Kawaii Computing: Scoping Out the Japanese Notion of Cute in User Experiences with Interactive Systems

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ABSTRACT

Kawaii computing is a new term for a steadily growing body of work on the Japanese notion of "cute" in human-computer interaction (HCI) research and practice. Kawaii is distinguished from general notions of cute by its experiential and culturally-sensitive nature. While it can be designed into the appearance and behaviour of interactive agents, interfaces, and systems, kawaii also refers to certain affective and cultural dimensions experienced by culturally Japanese users, i.e., kawaii user experiences (UX) and mental models of kawaii elicited by the socio-cultural context of Japan. In this scoping review, we map out the ways in which kawaii has been explored within HCI research and related fields as a factor of design and experience. We illuminate theoretical and methodological gaps and opportunities for future work on kawaii computing.

CCS CONCEPTS

• **Human-centered computing** → **Human computer interaction (HCI)**; • **General and reference** → **Surveys and overviews**; • **Applied computing** → *Psychology*.

KEYWORDS

Kawaii computing, kawaii, computer agents, virtual characters, robots, scoping review, literature review, human-computer interaction

1 INTRODUCTION

"Kawaii" is the Japanese term for "cute," simply put. Kawaii is recognized the world over as representative of Japanese popular culture [55]. Not limited in Japan, kawaii has been adopted as a global phenomenon across various forms of media and beyond [81]. It plays a critical role in the worldwide success of many Japanese products [38] and cultural exports [31, 39], such as Hello Kitty [34] and the Pokémon series of anime and games [2]. Although kawaii

is associated with the general idea of "cute" and often translated into English as "cute," there are nuanced differences between these concepts that psychological research has linked to Japanese culture [56]. Kawaii has positive meanings, such as lovable, adorable, pretty, charming, and sometimes pity [6, 35, 36, 56, 69, 81]. However, kawaii is not only a matter of appearance, but also a positive affective response that, among Japanese people, can be heightened by the social context [58].

The concept of kawaii has been explored in psychology from cognitive science and behavioural perspectives [55, 56, 58]. A small amount of work in human-computer interaction (HCI), human-robot interaction (HRI), and human-agent interaction (HAI) [15, 79] has followed suit. A wide array of often disconnected work exists. Kawaii has been explored in agent design (e.g., crafting agents with kawaii features to improve user ratings [77, 78]), user experience or UX (e.g., people having more tolerance [41], care responses to agents [51]), interpretive frameworks (e.g., a visual framework of kawaii attributes [86], and user models, including those grounded in participant data [36, 37]). However, little research has distinguished kawaii and cute clearly in HCI context. This makes it difficult to clarify what is meant by "kawaii," especially when the term is used outside of the Japanese context, i.e., without Japanese researchers, designers, and/or users (e.g., compare [96] and [77]). Indeed, there is yet no kawaii computing "field of study" nor consensus, such as by way of a systematic review. This creates a disconnect between HCI and related domains with the strong theoretical and empirical foundation established in psychology [55, 56, 58]. We appear to have a gap in our understanding of how kawaii has been, could be, and perhaps should be explored in HCI and adjacent fields.

In this preliminary work, we offer a scoping review [48, 89] to better understand how kawaii has been used in HCI and related fields as a factor of interaction design and UX. Our goal was to map out and delineate **kawaii computing** as a concrete domain in HCI. To this end, we asked several sub-questions so as to be comprehensive in our coverage of the research content offered by this wide-reaching literature: What is "kawaii"? How has it been defined and operationalized? What fields and contexts of use has kawaii been explored in? What agents, interfaces, and systems have been deemed to embody kawaii design? What methods have been employed to study it as a UX phenomenon? What factors have been found to influence user perceptions of and reactions to kawaii? How has kawaii been approached as an object of study in HCI? We contribute a map of research that may be characterized as kawaii computing, as well as identify gaps and opportunities for future work. We set the stage for a more robust kawaii future in HCI.

