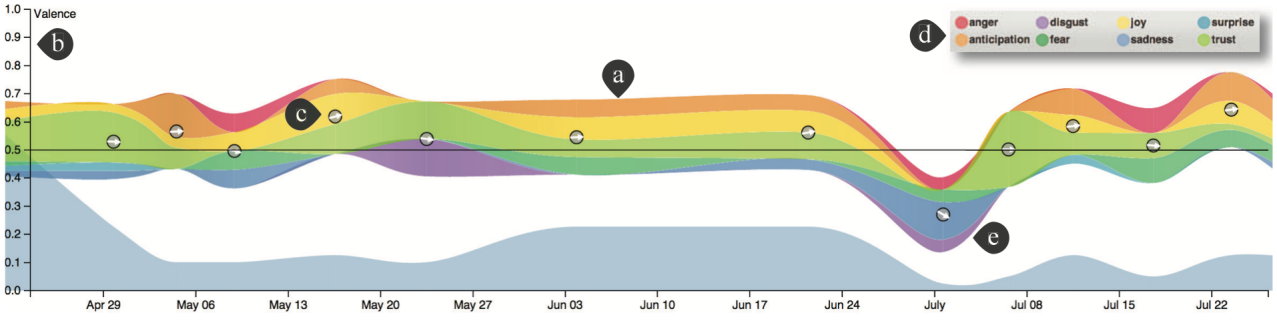
In the 66 articles, 69 design innovations were reported (see Appendix D). Design fidelity ranges from low (conceptual visuals, 23%), mid (prototypes for initial evaluation, 34%), and high (systems for field trials, 42%), to finalized (open-access products, 1%). They are (to be) implemented through diverse hardware platforms, predominantly computers (19%) and mobile phones (17%), followed by ambient or public installations (14%), smart mirrors or screens (13%), wearables (12%), handheld objects (9%), and other mediums (3%). Some designs (13%) incorporate multiple platforms for multi-modal operation or multiple user engagement. In our analysis, three types of design functionality emerged, which we used to classify mood-focused design innovations: (1) designs that support mood monitoring; (2) designs that support mood expression; and (3) designs that support mood regulation.[122]

Designs That Support Mood Monitoring

A total of 50 designs that support mood monitoring were reported, including those that support (1) detecting moods, (2) self-tracking moods, and (3) analyzing moods.

The first category includes designs that can autonomously detect user moods. In our dataset, most use physiological or behavioral indicators to detect moods. The used physiological signals include skin activity or temperature,[123] heart activity,[124] and scalp activity,[125] while behavioral signals include facial or verbal expressions,[126] gestural or bodily movements,[127] and user-product interaction behaviors.[128] An alternative approach to detecting mood is to use sentiment analysis (see Figure 2 for an example), which infers moods from texts posted on social media,[129] communicated in distributed teams[130] or chat windows,[131] or expressed in personal journaling tools.[132] In addition, several designs enable the detection of mood-related contextual data, such as date and time, locations, or weather.[133]

Designs can also support self-tracking moods. This function is predominantly achieved with web or smartphone applications.[134] To enable active input from users, many adopt pictorial scales, in which moods are represented by emoticons,[135] metaphorical graphics,[136] or color spectra.[137] Other designs do this through dialogues with virtual agents[138] or interactions with tangible



objects[139] and virtual reality devices.[140] Similar to mood detection, mood self-tracking collects contextual data, but it relies more on qualitative, user-input-required data, like events, activities, or personal thoughts.[141] For instance, EmotiCal (see Figure 3)[142] prompts users to reflect on events and write mood descriptions. Although mood detection and self-tracking can operate independently, there is a trend toward their combination for increased accuracy.[143]

Some designs can support mood data analysis. For instance, Health Mashups[144] evaluates the correlation between moods and contextual data like sleep, providing feedback such as "You tend to be happier on days when you sleep more." Another example is EmotiCal (see Figure 3),[145] which analyzes mood patterns and forecasts potential moods for the subsequent two days. It also assesses the connection between moods and activities, and based on this analysis, includes mood regulation suggestions.

Designs That Support Mood Expression

A total of 49 designs that support mood expression were reported, varying in modality and form. Most frequently, moods are visualized through multifarious graphs[146] or colored lights.[147] Other visual means include animations,[148] object or material motion,[149] and metaphorical poems.[150] Some designs use tactile modalities like friction[151] and vibration.[152] Only one design uses sound for mood expression.[153] Most expressions are in an abstract or ambiguous form to allow for open interpretation[154] or to ensure privacy.[155] Many depict mood dynamics in a historical or diachronic form to enhance understanding of user moods.[156] Some mood expressions are interactive, allowing for exploring the detail.[157] Additionally, several designs offer a customization function for users to enrich the meaning of their expressions.[158]

We subdivided designs that support mood expression into two categories based on user activeness in the process: (1) designs that display moods and (2) designs that enable users to share moods. The first category includes

122 It is worth noting that these themes are not mutually exclusive because many of the reviewed design innovations have multiple functionalities.

123 Ashoori et al., "Creating the Mood," 2005; Gluhak et al., "Mood Based Mobile Services," 170; Guo et al., "Designing a Smart Scarf," 397; Janssen et al., "Affective Music Player," 260; Jiang et al., "Smart Textiles," 304; MacLean et al., "Mood-Wings," 3; McDuff et al., "AffectAura," 851; Roseway et al., "BioCrystal," 22; Snyder et al., "Moodlight," 146; Anna Ståhl et al., "Experiencing the Affective Diary," *Personal and Ubiquitous Computing* 13, no. 5 (2009): 369, https://doi.org/10.1007/s00779-008-0202-7.

124 Ashoori et al., "Creating the Mood," 2005; Guo et al., "Designing a Smart Scarf," 397; Liu et al., "Animo," 4; MacLean et al., "MoodWings," 3; Xue and Liang et al., "AffectiveWall."

125 Cernea et al., "Group Affective Tone," 10.

126 Chi Tai Dang et al., "Towards Somaesthetic Smarthome Designs: Exploring Potentials and Limitations of an Affective Mirror," in *IoT '19: Proceedings of the 9th International Conference on the Internet of Things*, ed. Diego López-de-Ipiña, Kyriakos Vamvoudakis, and Diego Casado Mansilla (New York: ACM, 2019), 3, https://doi.org/10.1145/3365871.3365893; Nina Rajcic and Jon McCormack, "Mirror Ritual: An Affective Interface for Emotional Self-Reflection," in *CHI '20: Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems*, ed. Regina Bernhaupt et al. (New York: ACM, 2020), 4, https://

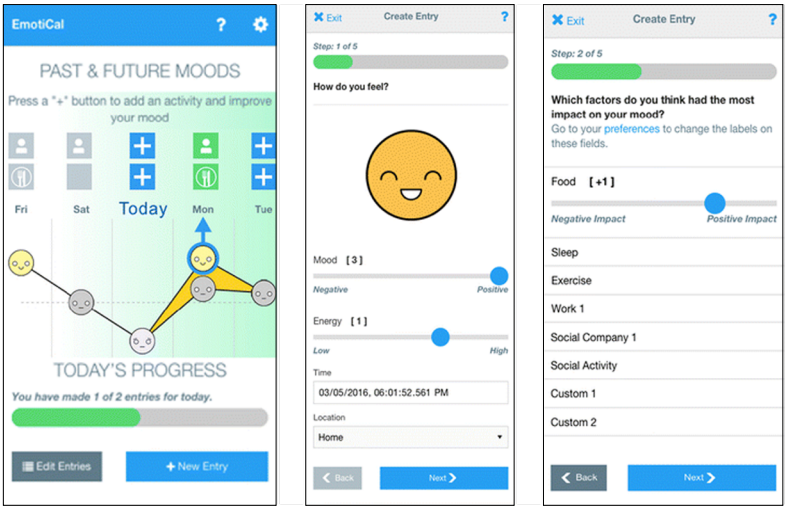


Figure 3
EmotiCal allows users to report moods and contextual data and to see historical mood variations and mood forecasts. Source: Victoria Hollis et al, "What Does All This Data Mean for My Future Mood? Actionable Analytics and Targeted Reflection for Emotional Well-Being," *Human-Computer Interaction* 32, no. 5-6 (2017): 221, figure 2, https://doi.org/10.1080/07370024.2016.1277724. Reprinted by permission of the publisher Taylor & Francis Ltd., http://www.tandfonline.com.

doi.org/10.1145/3313831.3376625; Stangl et al., "Moodcasting," 1306; Hitomi Tsujita and Jun Rekimoto, "HappinessCounter: Smile-Encouraging Appliance to Increase Positive Mood," in *CHI EA '11: Proceedings of the 2011 CHI Conference Extended Abstracts on Human Factors in Computing Systems*, ed. Desney Tan, Bo Begole, and Wendy A. Kellogg (New York: ACM, 2011), 118, https://doi.org/10.1145/1979742.1979608.

127 Alonso et al., "Squeeze, Rock, and Roll," 107; Boehner et al., "Affect," 65; Ståhl et al., "Affective Diary," 367.

128 Alonso et al., "Squeeze, Rock, and Roll," 107; Carneiro et al., "Collective Environments," 5; LiKamWa et al., "Moodscope," 389; Wensveen et al., "Emotionally Rich Interaction," 336.

129 Adams et al., "Social Reader," 979; Mora et al., "Supporting Mood Awareness," 274; Zhao et al., "Pearl," 204.

130 Benke et al., "Chatbot-Based Emotion Management," 11–14.

131 Sánchez et al., "Mood-Oriented Interfaces," 2.

132 Wang et al., "MirrorU," 4.

133 Bentley et al., "Health Mashups," 13; Church et al., "MobiMood," 130; Asma Ghandeharioun et al., "Emma: An Emotion-Aware Wellbeing Chatbot," in *ACII '19: Proceedings of the 8th International Conference on Affective Computing and Intelligent Interaction*, ed. Jonathan Gratch et al. (Washington: IEEE, 2019), 15, http://doi.org/10.1109/ACII.2019.8925455; LiKamWa et al., "Moodscope," 389; McDuff et al., "AffectAura," 851; Ståhl et al., "Affective Diary," 367; Stangl et al., "Moodcasting," 1306.

134 Balta and Read, "U OK?," 2412; Bentley et al., "Health Mashups," 13; Church et al., "MobiMood," 131; Felecia Davis et al., "Actuating Mood: Design of the Textile Mirror," in *TEI '13: Proceedings of the 7th International Conference on Tangible, Embedded and Embodied Interaction*, ed. Sergi Jordà and Narcis Parés (New York: ACM, 2013), 104, https://doi.org/10.1145/2460625.2460640; Hollis et al., "Future Mood," 221; Ellen Isaacs et al., "Echoes from the Past: How Technology Mediated Reflection Improves Well-Being," in *CHI '06: Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, ed. Rebecca Grinter et al. (New York: ACM, 2013), 1073, https://doi.org/10.1145/2470654.2466137; Kim et al., "Mood.Cloud," 348; Lutchyn et al., "MoodTracker," 297; Mora et al., "Supporting Mood Awareness," 272–73; Rivera-Pelayo et al., "Mood Self-Tracking," 9; Sánchez et al., "Mood-Oriented Interfaces," 4–5; Sundström et al., "Group Communication," 353; Sundström et al., "Messaging System," 392–93; Wang et al., "MirrorU," 2; Yamashita et al., "Changing Moods," 161.

135 Balta and Read, "U OK?," 2412; Lutchyn et al., "MoodTracker," 297; Sánchez et al., "Mood-Oriented Interfaces," 4–5.

136 Church et al., "MobiMood," 131; Kim et al., "Mood.Cloud," 348; Sundström et al., "Group Communication," 353; Wang et al., "MirrorU," 3.

137 Rivera-Pelayo et al., "Mood Self-Tracking," 9; Sundström et al., "Messaging System," 392–93.

138 Ashoori et al., "Creating the Mood," 2003.

139 Balaam et al., "Exploring Affective Technologies," 1624; Hansson and Skog, "The LoveBomb," 433; Krøger et al., "Affective Interaction," 6; Sundström et al., "Group Communication," 353; Sundström et al., "Messaging System," 392–93.

140 Wagener and Niess, "VR Mood Worlds," 258.

141 Bentley et al., "Health Mashups," 13; Church et al., "MobiMood," 130; Hollis et al., "Future Mood," 213; Isaacs et al., "Echoes," 1072; Krøger et al., "Affective Interaction," 7; Mora et al., "Supporting Mood Awareness," 273; Rivera-Pelayo et al., "Mood Self-Tracking," 9; Yamashita et al., "Changing Moods," 161.

