



# From Sex Dolls to Sex Robots and Beyond: A Narrative Review of Theoretical and Empirical Research on Human-like and Personified Sex Tech

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Accepted: 11 July 2022

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## Abstract

**Purpose of Review** Developments in human-like and personified sex tech require familiarity with a range of technologically sophisticated sex toys. Most sex toys approximating full-sized human bodies are inanimate, but recent advances in robotics, artificial intelligence, and digital interfaces are being incorporated into sex toy designs with the aim of providing humanized sexual and emotional experiences for users. This narrative review of scholarship on sex dolls, sex robots, and other forms of personified sex tech covers theoretical debates, recent empirical findings, and identifies gaps for future research in this field.

**Recent Findings** Review of 87 scholarly books, articles, and essays reveals several trends in the field. First, despite continued calls for empirically driven work, the bulk of research on sex dolls, sex robots, and personified sex tech continues to be theoretical. In some cases, theoretical models discussing how people might be affected by human-like and personified sex tech have outpaced the technological capabilities of sex toy manufacturers. Another trend is the noticeable focus on developments and users in North American and European countries. Finally, sex doll ownership is primarily researched and theorized in ways that center heterosexual men as the primary users. While empirical research shows that single middle-aged heterosexual men use sex dolls and sex robots more than women, developments in personified sex tech may push the industry in new directions.

**Summary** Current debates about sex dolls, sex robots, and personified sex tech frame such devices around the potential for escalation and harm reduction. Although more empirical attention is being paid to users' motivations and experiences, a dearth of research directly addresses these debates. More research is needed to refine theoretical assertions about the potential benefits and harms of human-like and personified sex tech. Specifically, robust quantitative data and samples from outside of Western contexts are needed to better assess how such technologies affect users.

**Keywords** Sex dolls · Sex robots · Chatbots · Sex tech · Sex toys

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This article is part of the Topical Collection on *Sexual Technology*

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## Introduction

Multiple definitions have been used to distinguish the various forms of human-like and personified sex tech. Since sex toys, such as dildos, represent only *part* of a human body, Nicola Döring and Sandra Pöschl define sex dolls as “material representations of the human body for sexual use” [1]. Once augmented with one or more technological affordance, sex dolls become sex robots — “They look like sex dolls but are equipped with sensors, actors and artificial intelligence. They are able to display conversation, emotions and preprogrammed personalities. And they can perform partially autonomous behavior such as simulating sexual movement, getting into various sexual positions, and expressing orgasm” [1]. While sex dolls and sex robots provide physically immersive

sexual experiences, some users prefer communicative sex tech to fulfil erotic and emotional needs, which is why many of the same companies now offer digitally personified sex tech. We define this technology as any digital experience presenting a humanoid character through images, audio, and/or chat features for users to interact with for the express purpose of sexual and/or emotional gratification.

Scholarship on sex dolls, sex robots, and other forms of humanized digital sexual experiences has made theoretical and empirical strides in understanding the rapidly evolving field of personified sex tech. Early research synthesized insights from human–computer interaction, robotics, psychology, feminist theorizing, legal studies, and ethics to offer a spectrum of insights into the potential benefits and consequences of such technologies [2–7]. One set of concerns posits that sex dolls and sex robots pose considerable risks to vulnerable populations, because their use may lead to escalated rates of violence against women and children [5–7]. Moreover, the use of such technologies may incentivize withdrawal from society and introversion [4, 9•, 10, 11]. Alternatively, human-like sex tech may present unique benefits for harm reduction in various therapeutic settings [2, 3, 6].

Early theorizing about sex robots made bold claims about their reach. David Levy’s early volume suggested that major advances in robotics and artificial intelligence would make sex robots commonplace by 2050 [2]. This prediction launched the field of “Lovotics” to explore the romantic, erotic, and emotional potential of sex robots [2, 3, 12, 13]. Today’s sex robots and other forms of personified sex tech have not been fully integrated into society, in part due to the stigma associated with sex tech [14•, 15•], less technological advancement than anticipated, and prohibitive costs [16]. The few available sex robots use the same silicone or thermoplastic elastomer sex doll bodies, but include various technological augmentations, such as chat features or mechanized facial expressions [1, 3]. Recent scholarly advancements have focused on interactive sex tech because user data suggests emotional benefits are comparably important to sexual benefits [10, 14•, 17]. Future work must consider how sex dolls, sex robots, and artificially intelligent interfaces are used as artificial companions [17].