2 METHODS

We carried out a scoping review of the literature using the guidelines by Munn et al. [48] and the protocol offered by the Preferred Reporting Items for Systematic Reviews and Meta-Analyses Extension for Scoping Reviews (PRISMA-ScR) [89]. The purpose of a scoping review, compared to other types of reviews, is to map out the "scope" of a topic or domain of study to identify gaps and generate new research directions [48]. Typically, scoping reviews reveal the state of affairs and help determine whether a systematic review is possible or necessary. Scoping reviews can also act as a way of solidifying an emerging area of focus, which we believe to be true in the case of kawaii computing. Our process is presented in Supplementary Materials Figure 1. Notably, we deviated from the PRISMA-ScR by not implementing those parts related to conventions in the medical field, e.g., structured abstracts. Our protocol was registered on January 11th, 2024[1]. We provide our data set as part of the Open Science initiative [54] here: https://bit.ly/kawaiicomputing.

2.1 Terms and Definitions

2.1.1 Kawaii. We restricted our focus to the Japanese conceptualization of "kawaii." However, reports written in English by and about Japanese people may translate kawaii as "cute" [59]. We structured our search queries around this possibility by considering "cute" within the context of Japan or Japanese participants. During screening, we carefully checked whether the authors or participants were Japanese when "cute" rather than "kawaii" was used.

2.1.2 Kawaii Computing. We characterize "kawaii computing" as *all human-centred research on kawaii involving computer-based agents, interfaces, environments, and systems*. This broad definition includes virtual characters, UI design patterns, machine learning techniques to process human data, user reactions to chatbots, and so on. The guiding principle is of kawaii as a fundamental psychological phenomenon premised in Japanese culture and experienced as emotion, cognitions, and/or behaviours by Japanese people, in line with the work of Nittono and colleagues [59].

2.2 Eligibility Criteria

We included research reports (short and long papers, conference proceedings and journals, etc.) on kawaii computing (according to the Japanese notion or "cute") from 2000 to 2023. We excluded non-human subjects research, researching not involving computer-based systems (not relevant to HCI), grey literature (unverifiable quality or publication status), and papers not in English, Japanese or Chinese languages (the languages known to the authors).

2.3 Information Sources and Search Strategy

We searched disciplinary databases relevant to HCI—the ACM Digital Library and IEEE Xplore–as well as Web of Science, a general database to which we had access through our institution, for HCI research or edge cases published outside of ACM and IEEE. We ran our searches between January 3rd and 25th, 2024. Our basic query structure was: *kawaii OR (cute AND Japan) AND (human factors computing OR human-computer interaction OR interaction design)*. Full details for each database search query are presented in Table 1.

We used Zotero to store, remove duplicates, and count the downloaded records returned by these searches. Refer to Supplementary Materials Figure 1 for counts at each stage.

2.4 Screening and Conflict Management

Two authors carried out two screening stages. The first involved checking the title, abstract, and keywords for face viability. This was done by the first author. The second author then checked the excluded records, re-including as needed. The second phase of screening involved both reading pertinent parts of the full texts with the aid of keyword searches to better determine viability. Importantly, we expected to find one of the author's own work returned. When this occurred, screening, data extraction and synthesis of these studies was conducted by the other author.

2.5 Data Items and Data Extraction

We used Google Sheets to screen, extract data, and carry out analysis of the data. Specifically, we extracted the following: metadata, including Authors, Year of publication, Title, Abstract, and URL; Topic, specifically Topic of study and Context; Terms, including Definition of kawaii, whether Explicit/implied, Citations for definitions/, and whether there was No mention of kawaii but from the Japanese context; Stimuli, including Stimuli details, the Measure of kawaii, and what Kawaii factors were identified; Methods, including Type of research, Research design, Participant nationality, Demographics, Sample size, and Data Analysis; Agent Types, including Virtual agents, Robots with a physical body, Interfaces, and Other; and How was Kawaii used, including Design (Feature, Control), User Reaction (Self-Reports, Biometrics), and Interpretive Framework (Data Analysis, Machine Learning, Heuristic analysis).

2.6 Data Analysis

We carried out two data analyses. For quantitative data, we generated descriptive statistics, including counts and percentages. For qualitative data, the first author used content analysis to categorize the "broad surface structure," focusing on surface meanings rather than latent interpretations, also called a "manifest analysis" [4].