142 Hollis et al., "Future Mood."

143 Ashoori et al., "Creating the Mood," 2003; Bentley et al., "Health Mashups," 13; Church et al., "MobiMood," 130.

144 Bentley et al., "Health Mashups," 13.

145 Hollis et al., "Future Mood."

146 Adams et al., "Social Reader," 979–81; Balaam et al., "Exploring Affective Technologies," 1624; Balta and Read, "U OK?," 2412; Benke et al., "Chatbot-Based Emotion Management," 11–13; Bentley et al., "Health Mashups," 13; Boehner et al., "Affect," 62; Cernea et al., "Group Affective Tone," 13; Church et al., "MobiMood," 131; Hollis et al., "Future Mood," 220; Krøger et al., "Affective Interaction," 8; Lutchyn et al., "MoodTracker," 297; McDuff et al., "AffectAura," 849; Mora et al., "Supporting Mood Awareness," 297; Rivera-Pelayo et al., "Mood Self-Tracking," 12; Sánchez et al., "Mood-Oriented Interfaces," 4; Ståhl et al., "Affective Diary," 367; Stangl et al., "Moodcasting," 1307; Sundström et al., "Group Communication," 353; Sundström et al., "Messaging System," 396; Tsujita and Rekimoto, "HappinessCounter," 118; Wagener and Niess, "VR Mood Worlds," 256; Wang et al., "MirrorU," 3–4; Xue and Liang et al., "AffectiveWall," 131290; Yamashita et al., "Changing Moods," 162; Zhao et al., "Pearl," 207.

147 Ashoori et al., "Creating the Mood," 2005; Balaam et al., "Exploring Affective Technologies," 1624; Chang et al., "LumiTouch," 314; Dang et al., "An Affective Mirror," 1; Jiang et al., "Smart Textiles," 304; Kim et al., "Mood.Cloud," 348; Mora et al., "Supporting Mood Awareness," 274; Roseway et al., "BioCrystal," 4; Snyder et al., "Moodlight," 146.

148 Boehner et al., "Affect," 65; Liu et al., "Animo," 2.

149 Davis et al., "Actuating Mood," 103; MacLean et al., "MoodWings," 5; Mora et al., "Supporting Mood Awareness," 275.

150 Rajcic and McCormack, "Mirror Ritual," 9.

151 Alonso et al., "Squeeze, Rock, and Roll," 107.

152 Hansson and Skog, "The LoveBomb," 433; Jiang et al., "Smart Textiles," 304; Liu et al., "Animo," 5.

153 Tsujita and Rekimoto, "HappinessCounter," 120.

154 Balaam et al., "Exploring Affective Technologies," 1625; Boehner et al., "Affect," 62; Chang et al., "LumiTouch," 314; Kim et al., "Mood.Cloud," 348; Liu et al., "Animo," 5; McDuff et al., "AffectAura," 850; Rajcic and McCormack, "Mirror Ritual," 7; Ståhl et al., "Affective Diary," 377; Sundström et al., "Group Communication," 353; Sundström et al., "Messaging System," 391.

155 Balaam et al., "Exploring Affective Technologies," 1624; Boehner et al., "Affect," 65; Pradana and Buchanan, "Imparting Otsukaresama," 3.

156 Bentley et al., "Health Mashups," 13; Church, Hoggan, and Oliver, "MobiMood," 130; Hollis et al., "Future Mood," 220; Isaacs et al., "Echoes," 1073; McDuff et al., "AffectAura," 853; Mora et al., "Supporting Mood Awareness," 273; Rivera-Pelayo et al., "Mood Self-Tracking," 9; Tsujita and Rekimoto, "HappinessCounter," 230; Wang et al., "MirrorU," 4; Xue and Liang et al., "AffectiveWall," 131290; Yamashita et al., "Changing Moods," 161–62.

157 Bentley et al., "Health Mashups," 13; Church et al., "MobiMood," 130; Hollis et al., "Future Mood," 223; McDuff et al., "AffectAura," 853; Rivera-Pelayo et al., "Mood Self-Tracking," 9-10; Tsujita and Rekimoto, "HappinessCounter," 120; Yamashita et al., "Changing Moods," 161–62; Zhao et al., "Pearl," 207.

158 Balta and Read, "U OK?," 2412; Sundström et al., "Group Communication," 353; Sundström et al., "Messaging System," 392–93; Wagener and Niess, "VR Mood Worlds," 258; Yamashita et al., "Changing Moods," 161–62.

159 MacLean et al., "MoodWings."

160 McDuff et al., "AffectAura."

161 Alonso et al., "Squeeze, Rock, and Roll"; Balaam et al., "Exploring Affective Technologies"; Bentley et al., "Health Mashups"; Dang et al., "An Affective

Figure 4
MoodWings displays real-time mood states through butterfly wing motion. Source: Diana MacLean, Asta Roseway, and Mary Czerwinski, "MoodWings: A Wearable Biofeedback Device for Real-Time Stress Intervention," in *PETRA '15: Proceedings of the 8th ACM International Conference on PErvasive Technologies Related to Assistive Environments*, ed. Fillia Makedon et al. (New York: ACM, 2013), 5, figure 4, https://doi.org/10.1145/2504335.2504406. Used with permission of ACM (Association for Computing Machinery).

designs displaying user moods to increase mood awareness. Half of these focus on individual mood awareness, like MoodWings (see Figure 4),[159] which communicates real-time stress levels through butterfly wing motion, and AffectAura,[160] which shows hourly mood changes for self-knowledge, among others.[161] Some designs foster collective mood awareness, like MoodTracker[162] and AffectiveWall,[163] which display group mood data in workspaces. Further examples exist in both workplaces[164] and other group contexts (e.g., classrooms or homes).[165] Several designs display moods to enhance mutual awareness in one-to-one communication, in both virtual[166] and physical environments.[167] A unique set of designs display mood data for educators,[168] caregivers,[169] and managers[170] to help them better understand client moods.

The second category encompasses designs that support users in expressing and sharing their moods. These designs require more user effort than those in the first category. An early example from 2001 is LumiTouch[171]—interactive picture frames that enable users to convey moods to loved ones, enhancing remote presence awareness and strengthening affective connections. Another example is mood-sharing social applications,[172] which allow friends to share their moods. Some user tests revealed that sharing improved mutual mood awareness and fostered peer support.[173] Beyond private interactions, users can also communicate moods with colleagues or strangers in public spaces.[174] Additionally, some designs have incorporated mood sharing as an auxiliary function.[175]

Designs That Support Mood Regulation

The review found 57 designs that can support mood regulation, based on one or more of the following six mechanisms: (1) self-awareness or self-reflection; (2) mood-sensitive interactions; (3) recommendations; (4) competence development; (5) system adjustments; and (6) mood regulation technologies.

Mirror"; Davis et al., "Actuating Mood"; Hollis et al., "Future Mood"; Isaacs et al., "Echoes"; LiKamWa et al., "Moodscope"; Rajcic and McCormack, "Mirror Ritual"; Rivera-Pelayo et al., "Mood Self-Tracking"; Snyder et al., "Moodlight"; Ståhl et al., "Affective Diary"; Tsujita and Rekimoto, "HappinessCounter"; Wagener and Niess, "VR Mood Worlds"; Wang et al., "MirrorU."

162 Lutchyn et al., "MoodTracker."

163 Xue and Liang et al., "AffectiveWall."

164 Ashoori et al., "Creating the Mood"; Benke et al., "Chatbot-Based Emotion Management"; Boehner et al., "Affect"; Cernea et al., "Group Affective Tone"; Mora et al., "Supporting Mood Awareness"; Rivera-Pelayo et al., "Mood Self-Tracking"; Sundström et al., "Group Communication."

165 Adams et al., "Social Reader"; Balaam et al., "Exploring Affective Technologies"; Kim et al., "Mood.Cloud"; Stangl et al., "Moodcasting."

166 Boehner et al., "Affect"; Gluhak et al., "Mood Based Mobile Services"; Sánchez et al., "Mood-Oriented Interfaces."

167 Balaam et al., "Exploring Affective Technologies"; Chang et al., "LumiTouch"; Roseway et al., "BioCrystal"; Snyder et al., "Moodlight."

168 Balaam et al., "Exploring Affective Technologies."

169 Krøger et al., "Affective Interaction"; Yamashita et al., "Changing Moods."

170 Lutchyn et al., "MoodTracker"; Rivera-Pelayo et al., "Mood Self-Tracking."

171 Chang et al., "LumiTouch."

172 Balta and Read, "U OK?"; Church et al., "MobiMood"; Liu et al., "Animo"; Pradana

and Buchanan, "Imparting Otsukaresama"; Sundström et al., "Messaging System."

173 Balta and Read, "U OK?," 2413–14; Church et al., "MobiMood," 134–35; Liu et al., "Animo," 8–10; Sundström et al., "Messaging System," 395.

174 Balaam et al., "Exploring Affective Technologies"; Guo et al., "Designing a Smart Scarf"; Hansson and Skog, "The LoveBomb"; Roseway et al., "BioCrystal"; Sundström et al., "Group Communication."

175 LiKamWa et al., "Moodscope," 399; Tsujita and Rekimoto, "HappinessCounter," 120; Wagener and Niess, "VR Mood Worlds," 259.

176 Alonso et al., "Squeeze, Rock, and Roll," 107.

177 Ibid., 105–8.

178 Davis et al., "Actuating Mood," 99–106.

179 MacLean et al., "MoodWings."

180 Roseway et al., "BioCrystal."

181 Snyder et al., "Moodlight."

182 Cernea et al., "Group Affective Tone."

183 Xue and Liang et al., "AffectiveWall."

184 Mora et al., "Supporting Mood Awareness," 268; Pammer, "Mood in the City," 76.

Figure 5
Mirror Ritual displays user mood states through metaphorical poems and invites users to reflect on their moods. Source: Nina Rajcic and Jon McCormack, "Mirror Ritual: An Affective Interface for Emotional Self-Reflection," in *CHI '20: Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems*, ed. Regina Bernhaupt et al. (New York: ACM, 2020), 1, figure 1, https://doi.org/10.1145/3313831.3376625. Used with permission of ACM (Association for Computing Machinery).

Self-awareness or self-reflection (mechanism 1) can be initiated when users report moods or when the system displays them, leading to proactive mood regulation actions.[176] For instance, Alonso et al. designed a smart pen for stress recognition via tactile feedback, prompting users to consciously change their behaviors to regulate their stressful mood.[177] Similar designs include Textile Mirror[178] and MoodWings[179] for individual use, BioCrystal[180] and Moodlight[181] for interpersonal use, and Pogat[182] and AffectiveWall[183] for collective use. As self-awareness is usually ephemeral (yet a precondition of self-reflection),[184] designs like Mirror Ritual (see Figure 5)[185] and an affective mirror[186] were developed to support prolonged self-reflection for effective self-regulation. User tests indicated that mood reflection was useful, for instance, to prepare a mood before starting the day,[187] or to optimize mood impacts on others.[188] Other designs facilitating self-awareness or self-reflection for mood regulation have been reported.[189] In addition, system reminders or notifications proved effective in raising mood awareness and triggering self-reflection.[190]

Mood-sensitive interactions (mechanism 2) involve designs that support mood expression and social sharing. These designs sensitize users to each other's moods, which can foster mutual empathy and trigger interpersonal mood regulation. For instance, Human Tamagotchi[191] allows users to share current moods with close ones via a smartwatch, potentially initiating mood-regulating conversations when one detects their partner's negative moods.[192] Additional examples of interactions with close ones exist in our dataset.[193] Some designs encourage mood-sensitive interactions among colleagues or team members, fostering mutual support.[194] Esnaf-Uslu et al. found that service providers, when more sensitive to client negativity, tend to offer help by employing regulation strategies.[195] This also applies to caregiver-patient,[196] manager-employee,[197] and teacher-student interactions.[198]

Recommendations (mechanism 3) involve designs that provide actionable mood regulation suggestions. For instance, the chatbots developed by Benke et al. can intervene in group interaction and recommend breaks when sensing a dissonant group vibe.[199] Similarly, EmotiCal (see Figure 3)[200] generates analytic reports suggesting mood-regulating actions, which were selected

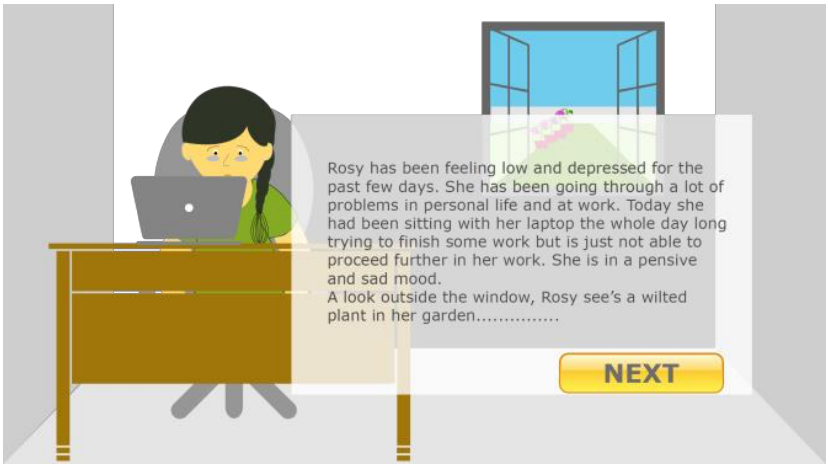


Figure 6
Journey introduces users to mood regulation strategies and improves their coping abilities. Source: Vasundhara Agrawal, Mayuri Duggirala, and Sushovan Chanda, "Journey: A Game on Positive Affect," in *CHI PLAY '18 Extended Abstracts: Proceedings of the 2018 Annual Symposium on Computer-Human Interaction in Play Companion Extended Abstracts*, ed. Florian Floyd Mueller et al. (New York: ACM, 2018), 375, figure 1, https://doi.org/10.1145/3270316.3271532. Used with permission of ACM (Association for Computing Machinery) .

from previous user behavioral patterns and mood regulation literature. Two other examples in our dataset also offer recommendations, typically provided following the monitoring of negative user moods.[201]

Competence development (mechanism 4) involves designs that allow users to acquire or enhance coping skills through learning and practice. In the game *Journey* (see Figure 6),[202] players guide a character out of a melancholic mood using actions like gardening and aiding strangers or animals, introducing users to mood regulation strategies from positive psychology. Another example is UpStage,[203] an educational toolkit for performers coping with pre-performance anxiety, incorporating training exercises in videos and booklets for stress management. Murphy Miserable Robot[204] was developed for children in hospital waiting rooms, prompting skills in reflection and self-regulation by embodying a patient role, activating children's empathy, and encouraging support for "a miserable peer."