In this narrative review, we attend to theoretical developments and recent empirical research that challenges narrow conceptualizations of sex dolls, sex robots, personified sex tech, and their users. A total of 87 scholarly books, essays, and articles were retrieved from ProQuest, Web of Science, and Google Scholar. Master’s and Doctoral theses were *not* included, nor were works published more than five years ago unless they were a major work in this field. Care was also taken to include articles from a range of perspectives. Our narrative review provides readers with a broad understanding of this interdisciplinary field and identifies new avenues for research. Moreover, we build upon previous literature

reviews in several ways. As numerous reviews have shown, empirical research on sex doll and sex robot users has been scarce, but it is becoming more common. Thus, rather than reviewing all types of sex tech [1] or mapping the entirety of the field for the express purpose of positing new lines of research [18], we are primarily interested in discussing how the growing empirical field of human-like and personified sex tech is in some cases confirming, while in other cases contradicting, various hypotheses about the nature of human-like and personified sex tech owners and users. Our review also attends to the technological progression from sex dolls to sex robots, and how developments in this industry are informing the design of new forms of personified sex tech. We believe it is critical to grasp the differences and connections between each form of sex tech, as much scholarship to date focuses on the potential of sex robots [18–21], and at times conflates sex doll owners with sex robot owners or users.

## Debates on Sex Doll Usage

Sex dolls are currently manufactured by more than a dozen adult novelty manufacturers and are available worldwide [6, 7]. Using sex dolls has remained controversial despite growing acceptance of other sex toys [18]. Debates about sex dolls focus on individual uses and their applications in medical and therapeutic settings. Much of the controversy stems from concerns about their ethical nature, while some question their efficacy as a therapeutic aide.

A central concern is the fact that most sex dolls are hyper-gendered feminine forms [11, 22]. Sex doll manufacturers estimate fewer than 10% of their customers are women [6], so the sex doll market caters primarily to heterosexual men. As Prayag Ray notes, female dolls tend to reflect Eurocentric beauty standards, with a particular emphasis on thin youthful bodies [11]. While sex dolls are designed to fulfil sexual fantasies rather than represent human diversity, some scholars argue the narrow range of sex doll models reproduces unrealistic expectations about women’s bodies [22]. Moreover, some scholars argue the inanimateness of sex dolls provides men with unabated sexual access to a feminine form. In that way, sex dolls are used as sex objects which may further the objectification of women [5]. With most attention being paid to heterosexual men’s use of feminine dolls, except for a few studies acknowledging women who own feminine dolls [14•, 23], limited attention has been paid to other possible owner-doll gender pairings.

Scholars are also concerned about the efficacy of sex dolls in therapeutic and applied settings. The most controversial application is producing childlike dolls for reducing child molestation [8]. Under current legislation, many Western countries have criminalized childlike dolls [24, 25]. While

a few arrests of childlike doll owners have been reported [26], the total number of childlike dolls in circulation is difficult to estimate. Records from Australian and the UK agencies seizing imported childlike dolls show that in Australia, between July 2013 and June 2018, customs agents seized 133 childlike dolls, and in the UK, between March 2016 and July 2017, 123 childlike dolls were seized [24]. While their applicability in professional settings is currently unknown, some contend that childlike dolls might satisfy desires sufficiently, making would-be offenders less likely to molest children [6]. It is worth noting that not all childlike dolls are made for sexual penetration, as some childlike dolls have vulvas but are not built to accommodate sexual intercourse [26]. Alternatively, the satisfaction derived from childlike dolls may dissipate. Thus, the criminalization of childlike dolls avoids risking children's safety [8, 16, 27].

Generally, therapeutic debates focus on people who experience difficulty finding sexual and romantic partners. It has been theorized that sex dolls might provide sexual and emotional comfort to people struggling to find sexual partners due to interpersonal difficulties, as well as elderly and isolated people [2, 6, 16, 28, 29]. Promoting such applications suggests that sex dolls are a viable technological solution for sexual, emotional, and intimate deficits typically met by humans. Yet, the inverse may be true, and sex dolls could fall short of meeting a person's needs [4, 10]. Thus, users may withdraw from society and see their interpersonal issues worsen [4, 24].

## Empirical Studies of Sex Dolls and Sex Doll Owners

Repeated calls for more empirical research to assess theoretical claims about sex doll ownership have been made [1, 18, 21]. Of the empirical scholarship on sex dolls thus far, their foci are the following: (1) sex doll ownership as a phenomenon of general interest in the media; (2) sex doll owners' self-described motivations and practices; and (3) statistical comparisons of sex doll owners' psychological traits to non-sex doll owners.

