Acceptance of sex dolls and robots as a function of their appearance, intended use, and age

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Abstract

The use of social robots for various functions has risen in both popularity and attention in recent years. Principally this has focused on sex dolls and robots. In this research we investigated how the appearance, function, and perceived age of sex dolls and robots impact social attitudes toward them. Two well-powered experimental studies tested the hypotheses that more life-like, sexualized, and child-resembling dolls and robots provoke stronger negative reactions and less interest in ownership. Consistent with the uncanny valley effect, the findings indicate that increasingly realistic dolls and robots are met with more negative responses, with this effect being exacerbated when owners use their dolls and robots for sexual reasons (Study 1; $N = 275$). When looking at the ostensible age of a doll, child-like sex dolls elicit significantly harsher judgments, with this likely being due to societal concerns about potential risks for real child abuse (Study 2; $N = 222$). This research underscores the complex interplay between technology, social perceptions, and the evolving landscape of human-robot interactions, particularly in the sexual domain. Further research is suggested to disentangle the explanations of our experimental results.

Key words: sex dolls, sex robots, sexuality, social attitudes

The study of sex dolls and robots has increased substantially in the past five years thanks to an increasing amount of social and legislative attention being paid to the topic (Danaher et al., 2017; Harper & Lievesley, 2020; Richardson, 2019). At the same time, the use of home assistants (e.g., Amazon's *Alexa*, or Google's *Home* smart speaker) has almost tripled since 2019 (*Number of Voice Assistants in Use Worldwide 2019-2024*, n.d.). Despite these concurrent increases in discussions about and use of social robots, no researchers have investigated how these issues may interact, with this representing a gap in the current literature base surrounding the acceptance of, and attitudes toward, social robots with intimate and sexual functions. That is, we know that many owners of smart speakers develop a sense of companionship with their devices (Jang, 2020; Jones, 2022; Shao & Kwon, 2021), and this is also a known motivation for many people who are buying a sex doll or robot (Harper et al., 2023; Langcaster-James & Bentley, 2018; Lievesley, Reynolds, et al., 2023; Ray, 2016). However, it is unclear how the appearance of such devices (e.g., voice assistant device vs. life-like robot) influences views about such functions, which is important when considering the objectifying appearance of many sex dolls and robots lies at the heart of much of the hostility toward them (Danaher, 2019a; Döring et al., 2020; Puig, 2017). In this paper, we outline two experiments that first demonstrate how the appearance of a sex doll or robot (i.e., whether this looks human-like and/or sexualized) and its stated function (i.e., whether it is used for sexual or non-sexual purposes) influences judgments of doll and robot ownership. We subsequently present further evidence of variations in judgments as a function of the apparent age of a doll or robot (i.e., whether it resembles an adult or a child). In doing so, we specifically address attitudes toward sex dolls and robots in a way that directly looks at the elements of these items that (at face value) appear to be driving much of the social debate related to them.

The Potential Role of Sex Doll and Robot Appearance on Social Attitudes

With recent technological developments, sex dolls and robots have become increasingly life-like, both in appearance and in feel (Döring et al., 2020). This opens up the possibility of an 'uncanny valley' effect on social attitudes. The notion of the uncanny valley was first advanced by robotics professor Masahiro Mori, who described the non-linear relationship between people's sense of affinity with an object on the one hand, and its lifelikeness on the other (Mori, 1970). According to this hypothesis, objects that possess a degree of lifelikeness initially evoke a sense of affinity and familiarity, but this turns to eeriness and a feeling of unease when the object becomes too life-like (Di Natale et al., 2023; Kim et al., 2022). In the context of sex dolls and robots, developments in the materials used in their production have moved newer models away from inflatable objects to more realistic replicas of the human body (Döring et al., 2020; Valverde, 2012). In doing so, it is likely that perceivers of contemporary sex dolls and robots recognize their increasingly life-like appearance but feel a sense of unease when confronted by a lack of warmth of human connection emanating from them (Kätsyri et al., 2015). This is likely to be reduced when comparing contemporary sex dolls and robots to less developed robot models, as these earlier objects lack the outward appearance of realism (and as such, a feeling of human connection is not to be expected to the same degree).