3 RESULTS

We identified 238 records through database searching. After screening and eligibility, 69 records were included (Supplementary Materials Figure 1). The full list of included papers is available at https://bit.ly/kawaiicomputing

3.1 Kawaii in Topics and Contexts

We found seven contexts and a variety of topics in kawaii computing. The most common context was HRI (n=29, 42%), followed by HCI (n=16, 23%) and HAI (n=15, 22%). Several papers covered machine learning (ML) (n=4, 6%), human-machine interaction (HMI) (n=2, 3%), culture (n=2, 3%) and human-human communication (n=1, 1%).

Although covering a wide array of topics, most papers only referenced kawaii in participants' open-ended answers and the authors' discussion. Less than half (n=31, 45%) included kawaii as a main topic. In HAI, models for kawaii virtual agents were proposed, e.g., Ohtsuka et al. [66] set up kawaii attributes for evaluating kawaii virtual characters and Seaborn et al. [81] proposed a preliminary

Table 1: Search queries used in each data base and number of records returned.

Database	Query	Filters	Count	Date
ACM DL	[[All: "kawaii"] OR [All: "cute in japan"]] AND [[All: "computer"] OR [All: "computing"] OR [All: "interactive design"] OR [ALL:"robot"]]	/	43	2024.1.3
	[[All: "kawaii"] OR [[All: "cute"] AND [All: "japan"]]] AND [[All: "human factors computing"] OR [All: "human-computer interaction"] OR [All: "interaction design"]]	Research Article	146	2024.1.10
	[[All: "kawaii"] OR [[All: "cute"] AND [All: "japan"]]] AND [[All: "human factors computing"] OR [All: "human-computer interaction"] OR [All: "interaction design"]]	Abstract, Poster, Extended Abstract, Short paper, Work in progress	38	2024.1.24
IEEE Xplore	((kawaii OR (cute AND Japan)) AND (human factors computing OR human-computer interaction OR interaction design))	/	10	2024.1.10
Web of Science	((kawaii OR (cute AND Japan)) AND (human factors computing OR human-computer interaction OR interaction design))(All Fields)	/	44	2024.1.10

model for kawaii game vocalics. Others evaluated user feelings of kawaii-ness towards virtual characters [35, 74], 3D models of animals [90], VTubers [41], and preferences for kawaii and non-kawaii game characters [70]. In HRI, kawaii was framed as a feature of robot design, with the focus on identifying kawaii factors, e.g., NAO robot [69], 3D robots [38, 65], commercial delivery robots [15], virtual cross-cultural kawaii robots [6], and the design of Pepper's touch motion to express kawaii [67]. In HCI, kawaii was applied in social media, e.g., Hashiguchi and Ogawa [22] proposed a kawaii search engine for blogs, and Berque and Chiba [5] proposed and evaluated LINE's kawaii chat interface. Kawaii was also introduced to design other interfaces, such as the appearance of Kissenger (a remote communication device) [77], the LiveDeck interface for real-time collaborative editing [78], and a research through design (RtD) critical analysis of the aesthetic object design fiction "Menstruation Machine" [3]. In ML, Sripian et al. [86] and Laohakangvalvit et al. [38] developed framework to classify kawaii fashion with colour and clothing. Laohakangvalvit et al. [36] also proposed a model to compare the kawaiiness of online images of cosmetic bottles. Hohendanner et al. [24] explored the influence of culture-specific narratives on the imagination of future AI technology, in which kawaii is viewed as a specific feature of Japanese culture.