## Generalized Examinations of Sex Doll Ownership

Some scholarship has examined how sex dolls are culturally valued. One study of Swedish media publications ( $n=98$ ) collected from a corpus of Nordic print and digital sources suggests that sex doll ownership is discussed outside of academic contexts with some regularity [9]. Robin Björkas and Mariah Larsson found the discussions focus on six themes: (1) how the realism of dolls provokes thoughts about what it means to be human; (2) the future of societies if robotic and/or artificially intelligent sex dolls become widespread;

(3) whether the traumas and isolation men experience can be medically treated with sex dolls; (4) whether sex dolls are an appropriate way to fulfil sexual and emotional needs; (5) whether sex dolls objectify women and promote violence against women; and (6) whether childlike sex dolls normalize pedophilia [9]. These themes reflect the concerns of researchers — the ethical nature and efficacy in therapeutic interventions of sex dolls.

## Demographic and Psychological Characteristics of Sex Doll Owners

Measuring the extent to which sex doll owners' psychological characteristics and motivations confirm or challenge their hypothesized traits is difficult due to several methodological challenges. One issue is the relative infrequency of sex doll use. An online survey of German adults aged 18–69 ( $n=2000$ ) collected in 2016 found 2% of women and 9% of men had used a sex doll [1]. Given the rarity of sex doll use, let alone ownership, there is a dearth of robust quantitative research. However, recent evidence suggests the COVID-19 pandemic may have accelerated sex doll and sex toy purchasing. In North America, one online sex toy vendor reported a 30% sales increase in 2020, and some European retailers reported increases of more than 100% [30]. Precisely how much the surge of sex toy purchasing has affected the number of people who use, or own sex dolls remains to be seen. A second methodological challenge is the stigma associated with sex tech that may lead fewer people to identify as sex doll owners and participate in studies [14, 15].

Despite methodological limitations, it is becoming more common for scholars to sample data from current sex doll owners. Several approaches common in the social sciences have been used. These include small-scale surveys [4, 31, 32], mixed-methods [17], case studies [23, 31], in-depth interviews [14, 33], and ethnographic approaches [14, 23, 33]. Many studies recruit participants from website forums dedicated to sex doll and sex robot ownership. The online conversations among sex doll owners have also been analyzed [17, 33, 34]. Generalizing from these studies is difficult because they are often based on small non-random samples; however, several trends are apparent.

First, the majority of sex doll owners are heterosexual men [14, 17, 31, 32, 33, 34]. Because of this, several studies exclusively analyze men's use of dolls [32, 33]. Gender homogeneity among sex doll owners appears to affect the social dynamics on websites where they congregate. As Belinda Middleweek notes in her study of 505 online posts from a sex doll owner forum, users post in ways that are stylistically masculine and center heterosexual men's interests and concerns [34]. Some women and sexual and gender minorities are present on these sites, however. Kenneth Hanson's digital ethnographic study ( $n=41$ ) of sex doll

owners who use forums and social media reports the interview sample's gender distribution as 75% men, 17% women, 4.8% non-binary, 2.4% trans, and the sexual orientation distribution as 75% heterosexual, 9.7% bisexual, 4.8% queer, 2.4% demisexual, 2.4% pansexual, and 1% asexual [14•]. Mitchell Lancaster-James and Gilliam Bentley's mixed-methods study ( $n=83$ ) samples two sex doll owner forums and reports the sample's gender distribution as 90.4% men, 3.6% women, 2.4% gender fluid, 1.2% trans men, 1.2% trans women, 1.2% "other," and the sexual orientation distribution as 88% heterosexual, 7.2% bisexual, 1.2% asexual, and 3.6% "other" [17]. Owners and users other than heterosexual men have not been studied in-depth. One anthropological study conducted in Austria begins to overcome this issue via the researcher's attempt to have sex with a male sex doll in a sex doll brothel [23]. As the researcher notes, she found the male sex doll unappealing due to its lack of body hair and overly large penis.

A second finding is that most sex doll owners are middle-aged and not currently partnered [14•, 17, 33•]. The previously mentioned digital ethnography ( $n=41$ ) reports 29% of respondents were married or in a relationship, and the remaining respondents were single, with 37% choosing to be "single on a permanent basis," and the rest open to forming a relationship [14•]. The same study reports that more than 70% of respondents were age 40 or older. Similarly, the mixed-methods study ( $n=83$ ) reports 44.6% single, 22.9% married or in a domestic partnership, 13.3% divorced, 9.6% in a relationship, 2.4% widowed, 2.4% separated, and 4.8% "other" [17]. The same study reports 13.3% of their sample were ages 18–29.