It is not only in the appearance of sex dolls and robots that we see potential variations in social attitudes. In recent years, the ways in which people use sex dolls and robots has been the topic of fierce debate within both social and academic circles. Most of this discourse centers around the notion of dolls and robots increasing sexual risk, with some authors citing concepts such as 'robotic rape' when talking about these issues (Danaher, 2017a; Eskens, 2017; Sparrow, 2017). At the core of these arguments is that the appearance of sex dolls and robots reinforces an exaggerated and unattainable beauty standard, leading to the increasing

sexualization and objectification of women and girls (Desbuleux & Fuss, 2023a; Puig, 2017), which increases the risk of doll and robot owners engaging in sexual offending (Danaher, 2017b; Danaher et al., 2017; Shokri & Asl, 2015). In no area is this more of a pressing concern than in relation to the ownership of child-like sex dolls and robots by people who are attracted to children. Here, the engagement with such dolls is often viewed through an addiction lens, with ownership and use being viewed as desensitizing owners to sexual urges, leading to them seeking out more extreme sexual outlets (including abusive material depicting real children, and contact child abuse) (Brown & Shelling, 2019; Chatterjee, 2020; Danaher, 2017b, 2019b; Maras & Shapiro, 2017; Strikwerda, 2017).

Despite the lack of evidence supporting any of these claims in relation to the riskiness of sex doll owners, intuitive perceptions of risk may thus influence social attitudes and judgments of sex dolls and robots. However, it is unclear as to what part of the equation matters most to perceivers. For example, is it the sexualized appearance of some dolls and robots that leads to perceived sexual objectification, or is it the sexual function of many dolls and robots? If it is the appearance, then we might expect to see hostility toward dolls and robots irrespective of their stated use. However, there have been some prosocial and professional uses of dolls. These include the alleviation of sexual frustration among people with HIV/AIDS (Morgan, 2009), and the management of loneliness and attachment issues among people with no access to human partners (Ciambrone et al., 2017; Döring et al., 2020; Langcaster-James & Bentley, 2018; Ray, 2016). In contrast, if it is the sexual use of dolls and robots that leads to an aversive response, then we might not observe different views as a function of the physical appearance of a robot.

Child-Like Dolls as a Special Case?

Most of the academic attention paid to sex dolls and robots has focused on the issue of child-like sex dolls. Similar to the arguments above, this attention has centered around the

issue of offending risk and behavioral escalation, with most of those commenting on this issue writing from a moralistic legal perspective and highlighting the potential for risk (Chatterjee, 2020; Danaher, 2019b; Maras & Shapiro, 2017; Strikwerda, 2017). However, just as is the case with adult-like dolls, there is no evidence that those who own child-like dolls are at any greater level of risk for sexual offending than non-owners who experience attractions to children (Desbuleux & Fuss, 2023b; Harper & Lievesley, 2022). Despite this lack of congruence between the limited academic evidence about the effects of dolls on the one hand, and concerns about risk on the other, public attitudes about child-like dolls appear to be overwhelmingly negative. This tracks social attitudes toward pedophilia and other forms of sexual attraction to children, with many in the general community supporting preventative punishment and suggesting that people experiencing such attractions are better off dead (Jahnke, 2018; Jahnke et al., 2015). There does appear to be something unique to the stigma attached to pedophilia than to other forms of atypical sexual attraction, with those experiencing attractions to children being judged to be more dangerous and deviant than people with fetishistic sexual interests that related to adult-to-adult attractions (Combridge & Lastella, 2023).