System adjustments (mechanism 5) involve designs that adapt to user mood changes, aiming to sustain mood balance. These designs use mood-monitoring technologies and come in various forms, from small objects to large-scale environments. Personalized affective music players[205] autonomously generate mood-matched playlists, while an adaptive alarm clock[206] uses historical mood data to select optimal wake-up sounds. Other designs employ adaptive lights to affect moods, like an interior lighting system for the elderly,[207] a smart scarf for group members,[208] and a biofeedback crystal for partners.[209] Intelligent workspaces exemplify large-scale environment designs,[210] detecting employee mood shifts and adjusting environmental conditions like luminosity and background sound to enhance or alter moods.

Mood regulation technologies (mechanism 6) are designs that directly affect moods, often requiring self-motivation and sustained effort from users. The Getting a GRIP project (see Figure 7)[211] exemplifies this, enabling relaxation through interactive lights and objects. Our dataset includes five categories of mood regulation technologies: (1) relaxation technologies that facilitate venting, resting, or meditating;[212] (2) distraction technologies that

185 Rajcic and McCormack, "Mirror Ritual."
186 Dang et al., "An Affective Mirror."
187 Rajcic and McCormack, "Mirror Ritual," 6.
188 Dang et al., "An Affective Mirror," 7.
189 Balaam et al., "Exploring Affective Technologies"; Bentley et al., "Health Mashups"; Church et al., "MobiMood"; Isaacs et al., "Echoes"; McDuff et al., "AffectAura"; Pammer, "Mood in the City"; Rivera-Pelayo et al., "Mood Self-Tracking"; Roseway et al., "BioCrystal"; Ståhl et al., "Affective Diary"; Wagener and Niess, "VR Mood Worlds"; Wang et al., "MirrorU"; Xue and Liang et al., "AffectiveWall."
190 Bentley et al., "Health Mashups," 12; Church et al., "MobiMood," 136; Isaacs et al., "Echoes," 1073; Mora et al., "Supporting Mood Awareness," 71; Ståhl et al., "Affective Diary," 372.
191 Pradana and Buchanan, "Imparting Otsukaresama," 34–43.
192 Ibid., 41.
193 Balta and Read, "U OK?"; Liu et al., "Animo"; Tsujita and Rekimoto, "HappinessCounter"; Wagener and Niess, "VR Mood Worlds."
194 Adams et al., "Social Reader"; Guo et al., "Designing a Smart Scarf"; Lutchyn et al., "MoodTracker"; Mora et al., "Supporting Mood Awareness"; Rivera-Pelayo et al., "Mood Self-Tracking"; Xue and Liang et al., "AffectiveWall."
195 Esnaf-Uslu et al., "Mood-Sensitive Service Encounters," 131–33.
196 Krøger et al., "Affective Interaction"; Yamashita et al., "Changing Moods".
197 Lutchyn et al., "MoodTracker"; Rivera-Pelayo et al., "Mood Self-Tracking."
198 Balaam et al., "Exploring Affective Technologies."

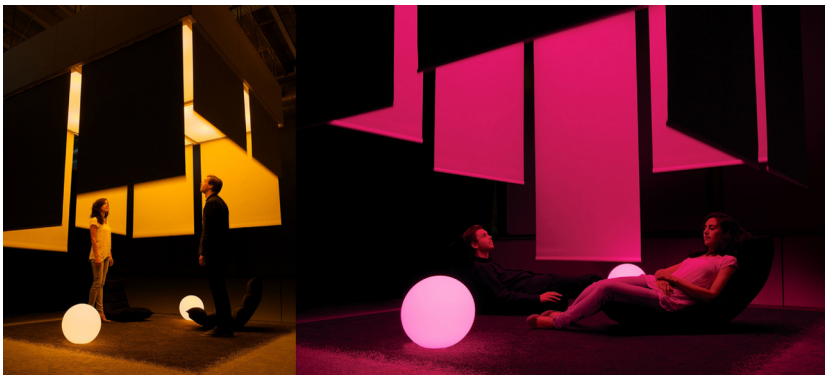


Figure 7
The relaxation space from the Getting a GRIP project allows relaxation through interactive lights and objects. Source: Evelien van de Garde-Perik et al., "Getting a GRIP on Work-Related Stress: Design and Evaluation of a Nature Inspired Relaxation Space," *International Journal of Arts and Technology* 9, no. 3 (2016): 269, figure 6, https://dx.doi.org/10.1504/IJART.2016.10000207. Used with permission of Inderscience Enterprises Limited (UK).

divert attention from stressors;[213] (3) energizing technologies that guide users in exercises to counter lethargy[214] or work fatigue;[215] (4) playful technologies that induce cheerfulness;[216] and (5) ritual-performing technologies that aid users in achieving suitable moods before demanding interactions or events, such as driving[217] or serving customers.[218]

Summary and Discussion

What can design do to — or for — moods? Our review indicates that different designs can monitor moods via mood detection and self-tracking, consistent with findings by Desmet[219] and Spillers.[220] Our study offers two novel insights. First, beyond physiological and behavioral measures, sentiment analysis emerges as a third mood detection method. Second, available technologies can analyze mood patterns using detected or reported moods and their contextual data. This advancement can enhance the quality of mood-monitoring designs, enriching self-information and improving self-knowledge.

Once moods are monitored, they can be expressed through designs. We identified two modes of mood expression: users actively sharing their moods, and designs autonomously expressing moods without requiring active user involvement. Each mode offers specific application possibilities. Designs that autonomously display moods excel at enhancing individual mood awareness and prompting self-reflection, while designs that enable users to share moods are better suited for enhancing mutual awareness and triggering interpersonal communications.

Our study found six mechanisms by which designs can support mood regulation. We posit that these mechanisms offer two general ways to design for mood regulation: (1) developing designs that support people in attaining mood-regulating abilities, and (2) developing designs that enable people to take mood-regulating actions. Our findings resonate with the overview of Slovak et al. on emotion-regulating intervention mechanisms, including emotional awareness, regulatory instructions, and relaxation exercises.[221] We recognize mood and emotion regulation strategies often converge,[222] with tactics like venting or embracing bad feelings.[223] Nonetheless, we suggest

199 Benke et al., "Chatbot-Based Emotion Management," 11–13.
200 Hollis et al., "Future Mood."
201 Carneiro et al., "Collective Environments"; Ghandeharioun et al., "Emma."
202 Vasundhara Agrawal, Mayuri Duggirala, and Sushovan Chanda, "Journey: A Game on Positive Affect," in *CHI PLAY '18 Extended Abstracts: Proceedings of the 2018 Annual Symposium on Computer-Human Interaction in Play Companion Extended Abstracts*, ed. Florian Floyd Mueller et al. (New York: ACM, 2018), 373–79, https://doi.org/10.1145/3270316.3271532.
203 De Luca et al., "Performers," 2426–27.
204 Daniel Ullrich, Sarah Diefenbach, and Andreas Butz, "Murphy Miserable Robot: A Companion to Support Children's Well-Being in Emotionally Difficult Situations," in *CHI EA '16: Proceedings of the 2016 CHI Conference Extended Abstracts on Human Factors in Computing Systems*, ed. Jofish Kaye et al. (New York: ACM, 2016), 3234–40, https://doi.org/10.1145/2851581.2892409.
205 Janssen et al., "Affective Music Player."
206 Wensveen et al., "Emotionally Rich Interaction."
207 Huldtgren et al., "Adaptive Lighting."
208 Guo et al., "Designing a Smart Scarf."
209 Roseway et al., "BioCrystal."
210 Ashoori et al., "Creating the Mood"; Carneiro et al., "Collective Environments."
211 Evelien van de Garde-Perik et al., "Getting a GRIP on Work-Related Stress: Design and Evaluation of a Nature Inspired Relaxation Space," *International Journal of Arts and Technology* 9, no. 3 (2016): 253–72, https://doi.org/10.1504/IJART.2016.10000207.
212 Ashoori et al., "Creating the Mood"; Baños et al., "Virtual Environments"; Cavanagh et al., "Multisensory Environment"; Desmet, "Design for Mood," 10; Van de Garde-Perik et al., "Getting a GRIP."

that future design (research) should be mindful of the differences. First, as emotions typically refer to the relationship between the person and a particular object or event,[224] design-supported emotion regulation can directly address this relationship. Conversely, moods are not object-related,[225] and design-supported mood regulation should thus support mood-regulating activities. Second, since moods persist longer than emotions, designs should aim for enduring mood effects over momentary emotional ones. Potential approaches include regular mood checks, nudging people to engage in routine mood-regulating activities, and promoting mood regulation as a human skill.

RQ3: What Issues Related to Mood-Focused Design Have Been Discussed?

Our study identified eight critical issues, which we classified into the following categories: (1) issues related to mood-monitoring designs, (2) issues related to mood-expressing designs, and (3) issues related to mood-regulating designs. Additionally, we found suggestions on how to address each issue in the literature. Table 4 provides a summary of those issues and corresponding design suggestions.

Table 4 **Issues and design suggestions.**

Issue	Design Suggestion
Issues related to mood-monitoring designs	
Lack of reliability	• To combine mood detection and self-tracking • To request user confirmation • To combine multiple mood signals
Lack of granularity	• To optimize the computational model • To provide abundant mood choices • To provide a customization function
System surveillance	• To request user authorization • To add a turn-off function • To strengthen data management
Issues related to mood-expressing designs	
Misinterpretation	• To provide rich interactions • To provide rich contextual information • To provide a hierarchical interaction mode
Mood privacy	• To anonymize personal information • To provide private versus public modes • To provide private indications
Issues related to mood-regulating designs	
Negative effects of introspection	• To moderate exposure to negative content • To encourage positive recordings
Individual preferences	• To expand recommendations • To personalize recommendations
System intrusiveness	• To explore unobtrusive interventions • To design with people's routines or workflows • To provide user autonomy

213 Jiang et al., "Smart Textiles"; Ullrich et al., "Murphy."
214 Besserer et al., "Fitmirror," 48–55.
215 Desmet, "Design for Mood," 10.
216 Baños et al., "Virtual Environments"; Lee et al., "Laughing Dress"; Tsujita and Rekimoto, "HappinessCounter."
217 Wu et al., "Driver's Emotional Transitions."
218 Yoon et al., "The Mood Street."
219 Desmet, "Design for Mood," 3–6.
220 Spillers, "Getting in the Mood," 2–3.
221 Petr Slovak et al., "Designing for Emotion Regulation Interventions: An Agenda for HCI Theory and Research," *ACM Transactions on Computer-Human Interaction* 30, no. 1 (2022): 45–48, https://doi.org/10.1145/3569898.
222 Sander L. Koole, "The Psychology of Emotion Regulation: An Integrative Review," *Cognition and Emotion* 23, no. 1 (2009): 7, https://doi.org./10.1080/02699930802619031.
223 Desmet, "Design for Mood," 8-10; Jung-Kyoon Yoon et al., "Towards Emotional Well-Being by Design: 17 Opportunities for Emotion Regulation for User-Centered Healthcare Design," in *PervasiveHealth '19: Proceedings of the 13th EAI International Conference on Pervasive Computing Technologies for Healthcare*, ed. Oscar Mayora et al. (New York: ACM, 2019), 351–55, https://doi.org/10.1145/3329189.3329227.
224 Antony S.R. Manstead and Agneta H. Fischer, "Emotion Regulation in Full," *Psychological Inquiry* 11, no. 3 (2000): 188–89, https://www.jstor.org/stable/1449801.
225 Larsen, "Mood Regulation," 131.