3.2 Distribution of Kawaii Computing Research

Since kawaii is a concept from Japan and directly tied to Japanese culture, we considered participant demographics. Most studies included Japanese participants (n=56, 81%). Among these, 44 papers included only Japanese participants (64%) and 12 included both Japanese and participants from other countries (17%) and aimed at cross-cultural comparison or generalization. For example, Ohkura et al. [65] compared kawaii robot designs by Japanese and U.S. students, and Laohakangvalvit et al. [35, 36] included both Japanese and Thai participants to establish a framework for kawaii feeling evaluations. Some papers did not include Japanese participants (7%). These papers introduced "kawaii" into other culture contexts. For example, Lu et al. [41] studied kawaii as a part of otaku culture, which influenced Chinese viewer perceptions and attitudes towards live-stream VTubers. Patrick Rau et al. [69] also had a study in Chinese context to investigate if kawaii design is valuable to Chinese customers. The three papers about ML had no participants

(6%). Other demographics used were gender, age, occupation, education, etc. Notably, most work included combinations of women and men, except one paper for a new HMI interface for a straddle-type vehicle design tested with men [87]. One paper investigated the effect of robotic mediation in promoting conversation among older adults for improving behavioural and psychological symptoms of dementia (BPSD) and included only women [93]. Another was about a system with kawaii (cute in Japan) icons for product retrieval and only tested women because the design was inspired by the psychology of women's shopping activity [33]. Many papers (n=17, 25%) focused on students, from junior high to college, and another six (9%) focused on younger generations (under 30 years old) [43, 52, 61, 76, 77, 91]. Four focused on kawaii computing for older adults (7%), e.g., comparing perceptions of kawaii between the young and the old [69], a kawaii social robot for children-older adult interaction [51], and conversational robots for a care center [72] and older adults with dementia [93]. Two (4%) conducted research on children: a kawaii social robot mediating children-older adult interaction [51], and delivering negative feedback for improving the in-class learning experience [75].

3.3 Definition of Kawaii

More than a half papers (n=41, 65%) did not mention the word "kawaii," but we can infer that the use of "cute" meant "kawaii" because of the Japanese context. We equate uses of "cute" within the Japanese context to the concept of kawaii. In 96 papers, 24 (35%) used the definition of kawaii or cute in the Japanese context. 17 (25%) provided an explicit definition (13 with citations, 4 without citations), and nine (13%) provided an implicit definition (5 with citations, 4 without citations). The citations were sourced from critical, cultural, and psychological studies.

For explicit definitions, most wrote that kawaii means Japanese cuteness, period. Ohkura et al. [65, abstract] defined kawaii as "a Japanese adjective representing cute and adorable" [42, 57, 59, 62]. Seaborn et al. [80, 81] characterized kawaii as the Japanese concept of "cute++," linked to cognition, behaviour, and emotion, citing Nittono [55]. They also referenced impressions of cuteness, charm, endearment, and pity. Similarly, Scissors et al. [78, p. 1126] explained that kawaii is "an aspect of Japanese culture that refers to cute things that evoke positive emotions and feelings of social

affiliation," also citing Nittono [55]. Some mentioned that kawaii has positive connotations.Berque et al. [6] used the same definition in their previous work [5] that described kawaii as Japanese cuteness, a concept ingrained in Japanese contemporary society. They looked into Japanese history and literature, which described kawaii as pitiful, shameful, or too sad to see, small, weak, and someone or something that gives one the feeling of "wanting to protect" [95]. Laohakangvalvit et al. [35, 36, 38] defined kawaii as a positive adjective that denotes such meanings as cute or lovable. They state that it is critical as a kansei value plays a leading role in the worldwide success of Japanese products, such as Hello Kitty [34] and Pokémon [2]. Okada et al. [67] and Minakawa and Takada [45] defined kawaii as a Japanese word that has positive connotations as cute [56, 59], which is employed when designing robot. Okada et al. [67, p. 11276] position kawaii as is a critical factor in Japanese commercial aspects and pop culture [31, 39].

Others provided a definition of kawaii in design. Hashiguchi and Ogawa [22] linked kawaii with pretty or lovely design. Patrick Rau et al. [69, 258] characterized kawaii as "an affective concept rooted in Japanese aesthetics". For artificial products, they thought kawaii is a critical factor of Japanese kansei design, which can mean cute, lovely, small, and other related emotional values [63]. Dobrosovestnova et al. [15] described kawaii in the context of robot design. Kawaii, an important concept in Japanese pop culture and design [67], has been operationalized in some studies in HRI [7], as not only the perceivable features of robots, but also sociality and approach motivation [15, 58]. Mubin et al. [47] also described kawaii in robot design as descriptive features that characterize a robot, such as manga eyes and low resemblance to a human. Some related kawaii with girlish. Sajadieh [74, p. 4] proposed that "kawaii has become an important component of aesthetics in Japanese consumer culture and has also spread to international markets and audiences", which became a popular way to describe female idols in 80s Japanese pop culture [85]. They also argued that kawaii inspired the performance of cuteness, innocence, and femininity which contributes to the fetishization and commodification of a particular type of culturally-desired gender dynamics: cute artificial women and male consumers [8]. Bardzell et al. [3] described kawaii style as Japanese cute girl aesthetic characterized by rainbow-colored hair, glamour make-up and so on.