As for *why* people own sex dolls, empirical research presents a mix of sexual and non-sexual motivations among doll owners. Sexual satisfaction is always salient within studies, but it is not always the main motivator. Kenneth Hanson argues many sex doll owners view sex dolls as a means of satisfying their emotional and sexual interests without enduring the unpredictability of human relationships [14•]. A survey of sex doll owners ( $n=12$ ) sampled from social media reports that only 16% of the sample cited sexual purposes as the primary reason they purchased a sex doll [31•]. However, the mixed-methods study by Mitchell Lancaster-James and Gillian Bentley ( $n=83$ ) reports that sexual functions were the main purpose for 77.1% of the sample [17]. Non-sexual motivations include the following: (1) companionship; (2) emotional satisfaction; (3) friendship; (4) photography; (5) business ventures; and (6) collecting [17, 31•]. As customizable sex toys, another motivation is the opportunity to experience sex practices that human partners may not be able or willing to perform. One study notes how owners change the genital configuration of dolls depending on their desired sexual experience [14•]. Given the range of sexual and non-sexual functions sex dolls fulfil,

the term "sex doll" has been eschewed by some scholars. Instead, they use "doll" [14•], "allodoll" [17], or "love doll" [26, 35].

One study compares sex doll owners' psychological characteristics to non-sex doll owners to assess personality differences [32•]. Craig Harper et al. compare a sample of male sex doll owners ( $n=158$ ) to a sample of male non-owners ( $n=135$ ) across numerous items. The sex doll owners were sampled from forum style websites, meaning that a majority (93%) of respondents came from North America or Europe. Non-owners were recruited and surveyed via the web-based research platform Prolific. The findings suggest that most differences were *not* statistically significant: (1) sexual aggression (proclivity and biastophilic fantasies); (2) belief that the world is dangerous; (3) possessing an uncontrollable sex drive; (4) personality styles (schizotypal, narcissistic, avoidant, obsessive–compulsive, antisocial); (5) emotions (affect and sexual self-esteem); and (6) attachment styles. Some differences were statistically significant. Specifically, sex doll owners were more likely to score higher on three measures: (1) viewing women as sex objects; (2) expressing sexual entitlement; and (3) viewing women as unknowable. Finally, sex doll owners were less likely to exhibit borderline personality issues than non-sex doll owners. These findings are among the first to empirically test theorized differences between sex doll users and the general population. The results of this study suggest that sex doll owners and non-owners are psychologically similar in many ways, and the null findings on sexual aggression measures may suggest that sex doll owners are no more likely to offend than non-owners. Notably, the sample is restricted to heterosexual men who own adult sex dolls, most of whom are from North America and Europe, making it difficult to generalize to other populations and people who own childlike sex dolls.

Finally, there is a considerable geographic bias in most empirical work on sex doll owners. Sampling from website forums restricts researchers to the people on those sites. Because many forums are in English, the samples collected from those websites are mainly people from English-speaking countries [14•, 17, 32•]. Yet, many sex dolls and sex robots are owned and manufactured in Asian countries [26, 31•, 33•, 36]. The focus on English-speaking sex doll owners is noteworthy considering how the Japanese term "Otaku" has been applied to sex doll owners [10, 26]. One study ( $n=261$ ) of US residents sampled from MTurk specifically used the concept of "Otaku" to predict the appeal of sex robots [10]. "Otaku" is a Japanese cultural phenomenon that describes some Japanese men's apparent disinterest in sexual partnering with humans. Typical traits associated with Otaku men include interests in anime, manga, video games, and shyness. A case study of Mr. Kondo, a self-described Otaku Japanese man, is one of the few empirical investigations of people interested in forming relationships

with human-like and personified sex tech outside of Western contexts [31•]. The rapid development and application of new technologies to sex dolls to make them into sex robots, and the creation of AI chatbots and other forms of personified sex tech, could be more culturally accepted in some non-Western countries [26, 36]. Future work should examine sex doll ownership as a global phenomenon.

### Contributions to Sex Robot Studies

Sex robot usage is low compared to sex doll ownership [16]. Nevertheless, many scholars are interested in how sex robots can be used and the impact they might have on society. Theoretical debates related to sex robots are often interdisciplinary, as scholars interrogate both the ethical dilemmas stemming from their arrival and the increasing number of applications that come with more advanced technology [2, 3, 12, 13]. Many debates extend previous concerns about sex dolls, while some are unique to their robotic and artificially intelligent features.