Issues Related to Mood-Monitoring Designs

The lack of reliability of mood monitoring—via either mood detection or self-tracking—is highlighted in the literature. Instability of physiological signals due to factors like user age,[226] sensor invasiveness,[227] and environmental conditions[228] hinders reliable mood detection. Detection through behavioral signals is also unreliable, given the difficulty in filtering the signals[229] and the potential discordance between user expressions and true feelings.[230] Moreover, the relationship between physiological or behavioral signals and moods remains unclear.[231] Mood self-tracking suffers from its subjective nature;[232] users may inaccurately recall or misrepresent their feelings.[233] An often-made recommendation to increase reliability is by combining automated mood detection and user self-tracking.[234] Additional suggestions involve allowing users to manually adjust or confirm results,[235] and combining the measurement of multiple mood signals, like physiological or behavioral signals and contextual data.[236]

The lack of granularity is also discussed in the literature. Many mood-monitoring designs fail to detect or allow users to report nuanced mood states. For instance, physiological measures like electrodermal activity (EDA) cannot discern subtle variations in arousal.[237] Janssen et al. noted that their computation model is limited to extremely positive or negative moods.[238] Some user studies revealed dissatisfaction with restricted choices in self-reporting, with users desiring to report subtler, more neutral, or mixed moods.[239] To improve granularity, one suggestion is to develop sophisticated models for differentiating mood dimensions, such as valence, energy, and tension.[240] Another suggestion is to provide a larger array of mood choices for self-tracking.[241] However, this needs to balance with the simplicity of reporting interfaces.[242] In addition, researchers suggested providing a customization function.[243]

Another raised concern is system surveillance, where users feel monitored by "always-on" mood-monitoring designs, leading to perceived privacy invasion and judgment.[244] In a test of mood-managing chatbots, participants reported feeling uneasy, comparing their experience to "a surveilling micromanager who keeps looking over your shoulder."[245] Additionally, users expressed worries about their mood data security, fearing hacker access and potential misuse of health-related information.[246] Several resolutions have been suggested, including requesting user authorization and providing informed consent prior to use,[247] adding a turn-off function,[248] and fortifying mood data management via encryption,[249] data deletion after analysis,[250] or data storage optimization.[251]

Issues Related to Mood-Expressing Designs

Misinterpretation, where users may misconstrue their own or other people's moods, poses a significant issue. Mood-expressing designs employing ambiguous expressions may lead to confusion due to individual and cultural differences in interpreting mood representations, such as colors, icons, and metaphors.[252] Another risk of ambiguous mood expression is that it can lead to incorrect interpretations about what causes the mood.[253] One suggested solution involves providing rich interactions through rich mood-expressing modalities like mixed visual representations[254] and multimodal feedback,[255] or through rich mood-expressing functionalities like customization,[256] detail

226 Huldtgren et al., "Adaptive Lighting," 20.
227 Carneiro et al., "Collective Environments," 3; De Lera, "Emotion-Centered-Design," 408–9; LiKamWa et al., "Moodscope," 391.
228 De Luca et al., "Performers," 2424.
229 Krøger et al., "Affective Interaction," 3; Mora et al., "Supporting Mood Awareness," 270; Roseway et al., "BioCrystal," 21.
230 LiKamWa et al., "Moodscope," 391.
231 De Lera, "Emotion-Centered-Design," 408–9; LiKamWa et al., "Moodscope," 391.
232 De Lera, "Emotion-Centered-Design," 408; De Luca et al., "Performers," 2424.
233 Carneiro et al., "Collective Environments," 3; Krøger et al., "Affective Interaction," 3.
234 Ashoori et al., "Creating the Mood," 2005; Balaam et al., "Exploring Affective Technologies," 1631; Bentley et al., "Health Mashups," 13; Church et al., "MobiMood," 130; Pammer, "Mood in the City," 79; Yamashita et al., "Changing Moods," 166.
235 LiKamWa et al., "Moodscope," 399; Mora et al., "Supporting Mood Awareness," 270.
236 Bentley et al., "Health Mashups," 22–24; Hollis et al., "Future Mood," 253; Huldtgren et al., "Adaptive Lighting," 24; Janssen et al., "Affective Music Player," 273; LiKamWa et al., "Moodscope," 400; Xue and Liang et al., "AffectiveWall," 131297.
237 Snyder et al., "Moodlight," 150.
238 Janssen et al., "Affective Music Player," 274.
239 Balaam et al., "Exploring Affective Technologies," 1627; Sánchez et al., "Mood-Oriented Interfaces," 6.
240 Janssen et al., "Affective Music Player," 274.
241 Lutchyn et al., "MoodTracker," 296–97; Sánchez et al., "Mood-Oriented Interfaces," 6.
242 Sánchez et al., "Mood-Oriented Interfaces," 6.
243 Church et al., "MobiMood," 135; Krøger et al., "Affective Interaction," 7; Rivera-Pelayo et al., "Mood Self-Tracking," 19.
244 Benke et al., "Chatbot-Based Emotion Management," 24; Dang et al., "An Affective Mirror," 5; Huldtgren et al., "Adaptive Lighting," 24; Mora et al., "Supporting Mood Awareness," 271; Pammer, "Mood in the City," 79; Snyder et al., "Moodlight," 150–51; Xue and Liang et al., "AffectiveWall," 131299; Yamashita et al., "Changing Moods," 160.
245 Benke et al., "Chatbot-Based Emotion Management," 24.
246 Dang et al., "Affective Mirror," 7.
247 Adams et al., "Social Reader," 984; Benke et al., "Chatbot-Based Emotion Management," 24; Huldtgren et al., "Adaptive Lighting," 24; Pammer, "Mood in the City," 79; Stangl et al., "Moodcasting," 1306; Xue and Liang et al., "AffectiveWall," 131299.

description,[257] or interactive examination.[258] Additionally, providing rich contextual details has been suggested to guide interpretation.[259] This should be done with caution because while providing insufficient context impedes interpretation,[260] too much context can lead to cognitive overload.[261] This can be solved with a hierarchical interaction mode, enabling users to quickly view moods and delve into details as needed.[262]

Mood privacy is a prevalent concern. Users—especially when publicly expressing moods—may want to avoid the display of personal, particularly negative, moods to prevent unwanted attention or judgment.[263] Privacy concerns vary by audience[264] and situation.[265] In some user studies teenagers resist sharing moods with strangers,[266] students hesitate to share moods with unfamiliar classmates,[267] and employees avoid revealing negative moods in professional settings.[268] Some intricacies were reported—privacy needs differ among individuals, with some desiring absolute mood privacy, while others value openness that helps acquire support.[269] Strategies to address mood privacy include anonymizing personal information and/or aggregating group mood data,[270] providing a toggle between private or public modes or turn on-off function based on contexts and preferences,[271] and providing private mood indications like tactile feedback.[272]

Issues Related to Mood-Regulating Designs

The potential adverse effects of reflecting on negative moods is one issue. While such reflection can improve one's ability to analyze information and create remedial plans,[273] several potential risks were identified. Recalling negative experiences can reignite uncomfortable feelings and may not always contribute to personal growth.[274] Moreover, dwelling introspectively on intensely negative past experiences has the potential to undermine subjective well-being.[275] To address this, researchers suggested moderating user exposure to negative content, such as filtering extremely negative records or displaying such content only during positive moods.[276] Given the evident effects of reflecting on positive content,[277] encouraging users to document more positive content before entering the reflection stage has been suggested, through strategies like adding timely textual reminders[278] or semi-structured checklists guiding positive reflections.[279]

Another issue lies in the challenge of catering to individual preferences for system recommendations, including aspects like difficulty, intensity, and duration of suggested mood-regulating activities.[280] To address this, designs can expand the recommendations by building an extensive dataset of diverse activities[281] and adopting strategies that transcend habitual actions of users.[282] This approach can enhance motivation and reduce habituation.[283] Additionally, recommendations can be personalized through machine-learning technologies,[284] identifying patterns across user subgroups through clustering,[285] or tailoring activities to personal contexts or current tasks.[286]

System intrusiveness, referring to the feelings of disturbance or interruption caused by mood-regulating designs, is a concern too. Designs that facilitate self-awareness or self-reflection often use attention-grabbing signals, potentially causing distraction.[287] Instances were also observed, where overactive chatbot interventions disrupted group discussions and impeded

248 Adams et al., "Social Reader," 983.
249 Dang et al., "An Affective Mirror," 7.
250 Ibid.
251 Krøger et al., "Affective Interaction," 7; Pammer, "Mood in the City," 79.
252 Adams et al., "Social Reader," 983; Balaam et al., "Exploring Affective Technologies," 1629; Guo et al., "Designing a Smart Scarf," 400; Krøger et al., "Affective Interaction," 11; Rajcic and McCormack, "Mirror Ritual," 8; Snyder et al., "Moodlight," 149; Stangl et al., "Moodcasting," 1308; Wang et al., "MirrorU," 5.
253 Church et al., "MobiMood," 136; Liu et al., "Animo," 12; Ståhl et al., "Affective Diary," 374.
254 Adams et al., "Social Reader," 985; Liu et al., "Animo," 14; Zhao et al., "Pearl," 209.
255 Church et al., "MobiMood," 136; Jiang et al., "Smart Textiles," 311.
256 Church et al., "MobiMood," 135; Sundström et al., "Group Communication," 357–58; Sundström et al., "Messaging System," 392–93; Wagener and Niess, "VR Mood Worlds," 258.
257 Balta and Read, "U OK?," 2412; Church et al., "MobiMood," 135; Yamashita et al., "Changing Moods," 161.
258 Liu et al., "Animo," 14; Zhao et al., "Pearl," 204.
259 Benke et al., "Chatbot-Based Emotion Management," 23; Boehner et al., "Affect," 66; Church et al., "MobiMood," 136; Huldtgren et al., "Adaptive Lighting," 18; Liu et al., "Animo," 12; McDuff et al., "AffectAura," 850; Mora et al., "Supporting Mood Awareness," 271; Rivera-Pelayo et al., "Mood Self-Tracking," 11; Ståhl et al., "Affective Diary," 372; Stangl et al., "Moodcasting," 1306; Sundström et al., "Messaging System," 401; Yamashita et al., "Changing Moods," 164; Zhao et al., "Pearl," 209.
260 Church et al., "MobiMood," 136; McDuff et al., "AffectAura," 857.
261 Hollis et al., "Future Mood," 212; McDuff et al., "AffectAura," 856.
262 Bentley et al., "Health Mashups," 18; Church et al., "MobiMood," 130; McDuff et al., "AffectAura," 857; Rivera-Pelayo et al., "Mood Self-Tracking," 11; Wang et al., "MirrorU," 4; Xue and Liang et al., "AffectiveWall," 131299; Yamashita et al., "Changing Moods," 161; Zhao et al., "Pearl," 207.
263 Alonso et al., "Squeeze, Rock, and Roll," 107; Ashoori et al., "Creating the Mood," 2005; Guo et al., "Designing a Smart Scarf," 401; Hansson and Skog, "The Love-Bomb," 433; Isaacs et al., "Echoes," 1073; MacLean et al., "MoodWings," 7; Stangl et al., "Moodcasting," 1308.
264 Mora et al., "Supporting Mood Awareness," 269.

265 MacLean et al., "MoodWings," 7.
266 Balta and Read, "U OK?," 2415; Church et al., "MobiMood," 134.
267 Balaam et al., "Exploring Affective Technologies," 1629.
268 Mora et al., "Supporting Mood Awareness," 269; Rivera-Pelayo et al., "Mood Self-Tracking," 6; Roseway et al., "BioCrystal," 22; Sundström et al., "Group Communication," 355.
269 Balaam et al., "Exploring Affective Technologies," 1629; Mora et al., "Supporting Mood Awareness," 271; Rivera-Pelayo et al., "Mood Self-Tracking," 22; Roseway et al., "BioCrystal," 22; Xue and Liang et al., "AffectiveWall," 131297–98.
270 Cernea et al., "Group Affective Tone," 15; Hansson and Skog, "The LoveBomb," 433; LiKamWa et al., "Moodscope," 400; Lutchyn et al., "MoodTracker," 297; Mora et al., "Supporting Mood Awareness," 269; Pammer, "Mood in the City," 79; Rivera-Pelayo et al., "Mood Self-Tracking," 10; Wagener and Niess, "VR Mood Worlds," 258; Xue and Liang et al., "AffectiveWall," 131300.
271 Balaam et al., "Exploring Affective Technologies," 1629; Balta and Read, "U OK?," 2415; Hansson and Skog, "The LoveBomb," 433; Jiang et al., "Smart Textiles," 310; Lutchyn et al., "MoodTracker," 301; Mora et al., "Supporting Mood Awareness," 271; Roseway et al., "BioCrystal," 22; Snyder et al., "Moodlight," 152; Sundström et al., "Group Communication," 357.
272 Alonso et al., "Squeeze, Rock, and Roll," 107; Ashoori et al., "Creating the Mood," 2005; Guo et al., "Designing a Smart Scarf," 396; Jiang et al., "Smart Textiles," 310; Liu et al., "Animo," 9; MacLean et al., "MoodWings," 7.
273 Hollis et al., "Future Mood," 212.
274 Isaacs et al., "Echoes," 1079.
275 Hollis et al., "Future Mood," 255.
276 Ibid., 256; Isaacs et al., "Echoes," 1080.
277 Yamashita et al., "Changing Moods," 166.
278 Wang et al., "MirrorU," 4.
279 Yamashita et al., "Changing Moods," 166.
280 Besserer et al., "Fitmirror," 55; Ghandeharioun et al., "Emma," 19; Hollis et al., "Future Mood," 254; Jiang et al., "Smart Textiles," 310.
281 Ghandeharioun et al., "Emma," 20.
282 Hollis et al., "Future Mood," 253.
283 Ghandeharioun et al., "Emma," 20; Hollis et al., "Future Mood," 253.
284 Bentley et al., "Health Mashups," 24.
285 Hollis et al., "Future Mood," 254.
286 Ghandeharioun et al., "Emma," 20; MacLean et al., "MoodWings," 7.
287 Balaam et al., "Exploring Affective Technologies," 1630.
288 Benke et al., "Chatbot-Based Emotion Management," 23.