Implicit definitions of kawaii were introduced with reference to other studies or general knowledge, without author clarification. Kawaii was described as am important part of otaku culture [41], by way of agents like Kewpie [24], which is one of the most universally recognized symbols of cuteness in Japan [71], attractive in a pretty or endearing way [30], an appearance similar to a stuffed toy [68, 77], borderline before reaching the Uncanny Valley [11], and Harajuku street fashion as kawaii fashion [86]. Ohtsuka et al. [66] and Sripian et al. [86] agreed that kawaii attracts attention as an affective value. Sripian et al. [86] further mentioned there are various kawaii attributes for design, such as color [64].

We used word frequency analysis to analyze the 20 definitions extracted. The top five frequency words (except kawaii) were "Japanese" (n=27), "cute" (n=13), "cuteness" (n=9), "culture" (n=8), "positive" (n=6), "pop" (n=5). "Japan," "affective," "products," and "important" (n=4) followed. This indicates that the definition of kawaii is highly related to a Japanese pop and consumer culture, is deemed connected to "cute," and has positive meanings.

3.4 Kawaii Stimuli, Measurement, and Factors

We found six general stimuli: visual, audio, movements, gestures, and text. Most of studies focus on one stimuli (n=49, 71%). The most common stimuli was visual (n=83, 87%), followed by movements (n=12, 17%), audio (n=8, 12%), gestures (n=2, 3%), text (n=1, 1%), and animation (n=1, 1%). The specific stimuli for visual were various, e.g., virtual agents, robots, avatars, images, emotes, etc. The movement stimuli were mainly robots with entities (n=8) followed by interfaces (n=2) [61, 68], virtual agents (n=2) [21, 76], and cars with eyes [21]. As for audio stimuli, the specific stimuli were game vocalics [81], robot [16, 29, 53], Hatsune Miku virtual character and TTS voice [74], and mucis vidio [3]. Specific stimuli of gestures were virtual agent [44], and robots [27].

41 papers (59%) proposed measurements of kawaii (refer to Supplementary Table 1 for full details). Among them, six papers measured kawaiiness without discussing kawaii factors. On the other hand, 15 papers discussed kawaii factors but did not provide or use measurements of kawaii. Researchers considered a variety of kawaii factors, but given the variety of the research, it is hard to summarize, so we describe the kawaii factors that occurred most frequently in our corpus. These were: physical features related to Baby Schema; anthropomorphism, which is an important feature for non-living things; and factors related to Japanese culture, such as animation, girlishness, and colour. Berque et al. [6], Hatada et al. [23], Ohkura et al. [65], Poeller et al. [70], Shiomi and Hagita [84], Yeh et al. [94] deemed the physical features of size and shape as one of the most common factors, which is consistent with Baby Schema. They found that a round shape [6, 94] and small size [23, 70] was perceived as more kawaii, because people felt less physical pressure or stress [84]. Anthropomorphism was another common factor in robot kawaiiness for visual but also audio stimuli [81, 83]. Human-like robots, animal-like robots, and virtual agents [73, 75] were deemed most kawaii. Animation and manga styling, which is a symbol of Japanese pop culture, were linked to greater levels of kawaii [45, 47]. Femininity is another common factor related to high levels of kawaiiness, especially girlishness [66, 74, 81]. Colour was a common kawaii factor. Yeh et al. [94] found that people perceived colourful drones as more kawaii. Berque et al. [6], Laohakangvalvit et al. [37], Ohkura et al. [65], Patrick Rau et al. [69] found similar colour factors and results linked to kawaiiness.