### Media and Technology Studies

Notable insights into how people might interact with artificially intelligent sex robots come from technology and media studies. The “CASA” (computers as social actors) paradigm observes that humans interpret computer’s cues similar to how they understand interactions with other human actors [37], suggesting that sex robots would be interpreted as actors as well. But embodiment is not necessary for people to have social interactions with technological interfaces [38]. Media Equation Theory notes that humans are capable of interacting with numerous types of artificial forms [38], and later work elaborated on this framework by suggesting that much interaction is based on relatively “mindless” re-enactments of human social scripts [39]. Application of these approaches to sex robots in particular, led to the development of the “sexual interaction illusion model.” In this model, it is suggested that users’ illusory experiences with a robotic artificial partner feel like a sexual interaction with a living being due to the psychological immersion that can come from sustained interaction and communication with a human-like robot [19]. Psychological immersion may not be predicated on an embodied sex robot however, as research examining erotic chatbots demonstrates similar immersive experiences with users [40]. Still though, fully embodied sex robots are likely important for satisfying sexual interactions for many users [41]. Indeed, sex robots may have uses for “parasocial relationships,” where humans identify with media characters [42]. By providing a physical medium for users, sex robots could manifest a fictional character in material form to satisfy a person’s sexual and emotional fantasies. Some highlight the consequences that could

result from thinking of sex robots as humans [43], but much research in this vein suggests that immersive interactions with human-like robots have the potential to be satisfying.

### Medicalized Contexts and Applications

Tentative research has explored potential uses for sex robots in medical and healthcare settings. If manufacturers overcome economic burdens and make their products more available to healthcare providers, sex robots may provide therapeutic benefits soon [16, 44]. One possible application is improving the sexual wellbeing of people who are impeded, unable, or unwilling to have sex with human partners. These barriers can be due to medical conditions and interpersonal issues such as socially isolated elderly people [45], physically disabled people [28], and people who lack social skills [46]. Criticisms of these applications argue that sex robots could be programmed to take advantage of vulnerable users [43] and that sex robots only simulate companionship which will ultimately exacerbate, rather than treat, isolation and related mental health issues [47]. However, the bulk of research is positive in its evaluation of therapeutic applications. In particular, the emotional affordances sex robots can provide are of special interest [48, 49].

### Sex Robots and “Safer” Sex

Some scholars have begun considering how sex robots might facilitate “safer” sexual encounters in settings where humans are at risk. Proponents of this approach suggest that sex robots could lessen the risk of sexual health complications [1–3]. Specifically, sex workers who are unprotected by laws regulating safe sex practices and are at risk of being exploited might benefit from “sex robot brothels” [50, 51]. Another application is prison, as sex robots might reduce rates of prison rape [50, 52]. However, while sex robots may be “safer” in one regard, their use introduces others risks that must be considered. Sex robots have the potential for technological malfunctions that might injure users, and smart technologies can be breached, thus putting users’ intimate data at risk [53].

Sex robots could also be used for harm reduction by satisfying transgressive sexual behaviors [14•, 54]. Researchers have theorized various applications where sex robots could mitigate the negative outcomes associated with sexual interests that victimize humans. Examples include sexual violence, pedophilia, and other non-consensual sexual desires [16, 29]. Like their doll counterparts, childlike sex robots are particularly contentious [8, 26, 27]. Similarly, child sex robots would be useful if they mitigate people’s pedophilic desires, but there is a paucity of empirical support for such claims [16, 25–27]. Further, as more artificially intelligent designs become available, the question of how and whether

they ought to require consent before engaging in sexual activity becomes a concern [55]. In some applications, non-consensual sexual fantasies directed at artificially intelligent sex robots may be seen as harm reduction, but others contend that non-consensual fantasies with sex robots will become less satisfying over time, in which case users may escalate to harming humans [8]. Importantly, discussions around the use of sex robots for satisfying non-consensual fantasies tend to frame such desires in a way that focuses on men's desire to overpower women, but as some have noted, women sometimes have non-consensual fantasies of being overpowered [56]. To what extent sex robots could be used in other roles to satisfy transgressive sexual interests safely necessitates a more nuanced discussion of sex robots' potential applications.

### Posthuman Applications and Issues

Integrating artificial intelligence into sex robots designed to be companions is a complicated issue. In addition to questions about whether sex robots should require consent [55], some argue we should also consider their posthuman agency. For example, to what extent are artificially intelligent sex robots entitled to make their own decisions compared to meeting users' needs [57]? A burgeoning corpus of work in philosophy attends to these issues and suggests that how humans interact with non-human entities may reveal how and under what conditions people become emotionally attached [58, 59, 60–62]. Emotional bonds with sex robots may become a significant factor in shaping users' desires in applied settings, as users renegotiate intimacy, sex, and love when working with medical providers and therapists who choose to employ human-like and personified sex tech in their practices.