engagement.[288] Furthermore, mood-enhancing exercises have the potential to annoy users who are already in a pleasant mood.[289] In addition, abrupt system adjustments to user moods can disrupt ongoing tasks and compromise their performance.[290] Suggested solutions include the exploration of unobtrusive interventions,[291] seamless integration of designs into daily routines or workflows,[292] and affording user autonomy in initiating and modifying the interaction.[293]

Summary and Discussion

In the practice of mood-focused design, ethical concerns related to design-supported mood monitoring, expression, and regulation hold significant prominence. Issues like system surveillance, mood privacy, and system intrusiveness come to the forefront. Indeed, given the advancements in artificial intelligence and social robotics, ethical considerations now have a central role in the realm of design. For instance, ethical issues in the design of affective health interventions[294] and personal informatics systems[295] have also been identified by other review studies. To address the ethical dimensions of mood-focused design, some articles in our dataset suggest the provision of user autonomy as a viable solution. To illustrate, designs might allow users to deactivate mood monitoring if they feel surveilled, to deactivate public expression for their privacy, or to have full control of mood-regulating interventions. These suggestions align with research that emphasizes autonomy as a critical principle for technology and design ethics, recognizing it as a fundamental human need that significantly influences user experience and well-being.[296]

The articles in our dataset revealed that the accuracy of mood monitoring is currently below optimal levels. There is an ongoing ambiguity regarding the more promising approach between autonomous detection and self-tracking too. This observation is in line with the belief of Desmet et al. that psychological, behavioral, and self-report measures each have their own strengths and limitations.[297] A promising avenue is the combination of mood detection with self-tracking, which has shown encouraging initial results.[298] There is also momentum toward expanding the scope of mood signals,[299] exemplified by innovations such as the model proposed by Alibasa et al. predicting mood based on a user's "digital footprints" such as search history and social media activity.[300] Our analysis also indicates a limited granularity in the types of mood that can be effectively monitored. While we found two promising typologies encompassing diverse and fine-grained mood types,[301] no studies have yet employed them. We recommend the adaptation of these typologies for the development of new mood detection techniques or the enhancement of self-reporting functions.

RQ4: What Methods for Mood-Focused Design Are Available?

Few articles addressed this topic, from which we identified two categories of methodological resources. The first category supports empathizing with users, while the second category supports ideation in a mood-focused design process.[302]

289 Ghandeharioun et al., "Emma," 19.
290 Janssen et al., "Affective Music Player," 259.
291 Alonso et al., "Squeeze, Rock, and Roll," 106; Benke et al., "Chatbot-Based Emotion Management," 24; Bentley et al., "Health Mashups," 12; Janssen et al., "Affective Music Player," 259; Liu et al., "Animo," 2; Mora et al., "Supporting Mood Awareness," 271; Pradana and Buchanan, "Imparting Otsukaresama," 36; Roseway et al., "Bio-Crystal," 21; Stangl et al., "Moodcasting," 1307; Van de Garde-Perik et al., "Getting a GRIP," 262.
292 Benke et al., "Chatbot-Based Emotion Management," 12; Besserer et al., "Fit-mirror," 49; Dang et al., "An Affective Mirror," 7; Lutchyn et al., "MoodTracker," 299; MacLean et al., "MoodWings," 7; Rajcic and McCormack, "Mirror Ritual," 6; Rivera-Pelayo et al., "Mood Self-Tracking," 24; Snyder et al., "Moodlight," 152; Stangl et al., "Moodcasting," 1307; Tsujita and Rekimoto, "HappinessCounter," 119; Xue and Liang et al., "AffectiveWall," 131299.
293 Besserer et al., "Fitmirror," 50; Desmet, "Design for Mood," 6; Huldtgren et al., "Adaptive Lighting," 25; Van de Garde-Perik et al., "Getting a GRIP," 262.
294 Pedro Sanches et al., "HCI and Affective Health: Taking Stock of a Decade of Studies and Charting Future Research Directions," in *CHI '19: Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems*, ed. Stephen Brewster et al. (New York: ACM, 2019), 9–10, https://doi.org/10.1145/3290605.3300475.
295 Daniel A. Epstein et al., "Mapping and Taking Stock of the Personal Informatics

Resources That Support Empathizing

Our dataset encompasses two mood typologies that facilitate a granular understanding of the mood phenomenon. Xue and Desmet et al. provided a typology of twenty distinct moods (see Figure 8), including positive moods like "relaxed" and "cheerful," negative moods like "miserable" and "anxious," and ambiguous moods like "sentimental" and "rebellious."[303] This typology offers rich descriptions of subjective feelings, perceptions, reactions, tendencies, likes, and dislikes, accompanied by illustrations and narratives for each mood.[304] Sönmez et al., on the other hand, introduced a typology of eight group moods, such as "chill flow," "fiery," and "jolly," determined by four experiential factors: feelings, interpersonal communication, workflow, and motivation.[305] These mood typologies can support empathizing in design by providing a nuanced vocabulary for understanding and discussing moods. In user research, like surveys or interviews, they can assist users in articulating their desired (or undesired) mood experiences.[306] Additionally, they can facilitate nuanced communication about user moods within the design team, helping to reach a consensus and clarify design intentions.[307]

Our dataset includes a mood tendency space with 68 mood-stimulated tendencies (see Figure 9), which offers an additional dimension for understanding mood manifestations.[308] It is based on the suggestion that individuals are constantly moving around in that space, with their moods influencing their thoughts and interactions with others and their environments.[309] Consistent with this, De Lera proposed that designers should consider multiple distinct interaction paths for a single user at any given time.[310] The mood tendency space can support empathizing in design by facilitating mood-related user profiling (e.g., stressed individuals tend to behave impatiently), which can further inform design intentions (e.g., accommodating a lack of patience).[311] It can also be used to cultivate empathy amongst designers. Desmet et al. introduced a "Mood-Empathy Game" that engages

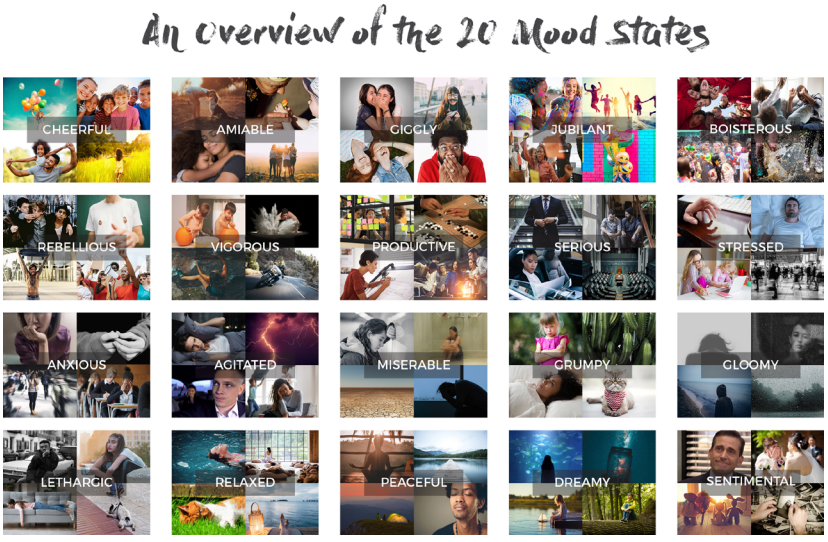


Figure 8
A typology of twenty moods. Source: Pieter M. A. Desmet, Steven F. Fokkinga, and Haian Xue, *Twenty Moods: Holistic Typology of Human Mood States* (Delft: Delft University of Technology, 2020), iii. © 2020 Pieter M. A. Desmet, Steven F. Fokkinga, and Haian Xue.

Figure 9
The mood tendency space. Source: Pieter M. A. Desmet, Haian Xue, and Steven F. Fokkinga, "The Same Person Is Never the Same: Introducing Mood-Stimulated Thought/Action Tendencies for User-Centered Design," *She Ji: The Journal of Design, Economics, and Innovation* 5, no. 3 (2019): 173, figure 1, https://doi.org/10.1016/j.sheji.2019.07.001. © 2019 Pieter M. A. Desmet, Haian Xue, and Steven F. Fokkinga.

designers in a role-playing activity to explore how mood affects motivations and behaviors, thus familiarizing them with mood-stimulated tendencies and building their empathy with potential users.[312]

Resources That Support Ideation

In our dataset, resources supporting ideation mainly involve mood regulation strategies and patterns. Desmet introduced twenty activity-based mood regulation strategies distributed across three categories representing different foci: seek relief (e.g., "seeking distraction," "venting"), restore balance (e.g., "seeking relaxation," "seeking social support"), and build resilience (e.g., "rationalizing," "embracing").[313] Some studies identified the daily mood-regulating patterns of individuals,[314] with many aligning with Desmet's framework. Notably, several patterns are new, such as performing rituals[315] or maintaining the beneficial part of stress.[316] Esnaf-Uslu et al. identified nine interpersonal mood regulation strategies in service encounters like "calming" or "apologetic,"[317] while Pradana and Buchanan discovered five mood-regulating patterns in mobile-mediated communications like "experience sharing" or "gift giving."[318] While not all these strategies necessitate design interventions, they can serve as a source of design inspiration.[319] Examples include a trumpet-like public installation for shouting burdens, using the "venting" strategy,[320] and a stretching game for office relaxation, using the

Literature," *Proceedings of the ACM on Interactive, Mobile, Wearable and Ubiquitous Technologies* 4, no. 4 (2020): 11–12, https://doi.org/10.1145/3432231.

296 Rafael A. Calvo et al., "Supporting Human Autonomy in AI Systems: A Framework for Ethical Enquiry," in *Ethics of Digital Well-Being: A Multidisciplinary Approach*, ed. Christopher Burr and Luciano Floridi (Cham: Springer, 2020), 31–54, https://doi.org/10.1007/978-3-030-50585-1_2.

297 Pieter M. A. Desmet, Martijn H. Vastenburg, and Natalia Romero, "Mood Measurement with Pick-A-Mood: Review of Current Methods and Design of a Pictorial Self-Report Scale," *Journal of Design Research* 14, no. 3 (2016): 265–67, https://doi.org/10.1504/JDR.2016.079751.

298 Ashoori et al., "Creating the Mood," 2003; Bentley et al., "Health Mashups," 13; Church et al., "MobiMood," 130.

299 Yan Wang et al., "A Systematic Review on Affective Computing: Emotion Models, Databases, and Recent Advances," *Information Fusion* 83-84 (2022): 19–52, https://doi.org/10.1016/j.inffus.2022.03.009.

300 Muhammad Johan Alibasa, Rafael A. Calvo, and Kalina Yacef, "Predicting Mood

from Digital Footprints Using Frequent Sequential Context Patterns Features," *International Journal of Human-Computer Interaction* 39, no. 10 (2022): 2061–75, https://doi.org/10.1080/10447318.2022.2073321.

301 Sönmez et al., "Group Mood," 104; Xue and Desmet et al., "Mood Granularity," 3.

302 To categorize the codes in this section, we referred to the d.school's design thinking process (empathize, define, ideate, prototype, and test) and IDEO's human-centered design model (inspiration, ideation, and implementation). "Design Kit: The Human-Centered Design Toolkit," IDEO, June 11, 2015, https://www.ideo.com/post/design-kit; Rikke Friis Dam, "The 5 Stages in the Design Thinking Process," *Interaction Design Foundation*, accessed August 20, 2023, https://www.interaction-design.org/literature/article/5-stages-in-the-design-thinking-process.

303 Xue and Desmet et al., "Mood Granularity," 3.

304 Ibid.

305 Sönmez et al., "Group Mood," 104.

306 Ibid., 109–10.

307 Xue and Desmet et al., "Mood Granularity," 11–12.

308 Desmet et al., "Mood-Stimulated Tendencies," 169–70.

309 Ibid., 179.

310 De Lera, "Emotion-Centered-Design," 413–14.

311 Desmet et al., "Mood-Stimulated Tendencies," 179–81.

312 Ibid., 177–79.

313 Desmet, "Design for Mood," 8–9.

314 De Luca et al., "Performers," 2428–30; Jiang et al., "Smart Textiles," 308; Wu et al., "Driver's Emotional Transitions," 127–28.

315 Wu et al., "Driver's Emotional Transitions," 127–28.

316 De Luca et al., "Performers," 2429.

317 Esnaf-Uslu et al., "Mood-Sensitive Service Encounters," 129.

318 Pradana and Buchanan, "Imparting Otsukaresama," 39–40.

319 Desmet, "Design for Mood," 10.

320 Ibid.

321 Ibid.

322 Esnaf-Uslu et al., "Mood-Sensitive Service Encounters," 133.

323 Erik Stolterman, "The Challenge of Improving Designing," *International Journal of Design* 15, no. 1 (2021): 65–74, http://www.ijdesign.org/index.php/IJDesign/article/view/3606/937.