3.5 Use of Kawaii

Kawaii has been used in different ways in HCI and related areas. We summarized how it has been approached in Table 2. Kawaii has be applied in HCI research for design, UX measurement, and establishment of an interpretive framework. In HCI design, kawaii has been used as a feature that makes robots more acceptable to people, especially social robots and interactive communication agents. Instead of embedding kawaii features in design, Tsuji et al. [90] controlled different levels of kawaii and compared these in 3D models to find a better design. Another study directly included the meaning of kawaii using the Japanese word "Puyo" in the product name to appeal to users [19]. Kawaii, which is related to emotions,

can act as a user reaction for UX evaluations. Furthermore, kawaii has been included in interpretive frameworks. Laohakangvalvit et al. [35] constructed a mathematical model of kawaii feelings, while Laohakangvalvit et al. [36] proposed a machine learning model to evaluate kawaii attributes of kawaii products. Sajadieh [74] used heuristic analysis to study the kawaii impacts on virtual agent design. Kawaii thus has versatility as a feature of design and a measurable user reaction or experience.

4 DISCUSSION

With the global spread of kawaii and Japanese culture, attention to the notion of "cute" as a cultural facet of Japan is on the rise. Kawaii research and design practice is also steadily increasing. When it comes to HCI and related fields, how do we ride this trend? Although existing studies were not exhaustive, they do provide inspiration and directions for future work.

4.1 Kawaii vs. Cute

The review of kawaii allows us to have an understanding of the differences between kawaii and cute. Compared to cute, kawaii embodies a particular Japanese aesthetic and culture frame [5, 37, 41, 74, 78]. It goes beyond just being cute, as cute does not have any cultural connotations. Cute works in HCI typically applies the "Baby Schema" concept defined by Lorenz in 1943 [40] to guide the creation of interactive artefacts [17]. Kawaii, however, is not limited to being a Baby Schema phenomenon, nor is it simply a feature of design [57]. Nittono [56] proposed a two-layer model of kawaii, with one layer as emotion and the other layer as social value. The kawaii as an emotion frame presents kawaii as a stimulus perceived as cute, friendly, harmless, pretty and so on, regardless of whether the stimulus is a living being. When kawaii affect is evaluated as significant through cognitive appraisal processes, it can be linked to a psychological state of kawaii [56]. Kawaii is also framed as social value, referring to kawaii as a medium of sociality [56]. This has be adopted in many kawaii works as well as in HCI (e.g., [6, 65, 67, 78, 81]). A more latent feature of kawaii is its basis in Japanese culture. Nittono [57] notes that features particular to Japanese culture appear to influence and temper the concept of kawaii, such as amae, one's drive for acceptance and adoration from other people, and chizimi shikou, the love of small things. We found no specific reference to these yet.

Research in kawaii computing is not the same topically as research on cute design based on Baby Schema in HCI. Kawaii is not only the feature of the design of a robot, virtual agent, or interface, but also emotion that occurs in the interaction between human-agent, human-robot, and human-interface (and perhaps between people with a facilitating computer). We propose that kawaii computing provides an approach to improve the relationship between people and technologies. Moreover, kawaii may vary in different social contexts, especially different culture. For example, a robot may become kawaii when it interacts with your pet [29]. Although work is limited (17%), some cross-cultural research has found that Japanese people are more sensitive and connected to kawaii computing [6, 24, 35, 78]. As expected, most kawaii computing work was done by Japanese researchers and included Japanese subjects

(81%). Still, kawaii as a psychological state of feeling positive emotions [56] is not limited in Japan. This shows a gap in cross-cultural kawaii design and user perceptions of kawaii towards robots, agents, interfaces, and so on.