### Feminist Reflections on Sex Robots

Given the hyper-gendered feminine form of most sex dolls and sex robots [11, 22], feminist contributions have further interrogated the ethical consequences of feminized technologies designed for sexual interactions [3, 5, 61–69]. Varying perspectives explore the significance of the industry's focus on gendering humanoid technologies as feminine [68]. For some radical feminists, this design choice results in the objectification of women by equating them to sex objects [5, 11], leading some to call for a complete ban of sex robots [5]. Their feminine form also leads to another problematic feature; sex robots might be programmed to replicate stereotypical tropes of women's behavior such as constant sexual and emotional availability. This possibility raises concerns about how programming decisions could affect users' expectations of human women [55, 68, 69]. Sex-positive feminists acknowledge that while the limited range of models reduces

women's bodies to a narrow typology, there may still be beneficial uses for sexual pleasure and wellbeing if the industry incorporates feminist perspectives into the design of future models [3, 62, 63].

Much theorizing pre-empts the current technological sophistication of sex robots. Often, the consequences of sex robots are framed as imminent issues that will result from the eventual production of artificially intelligent sex robots. Many scholars focus their attention on “Realdoll<sup>X</sup>”, the artificially intelligent and robotic models made by well-known U.S. sex toy manufacturer Realdoll. The focus on Realdoll and Realdoll<sup>X</sup> comes at the expense of theorizing about the development and use of sex robots in other contexts. The Chinese sex doll companies DS Doll and EX Doll are both planning to release robotic prototypes soon [33], and numerous models are currently produced in Japan that are unlike those made by Western manufacturers, such as impenetrable childlike models and plush “waifus” [26, 35, 36]. Given that sex dolls are a precursor to sex robot prototypes, the lack of attention to Japanese and Chinese manufactures is noteworthy. (For a discussion of products outside Western contexts, see Beatriz Aoki and Takeshi Kimura [31] or Agnès Giard [26, 35]).

### Empirical Insights into Sex Robot Usage

Much like research on sex doll owners, sex robot owners are rarely studied. Yet calls for more empirical research about sex robots are being met [1, 41]. The same limitations impeding empirical scholarship on sex doll owners is magnified for sex robot users [1, 16, 70]. Consequently, much work analyses promotional material. Such work emphasizes that the affordances of sex robots are promoted as emotionally beneficial [71–73]. Despite methodological challenges, a few empirical studies examining the general population, current sex doll/sex robot owners, and sex offenders have begun to consider whether sex robots might be beneficial for individuals or in therapeutic settings.

### Motivations and Acceptance of Sex Robot Usage

Sex robots are appealing to some medical providers. One survey ( $n = 72$ ) of sex therapists and physicians across Germany, Austria, and Switzerland finds that 45% could imagine recommending sex robots in therapy [29]. The same study reports three concerns were salient for providers: (1) the importance of the personal definition of sex robots for the assessment of their therapeutic benefits; (2) therapeutic benefits and dangers of sex robots; and (3) considering the quality of human–robot sexuality. While empirical research examining the efficacy of using sex robots in therapy is still lacking [16], the attitudes of

providers suggest some may begin implementing human-like and personified sex tech in their practices.

Since there are few sex robot owners, empirical research often samples from the same population of sex doll owners found on website forums [14•, 17] to gauge attitudes toward owning and using sex robots. Survey research of sex doll owners suggests that sex robots also have sexual and non-sexual uses, as they can provide companionship via interaction [17, 33•, 34•, 74]. However, studies find varying degrees of interest in using sex robots. One mixed-methods study of sex doll owners ( $n = 83$ ) found that 58% of current doll owners were interested in sex robots [17]. The remaining participants expressed several concerns. Mainly, they worried that artificially intelligent sex robots would require consent and thus, new ethical dilemmas would arise for the owner. In that way, current sex doll owners seem concerned about issues of consent [55] and posthuman agency [57].

Some empirical research has examined the general population to gauge attitudes and motivations for using or purchasing a sex robot. Several studies note that men are more interested in using sex robots than women [15•, 52, 75, 76]. Scholars find that the acceptability of sex robots varies by the application in which they would be used. In addition to personal use [10], heterosexual men view sex robots desirably when used for sex work [77]. Matthias Scheutz and Thomas Arnold's MTurk survey of U.S. adults ( $n = 100$ ) teases out specific applications more thoroughly [54]. They find most applications are viewed favorably by both men and women but note a strong gendered effect. The most positively viewed applications include the following: (1) using sex robots instead of cheating; (2) in place of human sex workers; (3) for sex education; (4) for disabled populations; (5) for sex offenders; (6) to improve the hormone levels of people with infrequent sex; (7) to improve self-esteem and overall psychological health; (8) for group sex; (9) in pornography; (10) to engage in transgressive sex practices such as rough sex; and (11) to reduce the risk of sexually transmitted diseases [54]. The same survey also finds that most "forms" of sex robots are viewed favorably, with the notable expectations of child-like sex robots, sex robots that resemble family members, and animals. They also report younger adults viewed sex robots as less appropriate than older adults [54]. Other research on the acceptance of sex robots suggests that people's views are shaped by depictions of artificial intelligence in media [78].