324 Ibid., 72–73.

325 Ibid., 72.

strategy of "seeking relaxation."[321] Esnaf-Uslu et al. also suggested creating virtual skylights to reduce patient stress in dental practices, based on the "calming" strategy.[322]

Summary and Discussion

For mood-focused design, we identified two categories of methodological resources: one for empathizing with users and the other for design ideation. These categories align with Stolterman's two design improvement approaches: preparation and inspiration.[323] The first category offers mood typologies and knowledge on its relation to the thoughts or action tendencies of individuals, facilitating nuanced understanding of mood from designers for greater empathy. This aligns with the preparation approach, which seeks to enhance the ability of designers to make judgments and develop innovative ideas.[324] The second category encompasses a diverse range of mood-regulation strategies that can inform design ideation. This aligns with the inspiration approach, which aims to provide designers with concrete designs, abstract ideas, concepts, theories, and metaphors.[325] While these resources to some extent inform mood-focused design processes, they do not yet offer a unified methodology, remaining as distinct components.

General Discussion

Mood, ubiquitous and influential in people's everyday lives, is a phenomenon that has consistently intrigued designers and design researchers. However, the current landscape of mood-focused design endeavors remains fragmented, presenting a notable challenge to its progression. To offer an overview, we conducted a scoping review of 66 relevant articles in the field, delving into how mood is addressed by designers and design researchers in the context of experience-driven design. Although mood is elusive, its multifaceted nature, including its long duration and its impacts on social relationships, has been partially comprehended in design. Designers and design researchers, despite a limited understanding of mood, have explored mood-focused design possibilities, developing innovations for mood monitoring, expression, or regulation. During these activities, various challenges of mood-focused design have emerged, such as concerns related to mood privacy and the intrusiveness of mood-regulating interventions. As the interest in mood-focused design continues to grow, researchers have provided preliminary tools to enhance mood empathy amongst designers and facilitate design ideation. However, these tools are currently limited in their comprehensiveness and systematic approach.

Our review offers several benefits to the field of mood-focused design. First, it deepens our comprehension of mood as a distinct facet of human experience that can both be studied (as a topic of design research) and designed for (as a design intention). While mood often gets confused with emotion in design research and practice, the reviewed articles highlight its unique position within experience design, calling for more deliberate and systematic investigations into mood. Second, by presenting the current landscape of mood-focused design, researchers can use our review to enhance

their understanding of mood, assisting them in identifying research gaps for further exploration. Additionally, this review can serve as a reservoir of references to mood-related design knowledge for practitioners, promoting a shift from intuition-based to evidence-based designing. As an example, our findings could offer guidance to design teams in making design decisions, such as whether they should focus on mood or emotion, what type of mood-focused design they aim to develop, and what to be cautious about when designing a mood-regulating intervention.

Avenues for Future Research on Mood-Focused Design

While current work in mood-focused design is enlightening, it is important to acknowledge that this field is currently in its early stages of development. To guide our contemplation on its future trajectory, we referred to Wobbrock and Kientz's classification of seven research contributions within human-computer interaction (HCI).[326] Their theoretical, artifact, opinion, and methodological contributions resonated with our inquiries and stimulated our reflections on potential contributions to mood-focused design. Consequently, we propose four avenues for further exploration, including initiatives to expand the theoretical comprehension of mood, create innovative artifacts, share informed opinions, and advance method development within this domain.

Expanding Theoretical Understanding of Mood in Design

Currently, the theoretical understanding of mood in design remains limited. To enrich understanding, we suggest three primary research avenues. First, there is a need to develop a practical understanding of mood functionality. This involves investigating how the signaling function of the mood system manifests in human-design interactions, enabling a more systematic analysis and comprehensive measurement of the experiential qualities and impacts of mood. Second, future research can deepen our understanding of mood as an emergent background experience during an individual's interactions with people, products, and environments. Such insights can inform designers when and how design might intervene in user moods, thereby opening new space for mood-focused design innovations. Last, research can delve into the sources or factors that contribute to specific positive or negative moods. This may seem counterintuitive, given that moods often result from a sequence of events, making their origins challenging to identify. Nevertheless, we propose that compiling an overview of potential mood sources, including both internal factors like self-consciousness and external factors like the weather, can bring clarity to the mood phenomenon and serve as inspiration for designers.

Exploring New Mood-Focused Design Possibilities

We propose the continuation of explorations with real-world design examples, such as mood-tracking apps,[327] to enrich our understanding of mood-focused design possibilities. Future studies could leverage technologies like artificial intelligence or ambient intelligence for their potential in capturing and storing prolonged mood-related data, with or without user

326 Wobbrock and Kientz identified seven research contribution types in the HCI field: (1) empirical research contributions that offer knowledge from findings based on observations, experiments, or interviews; (2) artifact contributions that manifest knowledge in novel artifacts from generative design-driven activities; (3) methodological contributions that create methods, measures, or instruments informing how research or practice can be conducted; (4) theoretical contributions that provide new or improved concepts, principles, models, or frameworks; (5) dataset contributions that offer new and useful corpora for research; (6) survey contributions that provide syntheses of work done on a certain topic; and (7) opinion contributions that provide arguments seeking to compel reflections and discussions. Jacob O. Wobbrock and Julie A. Kientz, "Research Contributions in Human-Computer Interaction," *Interactions* 23, no. 3 (2016): 39–44, https://doi.org/10.1145/2907069.

327 Various mood-tracking apps are available in Google Play and the App Store. Clara Caldeira et al., "Mobile Apps for Mood Tracking: An Analysis of Features and User Reviews," *AMIA Annual Symposium Proceedings* 2017 (2018): 495–504, https://pubmed.ncbi.nlm.nih.gov/29854114/.

introspection. Moreover, there is a need to explore novel design features that can induce specific mood experiences or support mood regulation. Research-through-design projects have the potential to investigate how diverse interaction qualities, like physicality, slowness, or temporary disconnection from the digital world,[328] may influence user mood experience and self-awareness of mood.

Probing Practical Mood-Related Design Experiences

The design literature has documented diverse perspectives, beliefs, and challenges concerning mood-focused design. Future studies can investigate how industry practitioners address mood, including their understanding of mood, their attitudes toward incorporating user or customer mood in experience-driven design, their approaches to mood-focused design, and the obstacles they encounter. We propose two research paths for approaching this subject. The first involves gaining insights from individuals who directly work with mood, such as designers working on products like the Philips Hue mood lighting system. The second is to explore the implicit design experiences of practitioners that pertain to mood. Experienced practitioners in fields like experience, service, or strategic design might subconsciously consider user or customer mood in their practices, even if they do not explicitly label their design projects as "mood-focused" or "mood-centric." Assessing their experiences and viewpoints could inform the development of design methods or tools tailored to mood-related challenges.

Developing Both Prescriptive and Descriptive Design Methods

Given the current limitations in mood-focused design methods, we propose two directions for the development of new methods or tools. First, we recommend creating prescriptive design methods, such as a systematic mood-focused design framework. This would provide designers a comprehensive overview of strategies to address user mood across various design scenarios, along with implementation guidelines. Second, there is potential for developing descriptive design methods. Future research could explore tools to support designers in building mood empathy, especially in the early stages of mood-focused design projects. These tools could range from heuristic cards that foster project-specific mood awareness within a design team to self-development training materials that support enhanced mood sensitivity.

Limitations of This Scoping Review

We acknowledge several limitations in our scoping review. First, despite conducting searches in Scopus, Web of Science, and the ACM Digital Library, it is possible that we have missed relevant articles from databases like ScienceDirect or IEEE Xplore. Additionally, we did not include search terms of specific mood states like "stress," "anxiety," and "relaxation." Second, our literature selection process might have introduced bias due to the interchangeable use of terms like "mood," "emotion," and "affect" in many articles. To address this, we employed psychological definitions of mood and emotion to guide our selection process. We ensured that the

328 For instance, researchers have explored traditional mood self-tracking methods (i.e., physical paper bullet journals) as an effective way to facilitate self-reflection. Parastoo Abtahi et al., "Understanding Physical Practices and the Role of Technology in Manual Self-Tracking," *Proceedings of the ACM on Interactive, Mobile, Wearable and Ubiquitous Technologies* 4, no. 4 (2020): article no. 115, https://doi.org/10.1145/3432236.

329 Munn et al., "Systematic Review or Scoping Review?," 4.

articles were screened collaboratively for intersubjective consensus too. Third, our focus was primarily on interaction design, which led us to exclude broader interdisciplinary fields like architecture or marketing, where mood is also considered. Exploring these fields can provide additional insights for mood-focused design or research. Last, our review aimed to provide a comprehensive overview of the field, which might have resulted in the omission of more niche topics. Nevertheless, this presents an opportunity for more targeted future studies, as scoping reviews often serve as valuable preliminary steps to systematic reviews.[329] Research could be conducted, for instance, to scrutinize the influencing factors of mood or the ethical issues of mood-monitoring designs.

Conclusion

This article presents the findings of a scoping review investigating how mood is currently addressed in the context of experience-driven design. Our review underscores that, although the understanding of mood in design is still evolving, designers and design researchers have ventured into mood-focused design, tackling a range of challenges along the way. To our knowledge, this review stands as the first comprehensive overview of the field of mood-focused design. It aids researchers in identifying potential areas for further explorations and provides practitioners with empirically grounded design insights. Ideally, this review can serve as a step toward systematically integrating mood into the design discipline. We propose that future research could prioritize enhancing the theoretical understanding of mood in design, exploring additional mood-focused design possibilities, investigating practical design experiences, and developing both prescriptive and descriptive design methods.

Declaration of Interests

There are no conflicts of interest involved in this article.

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Appendix A Search Strategies and Results

Primary Search I: Electronic Databases

Database 1: Scopus

Last search date: 17 January 2022
Articles identified: 3,064
Search strategy:
1. Title = (mood* OR emotion* OR affect*)
2. Title = (design*)
3. Publication date = (01.01.1999 to 17.01.2022)
4. Language = (English)
5. Document type = (article OR conference paper)
6. #1 AND #2 AND #3 AND #4 AND #5

Database 2: Web of Science Core Collection

Last search date: 17 January 2022
Articles identified: 2,356
Search strategy:
1. Title = (mood* OR emotion* OR affect*)
2. Title = (design*)
3. Publication date = (01.01.1999 to 17.01.2022)
4. Language = (English)

5. Document type = (articles OR proceedings papers)
6. #1 AND #2 AND #3 AND #4 AND #5

Database 3: ACM Digital Library

Last search date: 17 January 2022
Articles identified: 135
Search strategy:
1. Title = (mood* OR emotion* OR affect*)
2. Title = (design*)
3. Publication date = (01.01.1999 to 17.01.2022)
4. Document type = (research article)
5. #1 AND #2 AND #3 AND #4

Table A1 **Articles identified from electronic databases.**

Database	Number of Articles
Scopus	3,064
Web of Science Core Collection	2,356
ACM Digital Library	135
The total number of articles identified from three databases	5,555

Primary Search II: Electronic Journals and Conference Proceedings

Data sources: 20 design journals and 9 design conference proceedings (Table A2)
Search engines: Scopus, Google Scholar, and DSR Digital Library
Last search date: 21 January 2022
Articles identified (in total): 1,132
Search strategy: at least one of the terms "mood," "emotion," and "affect" (or their derivative words such as "emotional" or "affective") occurring in the article title

Table A2 **Articles identified from electronic journals and conference proceedings.**

Source Type	Source Name	Search Engine	Number of Articles
Journal	Applied Artificial Intelligence	Scopus	22
	Applied Ergonomics	Scopus	62
	CoDesign	Scopus	1
	Computer-Aided Design	Scopus	1
	Design Issues	Scopus	2
	Design Science	Scopus	3
	Design Studies	Scopus	10
	Digital Creativity	Scopus	9
	Ergonomics	Scopus	42

Table A2 (*continued*)

Source Type	Source Name	Search Engine	Number of Articles
	Human-Computer Interaction	Scopus	9
	Human Factors	Scopus	39
	International Journal of Design	Scopus	24
	International Journal of Human-Computer Interaction	Scopus	51
	International Journal of Industrial Ergonomics	Scopus	47
	International Journal of Technology and Design Education	Scopus	12
	Journal of Design Research	Scopus	8
	Journal of Engineering Design	Scopus	16
	Research in Engineering Design	Scopus	1
	She Ji: The Journal of Design Economics and Innovation	Scopus	2
	The Design Journal	Scopus	20
Conference proceedings	ACM Conference on Designing Interactive Systems (DIS)	Scopus	47
	ACM Conference on Human Factors in Computing Systems (CHI)	Scopus	424
	ACM International Conference on Mobile Systems, Applications, and Services (MobiSys)	Scopus	12
	Congress of the International Association of Societies of Design Research (IASDR)	Google Scholar	31
	Design Research Society Conference (DRS)	DSR Digital Library	29
	International Conference on Design and Emotion (D&E)	Scopus & Google Scholar	169
	International Conference on Designing Pleasurable Products and Interfaces (DPPI)	Scopus	16
	International Design Conference (DESIGN)	Scopus	16
	Nordic Conference on Human-Computer Interaction (NordiCHI)	Scopus	7
The total number of articles identified from 20 journals and 9 conference proceedings			1,132

Supplementary Search: Backward and Forward Citation Search

In addition to primary searches, we did a supplementary search to retrieve additional relevant articles, using a backward and forward search method. In the backward citation search, we checked the references of a collection of highly relevant articles we selected after the first-round full-text screening. After seeing the possibilities in their titles, we accessed some references online for abstract and full-text reading. In the forward citation search, we extensively used Google Scholar to check the cited-by records of selected articles. Both backward and forward citation searches adhered to our selection criteria. Please note that we did not further consider a snowballing method (also referred to as pearl-growing or cross-referencing). We considered the newly retrieved articles diverse enough as complements for the previously selected articles to scope the field. The supplementary search was completed on April 2, 2022 and yielded a total of 33 articles for the second-round full-text screening.