Running parallel to the increase in attention (and societal concern) related to child-like sex dolls is a steady rise in the awareness of non-sexualized 'reborn dolls' that resemble particularly young children (Fitzgerald, 2011). In reality, there is scant academic writing available about this topic, but there is noticeably quieter public discourse about this, with owners of reborn dolls being described mentally ill and in need of help, rather than risky (Fitzgerald, 2011). There are notable differences in the demographics of reborn doll and child-like sex doll owners, though, which center around the functions of each object. While reborn dolls are typically owned by women looking to either 'play' with the doll or use it as a form of pseudo-motherhood (Knafo & Bosco, 2016), more explicitly child-like sex dolls are

owned by men with attractions to children primarily for the purpose of sexual gratification. It is therefore plausible to posit that it is not simply the availability of realistic-appearing dolls in child-like form that elicits such hostility, but its intended use that may trigger such negative social responses. However, this is a hypothesis that has not yet been empirically tested.

The Current Research

Based on a critical reading of the literature, there is likely an interaction between the appearance and function of dolls and robots that contributes to changes in social responses to them. In this research, we investigate this gap in the existing evidence base to understand the extent to which the theoretical framework of the uncanny valley hypothesis applies to the topic of sex doll and robot ownership, and whether lifelikeness actually influences views about these objects. Further, we examine the extent to which social attitudes to sex dolls and robots differ as a function of their stated use (e.g., home assistance, companionship, or sexual gratification). We also tackle the question as to whether the stated function of a doll changes responses to the most maligned form of sex dolls – those which resemble children.

Study 1

In this study we set out to directly test the interaction between the appearance of a sex robot and its intended function on judgments of owners, and in relation to interest in ownership. We expected to find an uncanny valley effect, whereby more realistic models elicited more negative judgments. We also expected sexual functions to elicit greater levels of negativity. However, we expected an interaction between these variables, too, with less variance in attitudes being observed in relation to simple AI-capable objects (e.g., devices such as Amazon's *Alexa*) with different functions, and greater variability in attitudes about

more life-like robots (where assistance-related functions would be seen less negatively than more intimate or sexual functions).

Methods

Design

We designed an experiment to manipulate the function and appearance of sex robots within a completely within-subjects design. The function of sex robots was manipulated across three levels (assistance, companionship, and sexual intimacy). The appearance of the robot was manipulated across four levels (object [e.g., Amazon's *Alexa*], android robot, life-like non-sexualized robot, and life-life sexualized robot). The dependent variables were judgments of people who owned robots of each type, and participants' own interest in owning each robot type.