### Harm Reduction for Extreme Sexual Transgressions

Sex robots may be used for harm reduction in cases of extremely transgressive sexual desires, such as pedophilia

and forcible rape. Due to the criminalization of and harm caused by such sexual transgressions, the efficacy of such methods is difficult to assess for ethical and methodological reasons [8, 26, 27]. Instead, some research has measured whether people with extremely transgressive sexual desires are open to using sex robots. One study compared a sample of Czech Republic men ( $n = 806$ ) who participated in a survey on "Love and intimacy in the Czech population" to a sample of Czech men with pedophilic interests ( $n = 48$ ) and a sample of Czech men with non-consensual/violent sexual interests ( $n = 57$ ) to test the hypothetical applicability of sex robots for therapeutic interventions [79•]. All participants with transgressive sexual interests were recruited after being pre-screened from a pool of online survey respondents. Only 18% of the control group expressed an interest in a sex robot experience, but 37.5% of the sample of people with pedophilic interests and 26% of the sample with interests in non-consensual/violent sex were open to a sex robot experience, suggesting some potential. However, by limiting the study to men with transgressive sexual interests, there is still a lack of empirical data on how women might be interested in using sex robots to satisfy their transgressive sexual interests [56]. Compared to research by Matthias Scheutz and Thomas Arnold [54] which found that older U.S. adults were more accepting of sex robots, the study by Alena Marečková et al. found that younger Czech respondents were more open to sex robot experiences [79•]. More research is necessary to understand these conflicting findings.

Contrary to the above findings by Alena Marečková et al., a study of sex offenders compared to non-offenders found sex offenders were *less* open to using sex robots and *less* likely to believe sex robots would prevent sexual violence than non-offenders [80•]. Laura Zara et al. compared two samples of Italian men, one being a group of non-offenders ( $n = 244$ ), the other group sex offenders ( $n = 100$ ), to assess the viability of sex robots for harm reduction [80.]. Using a "SexBot Questionnaire" designed for the study, clinical psychologists conducted semi-structured interviews of consenting adults without knowledge of their criminal careers. They find that interest in having a "sexbot" was lower for sex offenders (12.4%) than for non-offenders (36.6%). Moreover, sex offenders were less likely to believe "sexbots" would reduce violence directed at humans (24.7%) than non-offenders (46.9%). Since there are so few studies examining this question, and the results sometimes contradict those of other studies, more empirical research is needed to explore possible mediating effects. As Nicola Döring et al. summarize, "There is a need to improve the theoretical elaboration and the scope and depth of empirical research examining the sexual uses of human-like full-body material artifacts" [18].

## The Future of Human-like and Personified Sex Tech

As human-like and personified sex tech continues to advance, we must consider how the limitations of sex dolls and sex robots, such as their cost [16], stigma [15•], and lack of diversity [11] push users toward other cheaper, private, and customizable options. Numerous companies offer fully mediated feminized personas, which can be augmented with virtual reality pornography, teledildonic systems, and erotic chatbots [59•]. Earlier, we defined digitally personified sex tech as any digital experience that presents a humanoid character through images, audio, and/or chat features for users to interact with for the express purpose of sexual and/or emotional gratification. Here we suggest these devices expand the field of human-like sex tech into new territory and bring with them new questions about their ethical nature and efficacy for clinical and individual use.

By moving away from physical sex toys approximating human bodies toward the emotional and communicative benefits of digital sex tech [17, 70•], new forms of sexual interaction become possible. Sexual activities can occur “through,” “with,” or “via” digital devices [70•], but research detailing these uses is limited. Many scholars focus on how people co-engage in sexual activities “through” or “via” digital technologies, such as sexting [81] or with dating apps [82]. But personified sex tech offers humanoid constructions for people to engage “with.” In so doing, the usual typology of sexual orientations and desires might be reconsidered, especially if people come to see themselves as desiring artificial companions specifically [14•, 83]. Scholars interested in people’s interactions with digitalized human-like and personified sex tech have offered new terms to describe these interests including, “erobotics” [84], “sexbots” [58], and “machine-cued partners” [40]. Each of these terms seeks to define the next turn in this field.