Appendix B Articles Included for Review

Publication Type	Author	Year	Title	Source
Journal article	Adams, Brett, Dinh Phung, and Svetha Venkatesh	2014	Social Reader: Towards Browsing the Social Web	Supplementary search
	Baños, Rosa María, Ernestina Etchemendy, Diana Castilla, Azucena García-Palacios, Soledad Quero, and Cristina Botella	2012	Positive Mood Induction Procedures for Virtual Environments Designed for Elderly People	Primary search
	Benke, Ivo, Michael Thomas Knierim, and Alexander Maedche	2020	Chatbot-Based Emotion Management for Distributed Teams: A Participatory Design Study	Primary search
	Bentley, Frank, Konrad Tollmar, Peter Stephenson, Laura Levy, Brian Jones, Scott Robertson, Ed Price, Richard Catrambone, and Jeff Wilson.	2013	Health Mashups: Presenting Statistical Patterns between Wellbeing Data and Context in Natural Language to Promote Behavior Change	Supplementary search
	Cavanagh, Bliss, Kirsti Haracz, Miranda Lawry, Kylie Wales, and Carole James.	2021	Changes in Emotions and Perceived Stress Following Time Spent in an Artistically Designed Multisensory Environment	Primary search
	Desmet, Peter M. A.	2015	Design for Mood: Twenty Activity-Based Opportunities to Design for Mood Regulation	Primary search
	Desmet, Pieter M. A., Haian Xue, and Steven F. Fokkinga	2019	The Same Person Is Never the Same: Introducing Mood-Stimulated Thought/Action Tendencies for User-Centered Design	Primary search
	Esnaf-Uslu, Pelin, Pieter M. A. Desmet, and Hendrik N. J. Schifferstein	2022	The Eye Inward and the Eye Outward: Introducing a Framework for Mood-Sensitive Service Encounters	Supplementary search
	Hollis, Victoria, Artie Konrad, Aaron Springer, Matthew Antoun, Christopher Antoun, Rob Martin, and Steve Whittaker	2017	What Does All This Data Mean for My Future Mood? Actionable Analytics and Targeted Reflection for Emotional Well-Being	Primary search
	Janssen, Joris H., Egon L. van den Broek, and Joyce H. D. M. Westerink	2012	Tune in to Your Emotions: A Robust Personalized Affective Music Player	Supplementary search
	Liu, Fannie, Mario Esparza, Maria Pavlovskaia, Geoff Kaufman, Laura Dabbish, and Andrés Monroy-Hernández	2019	Animo: Sharing Biosignals on a Smartwatch for Lightweight Social Connection	Supplementary search
	Rivera-Pelayo, Verónica, Angela Fessl, Lars Müller, and Viktoria Pammer	2017	Introducing Mood Self-Tracking at Work: Empirical Insights from Call Centers	Supplementary search
	Roseway, Asta, Yuliya Lutchyn, Paul Johns, Elizabeth Mynatt, and Mary Czerwinski	2015	BioCrystal: An Ambient Tool for Emotion and Communication	Supplementary search
	Sönmez, Alev, Pieter M. A. Desmet, and Natalia Romero Herrera	2022	Chill, Fiery, Slack, and Five Other Vibes: A Phenomenological Inquiry into Group Mood	Supplementary search
	Ståhl, Anna, Kristina Höök, Martin Svensson, Alex S. Taylor, and Marco Combetto	2009	Experiencing the Affective Diary	Supplementary search
	Sundström, Petra, Anna Ståhl, and Kristina Höök	2007	In Situ Informants Exploring an Emotional Mobile Messaging System in Their Everyday Practice	Supplementary search
	Van de Garde-Perik, Evelien, Federico Trevia, Adam Henriksson, Luc Geurts, and Helle Ullerup	2016	Getting a GRIP on Work-Related Stress: Design and Evaluation of a Nature Inspired Relaxation Space	Supplementary search
	Xue, Haian, Pieter M. A. Desmet, and Steven F. Fokkinga	2020	Mood Granularity for Design: Introducing a Holistic Typology of 20 Mood States	Primary search
	Xue, Mengru, Rong-Hao Liang, Bin Yu, Mathias Funk, Jun Hu, and Loe Feijs	2019	AffectiveWall: Designing Collective Stress-Related Physiological Data Visualization for Reflection	Primary search
Conference paper	Agrawal, Vasundhara, Mayuri Duggirala, and Sushovan Chanda	2018	Journey: A Game on Positive Affect	Primary search
	Alonso, Miguel Bruns, David V. Keyson, and Caroline C. M. Hummels	2008	Squeeze, Rock, and Roll; Can Tangible Interaction with Affective Products Support Stress Reduction?	Supplementary search

Appendix B (*continued*)

Publication Type	Author	Year	Title	Source
	Ashoori, Maryam, Rachel K. E. Bellamy, and Justin D. Weisz	2015	Creating the Mood: Design for a Cognitive Meeting Room	Primary search
	Balaam, Madeline, Geraldine Fitzpatrick, Judith Good, and Rosemary Luckin	2010	Exploring Affective Technologies for the Classroom with the Subtle Stone	Primary search
	Balta, Andra, and Janet C. Read	2016	U OK?: Txt Me the Colour of Ur Mood!	Primary search
	Besserer, Daniel, Johannes Bäurle, Alexander Nikic, Frank Honold, Felix Schüssel, and Michael Weber	2016	Fitmirror: A Smart Mirror for Positive Affect in Everyday User Morning Routines	Supplementary search
	Boehner, Kirsten, Rogério DePaula, Paul Dourish, and Phoebe Sengers	2005	Affect: From Information to Interaction	Supplementary search
	Carneiro, Davide, Paulo Novais, Fábio Catalão, José Marques, André Pimenta, and José Neves	2013	Dynamically Improving Collective Environments through Mood Induction Procedures	Supplementary search
	Cernea, Daniel, Christopher Weber, Andreas Kerren, and Achim Ebert	2014	Group Affective Tone Awareness and Regulation through Virtual Agents	Supplementary search
	Chang, Angela, Ben Resner, Brad Koerner, XingChen Wang, and Hiroshi Ishii	2001	LumiTouch: An Emotional Communication Device	Primary search
	Church, Karen, Eve Hoggan, and Nuria Oliver	2010	A Study of Mobile Mood Awareness and Communication through MobiMood	Primary search
	Dang, Chi Tai, Ilhan Aslan, Florian Lingenfelser, Tobias Baur, and Elisabeth André	2019	Towards Somaesthetic Smarthome Designs: Exploring Potentials and Limitations of an Affective Mirror	Primary search
	Davis, Felecia, Asta Roseway, Erin Carroll, and Mary Czerwinski	2013	Actuating Mood: Design of the Textile Mirror	Primary search
	De Lera, Eva	2015	Emotion-Centered-Design (ECD) New Approach for Designing Interactions That Matter	Primary search
	De Luca, Vanessa, Denise Lombardi, Cinzia Cruder, and Marta Pucciarelli	2018	How Do Performers Increase Their Wellbeing? An Investigation Among Music and Theater Professionals	Supplementary search
	Ghandeharioun, Asma, Daniel McDuff, Mary Czerwinski, and Kael Rowan	2019	Emma: An Emotion-Aware Wellbeing Chatbot	Supplementary search
	Gluhak, Alexander, Mirko Presser, Ling Zhu, Sohail Esfandiyari, and Stefan Kupschick	2007	Towards Mood Based Mobile Services and Applications	Supplementary search
	Guo, Chen, Yingjie Victor Chen, Zhenyu Cheryl Qian, Yue Ma, Hanhdung Dinh, and Saikiran Anasingaraju	2016	Designing a Smart Scarf to Influence Group Members' Emotions in Ambience: Design Process and User Experience	Primary search
	Hansson, Rebecca, and Tobias Skog	2001	The LoveBomb: Encouraging the Communication of Emotions in Public Spaces	Primary search
	Huldtgren, Alina, Christina Katsimerou, Andre Kuijsters, Judith A. Redi, and Ingrid E. J. Heynderickx	2015	Design Considerations for Adaptive Lighting to Improve Seniors' Mood	Primary search
	Isaacs, Ellen, Artie Konrad, Alan Walendowski, Thomas Lennig, Victoria Hollis, and Steve Whittaker	2013	Echoes from the Past: How Technology Mediated Reflection Improves Well-Being	Supplementary search
	Jiang, Mengqi, Martijn ten Bhömer, and Hai-Ning Liang	2020	Exploring the Design of Interactive Smart Textiles for Emotion Regulation	Primary search
	Kim, Younghui, Geri Gay, Lindsay Reynolds, and Hyuns Hong	2015	Mood.Cloud: Data as Art	Primary search
	Krøger, Erle, Frode Guribye, and Tor Gjøsæter	2015	Logging and Visualizing Affective Interaction for Mental Health Therapy	Supplementary search
	Lee, Sunmin, Wing Yi Chung, Emily Ip, and Thecla Schiphorst	2014	The Laughing Dress: Evoking Prosocial Interaction among Strangers	Supplementary search

Appendix B (*continued*)

Publication Type	Author	Year	Title	Source
	LiKamWa, Robert, Yunxin Liu, Nicholas D. Lane, and Lin Zhong	2013	MoodScope: Building a Mood Sensor from Smartphone Usage Patterns	Primary search
	Lutchyn, Yuliya, Paul Johns, Asta Roseway, and Mary Czerwinski	2015	MoodTracker: Monitoring Collective Emotions in the Workplace	Supplementary search
	MacLean, Diana, Asta Roseway, and Mary Czerwinski	2013	MoodWings: A Wearable Biofeedback Device for Real-Time Stress Intervention	Supplementary search
	McDuff, Daniel, Amy Karlson, Ashish Kapoor, Asta Roseway, and Mary Czerwinski	2012	AffectAura: An Intelligent System for Emotional Memory	Primary search
	Mora, Simone, Verónica Rivera-Pelayo, and Lars Müller	2011	Supporting Mood Awareness in Collaborative Settings	Supplementary search
	Pammer, Viktoria	2015	Mood in the City — Data-Driven Reflection on Mood in Relation to Public Spaces	Supplementary search
	Pradana, Gilang Andi, and George Buchanan	2017	Imparting Otsukaresama: Designing Technology to Support Interpersonal Emotion Regulation	Primary search
	Rajcic, Nina, and Jon McCormack	2020	Mirror Ritual: An Affective Interface for Emotional Self-Reflection	Primary search
	Sánchez, J. Alfredo, Ingrid Kirschning, Juan Carlos Palacio, and Yulia Ostróvskaya	2005	Towards Mood-Oriented Interfaces for Synchronous Interaction	Supplementary search
	Snyder, Jaime, Mark Matthews, Jacqueline Chien, Pamara F. Chang, Emily Sun, Saeed Abdullah, and Geri Gay	2015	Moodlight: Exploring Personal and Social Implications of Ambient Display of Biosensor Data	Supplementary search
	Spillers, Frank	2010	Getting in the Mood: The Role of Mood in Product Design and Interaction	Primary search
	Stangl, Abigale, Joshua Wepman, and Dylan White	2012	Moodcasting: Home as Shared Emotional Space	Primary search
	Sundström, Petra, Tove Jaensson, Kristina Höök, and Alina Pommeranz	2009	Probing the Potential of Non-Verbal Group Communication	Supplementary search
	Tsujita, Hitomi, and Jun Rekimoto	2011	HappinessCounter: Smile-Encouraging Appliance to Increase Positive Mood	Primary search
	Ullrich, Daniel, Sarah Diefenbach, and Andreas Butz	2016	Murphy Miserable Robot: A Companion to Support Children's Well-Being in Emotionally Difficult Situations	Primary search
	Wagener, Nadine, and Jasmin Niess	2021	Reflecting on Emotions within VR Mood Worlds	Supplementary search
	Wang, Liuping, Xiangmin Fan, Feng Tian, Lingjia Deng, Shuai Ma, Jin Huang, and Hongan Wang	2018	MirrorU: Scaffolding Emotional Reflection via In-Situ Assessment and Interactive Feedback	Primary search
	Wensveen, Stephan, Kees Overbeeke, and Tom Djajadiningrat	2002	Push Me, Shove Me and I Show You How You Feel: Recognising Mood from Emotionally Rich Interaction	Primary search
	Wu, Jiayu, Katrine Dalum Hesseldahl, Sam Johnson, Sheila Clark, Dan Quinlan, Dale Harrow	2021	Designing for Driver's Emotional Transitions and Rituals	Primary search
	Yamashita, Naomi, Hideaki Kuzuoka, Keiji Hirata, Takashi Kudo, Eiji Aramaki, and Kazuki Hattori	2017	Changing Moods: How Manual Tracking by Family Caregivers Improves Caring and Family Communication	Primary search
	Yoon, JungKyoon, Anna E. Pohlmeyer, and Pieter M. A. Desmet	2014	The Mood Street: Designing for Nuanced Positive Emotions	Primary search
	Zhao, Jian, Liang Gou, Fei Wang, and Michelle Zhou	2014	Pearl: An Interactive Visual Analytic Tool for Understanding Personal Emotion Style Derived from Social Media	Supplementary search