4.2 An Emerging Map of Kawaii Computing

Kawaii was found across HCI and adjacent contexts, with work in design (51%), user reactions (75%), and interpretive frameworks (13%). This indicates that kawaii can play several different roles in research and design. Most work studied user reactions through participants' kawaii emotions. There was limited work on kawaii data analysis frameworks [35], ML structures for kawaii evaluation [37, 66, 86], and heuristic analysis [22, 86]. However, even much work covered kawaii user reactions, there was no universal framework for kawaii measurement. Most researchers created their own scales [10, 47, 50, 66, 76, 81, 87], some employed (un/validated) items from other kawaii works [56, 57] in psychological and behavioural fields [52, 67, 90], and two used the objective measurement of biometrics [65, 69]. Many (28%) studied kawaii both as a feature of design and as a user reaction, which is consistent with the two-factor model of kawaii: not only features but also kawaii emotions in the interaction. Kawaii attributes of design were various within and across agents, robots, and interfaces [21, 37, 45, 47, 83, 94], which is similar to the situation of kawaii measures. This shows a need for researchers to establish a validated frameworks for understanding the components of kawaii computing.

4.3 An Agenda for Future Work

Based on this scoping review, we offer some ideas and prompts for future work on kawaii computing.

- **Standardization: Devise a taxonomy of attributes (stimulus design) and standard measures (user response) for kawaii computing.** In HCI and related domains, kawaii attributes across agents, robots, and interface designs as well as measures of evaluating kawaii are fragmented. Most relied on (unvalidated) self-designed materials based on the specific context. Establishing sets of attributes for kawaii computing and interpretive frameworks for evaluating kawaii reactions in HCI, HRI, and HAI will be a key endeavour.
- **Multiple Modalities: Explore kawaii computing with stimuli beyond the visual.** The body of work covered in this review indicates a focus on visual stimuli. While only a few works involved other stimuli, such as audio [80, 81], HCI is not always visually based, and sometimes uses only non-visual modalities, e.g., voice assistants.
- **Cultural Significance: Adapt kawaii cross-culturally.** "Kawaii" is defined by and has a reciprocal relationship with Japanese culture. Most research has been conducted in Japan or by Japanese people. However, the power of kawaii may not only be limited to the Japanese context. Future work can study the cross-cultural effects on and differences in kawaii perceptions and experiences. For example, comparisons of Japanese and non-Japanese foreigners living in Japan, or comparisons of kawaii computing artefacts and computing artefacts designed to be cute in non-Japanese contexts.

Table 2: Summary of how kawaii has been approached in HCI and adjacent domains.

Components	Details	Papers	Count (%)
Design	Feature	[3, 5, 6, 9, 10, 15, 16, 20, 24, 30, 35–38, 44, 45, 47, 49, 51–53, 60, 61, 65, 66, 68, 69, 74, 77, 78, 80, 86, 94]	34 (49%)
	Control	[90]	1 (1%)
	Name	[19]	1 (1%)
User Reaction	Self-reports	[1, 3, 6, 10, 12, 14, 15, 18, 21–23, 25–29, 32, 33, 35, 38, 41, 43, 46, 47, 50, 52, 53, 60, 61, 65–67, 69, 70, 72, 73, 75, 76, 78, 80–83, 87, 88, 90–94]	50 (72%)
	Biometrics	[35, 65]	2 (3%)
Interpretive Framework	Data Analysis	[35]	1 (1%)
	Machine Learning (ML)	[13, 24, 36, 37, 66, 86]	6 (9%)
	Heuristic Analysis	[22, 74]	2 (3%)

- **Sociality: Evaluate the social impacts of kawaii computing platforms.** Sociality refers to social interactions between users and agents and social reactions to kawaii stimuli. We may also need to explore the impact on society when it comes to kawaii computing platforms deployed at scale. Future work should explore how the social plays out so as to understand the social impacts of kawaii computing.
- **Adjacent Concepts: Explore the theorized relevance of other aspects of Japanese culture connected to kawaii, such as amae and chizimi shikou.** Amae may also relate to sociality. Could kawaii chatbots make us feel loved and accepted? Chizimi shikou could help explain preferences to small devices and robots.

5   CONCLUSION

Kawaii computing is nascent. While not exactly new, the lack of formalization around what it is leaves this area of study brimming with possibility. Researchers and designers across HCI, HRI, HAI, and beyond should draw from the formal theories and models established in psychology. We have the opportunity now to build on this foundation and direct the future of kawaii computing in a more rigorous, culturally-sensitive, and theoretically-driven way.

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