Many of the challenges facing scholars interested in digital sexual experiences are the same as those mentioned above. The theorizing has, in some cases, surpassed the technological capabilities of manufacturers, and the empirics are even more limited than that of sex doll and sex robot owners. A core issue is whether people are open to using these devices, especially given the stigma associated with sex tech [15•]. A representative survey of U.S. adults ( $n=7512$ ) found relatively broad appeal across key demographics [85]. The groups most open to use sex tech were men, non-heterosexual, non-white, younger, above average income, and more religious people [85]. These findings both conform to and challenge empirical findings of sex doll and sex robot users who are mostly heterosexual

men [14•, 17]. Some of the differences may be explained by the broader definition of sex tech Amanda Gesselman et al. use — they include camming, sexually explicit role-playing games, virtual reality pornography, teledildonic systems, erotic chatbots, and online pornography [85]. Indeed, in a global study of 130,885 women from 191 countries, considerable variation was explained by the type of sex tech used and region [86]. One of the most used sex tech devices by women was apps and websites designed for finding partners [86]. Thus, while empirical studies are limited, what is clear is the need to distinguish different forms of sex tech by their function and examine how those applications reflect cultural values about gender and sexuality.

Another issue stems from the industry’s repeated use of feminized personas, such as Realdoll<sup>X</sup>, mentioned earlier. Realdoll<sup>X</sup> is marketed as the “perfect companion,” with the aim of replicating desirable interactive aspects of companionship via feminized AI chatbots. As such, Realdoll<sup>X</sup> digitalizes the sex doll experience without addressing issues related to consent [55] and may conflate depictions of women with stereotypical traits of docile hyper-femininity [33•, 59•, 66, 87]. Scholars working in human–computer interaction have noted the tendency to personify machines and interfaces that work “for” people using similarly gendered constructions, even if the system is not built for erotic interactions. Yolande Strengers and Jenny Kennedy refer to this as the “Smart Wife Phenomenon,” wherein digital technologies designed and marketed for assistance are overtly feminized (e.g., Siri and Alexa) [68]. In that way, the gendered personification of artificially intelligent platforms suggests the feminine construction of erotic and emotional chatbots like Realdoll<sup>X</sup> are not failures of the adult industry per se, but merely a reflection of the biased trend among technology companies working on artificial intelligence [68]. Accordingly, scholars are concerned about ethical dilemmas that result from representing stereotypical behavior in such technology, and how these design choices could affect the way men relate to human women [59•].

Moving into the future, the field of personified sex tech will need to navigate multiple factors as more people become interested in using such technologies. Research exploring the linkages between sex doll, sex robot, and personified sex tech development will need to contend with enduring stigma and limited empirical data. As the scope of the field grows, scholars will need to reassess assumptions based on nascent technologies as the affordances brought on by new developments are better understood. Alongside this, sex tech researchers will also need to consider the global contours of development, manufacturing, and use.



## Conclusions

While empirical research on people who own and use sex dolls, sex robots, and other forms of personified sex tech is still limited, notable insights force a reconsideration of previous assumptions that sex dolls and sex robots are solely risky or beneficial. The evidence suggests that human-like and personified sex tech have promising uses in people's lives as sexual and emotional aides, but that some caution is warranted in interpreting these benefits as much of the literature focuses on a small demographic of consumers (e.g., single middle-aged heterosexual men). As companies continue to develop increasingly sophisticated sex tech, such devices may become appealing to diverse users. Importantly, the issues and findings described in this narrative review are limited in several ways. First, our focus on recent and peer-reviewed research means that not all scholarly works discussing these topics have been included. Second, as Western researchers, our own biases and cultural values inflect the way we have focused on certain studies over others, despite our assertion that more non-Western research in this area is a necessity. However, we believe the findings of this narrative review can still be used by researchers to inform work that will expand the currently limited scope of empirical findings to date. This is especially important for scholarship seeking to examine the contradictory findings discussed here (e.g., age effects and likelihood of sex offenders to use sex robots), and as justification for scholars working outside of Western countries. Despite evidence that sex doll and sex robot developments have broad appeal in several Asian countries (e.g., Japan and China), there is limited scholarship examines the lives of people who own sex dolls and sex robots in these countries. Providers are encouraged to consider how the motivations of patients who are using or express interest in using human-like personified sex tech compare to the psychological characteristics of users and non-users assessed in empirical work discussed here. While sex dolls, sex robots, and personified sex tech might be beneficial, clinicians should caution patients that the empirical validity of therapeutic claims is limited. However, this is also true of claims that sex tech is harmful. Thus, decision-making should come from a well-informed position by practitioners and users alike.

**Funding** Funding for this project was received from the Sasakawa Foundation UK.

## Declarations

**Conflict of Interest** The authors declare no competing interests.

**Human and Animal Rights and Information** All reported studies/experiments with human subjects performed by the authors were performed

in accordance with all applicable ethical standards including the Helsinki declaration and its amendments, institutional/national research committee standards, and international/national/institutional guidelines.

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