Appendix C Coding Scheme

Category	Theme	Code	Data Exemplar	Reference
RQ1: What facets of mood have been comprehended and explored?	Features of mood	Long duration	"… mood is typically less intensely felt by an individual and tends to last longer than emotion, e.g., persisting for days or hours instead of minutes or seconds."	LiKamWa et al. (2013)
		Diffuseness	"In line with existing research, we understand mood as more diffuse than emotions and with a less clear cause, longer in duration and less focused and intense."	Rivera-Pelayo et al. (2017)
		Dynamics	"Moods pass — they can last for hours, or sometimes even days, but they are constantly changing and converging into other moods."	Desmet (2015)
		Social relevance	"Group mood arises in the context of an ongoing collective activity in which group members interact to achieve a shared purpose; it is formed by its particular situational dynamics."	Sönmez et al. (2022)
	Impacts of mood	Health and subjective well-being	"A relationship between burnout and a broad range of negative health symptoms including physical and emotional exhaustion, has been found in several studies. It results in a lack of energy and enthusiasm, feelings of depression, frustration, hopelessness, and a sense of entrapment."	Carneiro et al. (2013)
		Performance	"The environment in which we work affects our mood, which in turn affects the decisions we make, our attitudes toward work, and how we interact with others."	Ashoori et al. (2015)
		Social relationships	"… it has been shown that when we are happy we are more likely to communicate with others, while when we are sad we tend to distance ourselves from friends and family."	Church et al. (2010)
RQ2: What mood-focused design innovations have been developed?	Designs that support mood monitoring	Detecting moods	"… MoodScope is a "sensor" that measures the mental state of the user and provides mood as an important input to context-aware computing."	LiKamWa et al. (2013)
		Self-tracking moods	"Our system is called EmotiCal (Emotional Calendar), a web and smartphone application. Like many current products, participants first log past moods and events triggering those moods."	Hollis et al. (2017)
		Analyzing moods	"EmotiCal analyzes past mood data to generate a 2-day forecast for a user's potential moods for tomorrow and the day after."	Hollis et al. (2017)
	Designs that support mood expression	Displaying moods	"AffectAura is a visualization of the user's estimated affective states over time. It incorporates two components 1) the affect prediction engine for labeling users' states and 2) a timeline interface, surrounded by other context, for the user to reflect on these data."	McDuff et al. (2012)
		Sharing moods	"MobiMood supports explicit mood sharing and awareness among groups of friends while on-the-go. Aside from mood, MobiMood also allows users to share other forms of context including location, time and social context (i.e., who I'm with)."	Church et al. (2010)
	Designs that support mood regulation	Self-awareness or self-reflection	"Once the product detects stress-related behavior it responds through tactile feedback to make the user aware of his or her way of manipulating the object. It continuously tries to modify the user's behavior by guiding them towards making a relaxed behavior."	Alonso et al. (2008)
		Mood-sensitive interactions	"… it is shown that anticipating a shared experience with their family, friend, or partner, can help them cope with their daily ups and downs. The new technology will only act as a tool — a trigger that leads to interpersonal emotional regulation process through actual conversation."	Pradana & Buchanan (2017)

Appendix C (*continued*)

Category	Theme	Code	Data Exemplar	Reference
		Recommendations	"The immersive ABT is conceptualized as a moderator that intervenes in team interactions through suggestion of breaks.... Emotional regulation strategies are designed to be stimulated by recommendations for action and direct mediation."	Benke et al. (2020)
		Competence development	"... from the results we designed UpStage, an open digital toolkit of behavioural practices and training methods for anxiety release and stress management. The toolkit aims to share how to integrate effective preventive strategies in daily performance preparation."	De Luca et al. (2018)
		System adjustments	"The presented work aims at creating a technical system that can detect an older resident's mood and consequently adapt the lighting in the room to either calm or activate the person."	Huldtgren et al. (2015)
		Mood regulation technologies	"The environment stimulates paced breathing, meditation and helps employees to become more aware and in control of their personal response to stressors and relaxation."	Van de Garde-Perik et al. (2016)
RQ3: What issues related to mood-focused design have been discussed?	Issues related to mood-monitoring designs	Lack of reliability	"... biological measures such as heart rate or body temperature do vary significantly with room temperature and may hence not reveal objective data. In addition, data based on self-report (e.g. pre-post mindfulness exercises) do merely produce information from a subjective perspective."	De Luca et al. (2018)
		Lack of granularity	"... in some cases, users referred to subtler moods that they wished they had available on the panel.... It would be possible to include dozens or even hundreds of affective states and to make them available for selection."	Sánchez et al. (2005)
		System surveillance	"People often feel uncomfortable and violated in their privacy when they are observed by a camera and judged by algorithms as our prototype does."	Dang et al. (2019)
	Issues related to mood-expressing designs	Misinterpretation	"... not all participants were able to interpret animos, and even when they did, their interpretations did not always match their partner's without a clarifying conversation."	Liu et al. (2019)
		Mood privacy	"... some students valued this choice since it engendered privacy around their emotional communication. And for some students it wasn't simply that an individual may not want fellow students within the class with whom they were not close to know how they were feeling..."	Balaam et al. (2010)
	Issues related to mood-regulating designs	Negative effects of introspection	"We showed overall benefits for recording and reflecting on the positive but that recording and reflecting exclusively on intensely negative past experiences detracts from well-being."	Hollis et al. (2017)
		Individual preferences	"We have already begun experiments to identify different emotional styles, finding that work activities have varied impacts on different user's mood. For one subset of users, work has positive effects on mood, for others it has negative effects, and for a final subset it has little emotional effect."	Hollis et al. (2017)
		System intrusiveness	"... there is a trade-off attached to actively reflecting on emotional experiences in the classroom, namely, thinking about one's emotional experiences within a classroom environment requires a conscious effort and diverts attention from the content being taught and learnt."	Balaam et al. (2010)
RQ4: What methods for mood-focused design are available?	Sources that support empathizing	Mood typologies	"The mood typology provides a fine-grained overview and a vocabulary of user moods. Designers and design researchers can use these results ... as a tool to facilitate user interviews in empathy-based design processes."	Xue and Desmet et al. (2020)
		Mood tendency space	"It aims to enable designers and service providers to become better aware of, and adequately respond to, the dynamics of mood-stimulated user preferences, feelings, and actions during the design process."	Desmet et al. (2019)
	Sources that support ideation	Mood regulation strategies and patterns	"We can, however, also imagine products that have the deliberate intention to enable, support, and inspire people to engage in mood-regulating activities. In light of this potential, I propose that each of the 20 strategies can be a source of design inspiration."	Desmet (2015)

Appendix D Mood-Focused Design Innovations

Reference	Name	Characteristic		Functionality		
		Design fidelity	Hardware platform	Monitoring moods	Expressing moods	Supporting mood regulation
Adams et al. (2014)	Social Reader	Concept	Computer	√	√	√
Agrawal et al. (2018)	Journey	Concept	Computer			√
Alonso et al. (2008)	Wigo	Prototype	Hand-held object	√	√	√
Ashoori et al. (2015)	Zen Garden	System	Ambient installation	√		√
	N/A*	System	Wearable	√	√	
Balaam et al. (2010)	Subtle Stone	System	Multiple platforms	√	√	√
Balta & Read (2016)	N/A*	Concept	Mobile phone	√	√	√
Baños et al. (2012)	N/A*	System	Wearable			√
Benke et al. (2020)	NeutralBot (NBT)	System	Computer	√	√	√
	SocialBot (SBT)	System	Computer	√	√	√
	ActionBot (ABT)	System	Computer	√	√	√
Bentley et al. (2013)	Health Mashups	System	Mobile phone	√	√	√
Besserer et al. (2016)	FitMirror	System	Smart screen			√
Boehner et al. (2005)	Miro	System	Smart screen	√	√	
	Affector	Prototype	Computer	√	√	
Carneiro et al. (2013)	N/A*	Concept	Ambient installation	√		√
Cavanagh et al. (2021)	Sensory-Art Space (SAS)	System	Ambient installation			√
Cernea et al. (2014)	Pogat	Prototype	Computer	√	√	√
Chang et al. (2001)	LumiTouch	Prototype	Handheld object		√	
Church et al. (2010)	MobiMood	Prototype	Mobile phone	√	√	√
Dang et al. (2019)	N/A*	Prototype	Smart mirror	√	√	√
Davis et al. (2013)	Textile Mirror	Prototype	Multiple platforms	√	√	√
De Luca et al. (2018)	UpStage	Finished product	Multiple platforms			√
Desmet (2015)	Grumble Bubble	Concept	Public installation			√
	Happiness Tree	Concept	Public installation			√
Ghandeharioun et al. (2019)	EMMA	Prototype	Mobile phone	√		√
Gluhak et al. (2007)	N/A*	Prototype	Mobile phone	√	√	
Guo et al. (2016)	N/A*	Concept	Wearable	√	√	√
Hansson & Skog (2001)	LoveBomb	Prototype	Hand-held object	√	√	
Hollis et al. (2017)	EmotiCal	Prototype	Mobile phone	√	√	√
Huldtgren et al. (2015)	N/A*	Concept	Ambient installation			√
Isaacs et al. (2013)	Echo	System	Mobile phone	√	√	√
Janssen et al. (2012)	N/A*	System	N/A*	√		√
Jiang et al. (2020)	N/A*	Prototype	Wearable	√	√	√
Kim et al. (2015)	mood.cloud	System	Ambient installation	√	√	
Krøger et al. (2015)	Clutch	Concept	Multiple platforms	√	√	√
Lee et al. (2014)	Laughing Dress	Prototype	Wearable			√

Appendix D (*continued*)

Reference	Name	Characteristic		Functionality		
		Design fidelity	Hardware platform	Monitoring moods	Expressing moods	Supporting mood regulation
LiKamWa et al. (2013)	MoodScope	System	Mobile phone	√	√	√
Liu et al. (2019)	Animo	System	Wearable	√	√	√
Lutchyn et al. (2015)	MoodTracker	System	Computer	√	√	√
MacLean et al. (2013)	MoodWings	System	Wearable	√	√	√
McDuff et al. (2012)	AffectAura	System	Computer	√	√	√
Mora et al. (2011)	MoodTimeline	Prototype	Mobile phone	√	√	√
	MoodDisplay	Concept	Smart screen		√	√
	Nabazmood	Prototype	Handheld object		√	√
	Twittmood	Concept	Mobile phone	√	√	√
Pradana & Buchanan (2017)	Human Tamagotchi	Concept	Wearable		√	√
Rajcic & McCormack (2020)	Mirror Ritual	System	Smart mirror	√	√	√
Rivera-Pelayo et al. (2017)	MoodMap	System	Computer	√	√	√
Roseway et al. (2015)	BioCrystal	System	Handheld object	√	√	√
Sánchez et al. (2005)	Affective IM	Prototype	Computer	√	√	
Snyder et al. (2015)	MoodLight	Prototype	Multiple platforms	√	√	√
Ståhl et al. (2009)	Affective Diary	System	Multiple platforms	√	√	√
Stangl et al. (2012)	Moodcasting	Concept	Smart screen	√	√	
Sundström et al. (2009)	eMoto	System	Multiple platforms	√	√	
Sundström et al. (2007)	FriendSense	Prototype	Multiple platforms	√	√	
Tsujita & Rekimoto (2011)	HappinessCounter	System	Smart mirror	√	√	√
Ullrich et al. (2016)	Murphy Miserable Robot	Prototype	Robot			√
Van de Garde-Perik et al. (2016)	GRIP	Prototype	Ambient installation			√
Wagener & Niess (2021)	VR Mood Worlds	Concept	Wearable	√	√	√
Wang et al. (2018)	MirrorU	Prototype	Mobile phone	√	√	√
Wensveen et al. (2002)	N/A*	Prototype	Handheld object	√		√
Wu et al. (2021)	Feeling Ready	Concept	Multiple platforms			√
Xue and Liang et al. (2019)	AffectiveWall	Prototype	Smart screen	√	√	√
Yamashita et al. (2017)	Family Mood and Care Tracker (FMCT)	System	Computer	√	√	√
Yoon et al. (2014)	Good night	Concept	Mobile phone			√
	The curtain	Concept	Ambient installation			√
	The big button	Concept	Public installation			√
Zhao et al. (2014)	Pearl	System	Computer	√	√	

* N/A: Not mentioned or available in the article.