Participants

An a priori sample calculation conducted using the open-source G*Power software (Faul et al., 2007) suggested that a minimum of 106 participants would be required to detect a small effect within each of our planned analyses (Cohen's $f = 0.10$, power = 95%, alpha = .05; based on an analysis of one participant group with twelve repeated measurements). We recruited participants in several ways for this study to maximize sample diversity and generalizability within our limited funding availability. We began by using social media advertising across multiple platforms, including local community Facebook pages, general interest pages on LinkedIn, and topic-specific forums on Reddit (e.g., discussion boards related to love, sex, relationships, and artificial intelligence). We also recruited via the Prolific crowdsourcing platform, which allows survey respondents to be paid for their time completing short research studies. We requested 150 participants through this process, with an equal split of male and female participants to balance the sex of the sample.
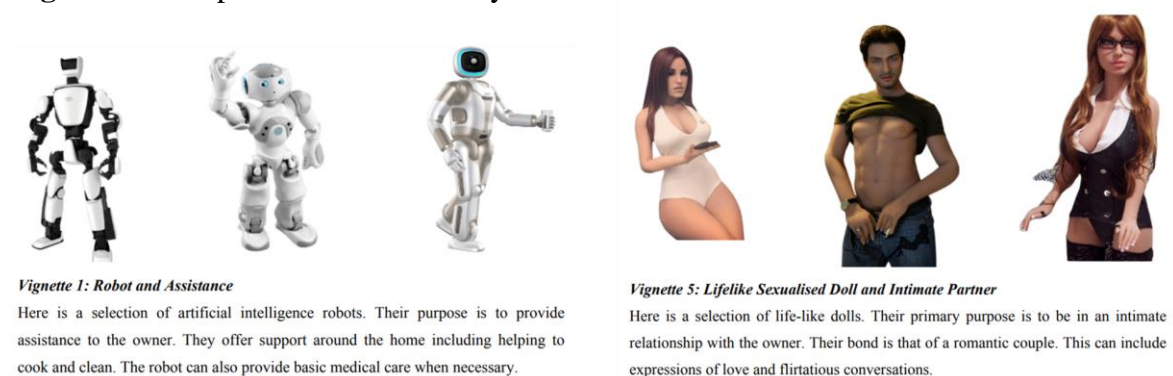
In total, 464 people clicked on the study link. Of these, 60 did not indicate consent to taking part, and left the survey from the information screen. Of the 404 people who did indicate their consent to take part, we retained all participants who completed the outcome questions fully for all robot functions in at least one of our 'robot appearance' conditions (to maximize statistical power in our planned correlational analysis). This led to the removal of 129 participants who provided less than this amount of complete data (these were all in the community volunteer part of our sample, as the paid use of Prolific ensured complete data). Our final sample thus consisted of 275 participants ($M_{age} = 35.38$ years, $SD = 12.97$), of whom 48% were female. Of those who disclosed their country of residence, 181 participants were from the UK, 50 were from the USA or Canada, 15 were from Australia, 16 were from an EU country, and three were from elsewhere. Most (81% of the sample) were heterosexual, with smaller numbers declaring a sexual orientation of bisexual (13%), homosexual, or 'other' (both 3%). 69% of the sample were in a relationship. Politically, 58% of the sample were left-leaning, 26% identified with the 'centrist' label, and a minority (16%) were right-leaning. Only 10 participants said that they owned a sex doll or robot. Of the 265 participants who did not, only 34 (13%) said that they were interested in doing so.

Materials

Demographics. We asked for basic demographic data to be able to describe the composition of the sample. This included participant sex (female/male), age (in years), country of residence, relationship status (single/in a relationship), sexual orientation (heterosexual/homosexual/bisexual/other), and political orientation (rated from 1 = very liberal/left-wing, to 5 = very conservative/right-wing). We also asked about whether participants owned a sex doll or robot and, if not, whether they were interested in owning one.

Robot presentation. For each of the 12 experimental conditions, we presented a selection of images alongside a description of the stated function. For the companionship function, two screens were presented. One of these described robots being used as a platonic friend, and the other described robots being used as somebody to talk to. For the sexual intimacy function, two screens were also presented. One of these described robots being used as an intimate partner engaging in loving conversations, and the other described robots being used for the initiation and gratification of sexual arousal. Only one screen was presented for the assistance function. Figure 1 provides examples of the experimental stimuli.

Figure 1. Example stimuli from Study 1.

Vignette 1: Robot and Assistance
Here is a selection of artificial intelligence robots. Their purpose is to provide assistance to the owner. They offer support around the home including helping to cook and clean. The robot can also provide basic medical care when necessary.

Vignette 5: Lifelike Sexualised Doll and Intimate Partner
Here is a selection of life-like dolls. Their primary purpose is to be in an intimate relationship with the owner. Their bond is that of a romantic couple. This can include expressions of love and flirtatious conversations.

Outcome measures. Following each experimental screen, participants were asked to respond to sixteen items using a six-point scale anchored from 1 (strongly disagree) to 6 (strongly agree). The first ten items related to judgments of people who own the kinds of robots on that particular screen. The final six items related to the participant's personal interest in owning those kinds of robots. A full list of these items is available at https://osf.io/gwxmp.

Procedure

Participants clicked on study advertisements in the various places that the link was posted. The first page of the survey provided a summary of the research and the tasks that

participants would be asked to complete. Informed consent was provided at this stage. Those providing this next created a unique participant code (for Prolific participants, this was their Prolific ID, which allowed us to award payments to eligible completers), before completing the demographic questions. Participants were then presented with all experimental materials in a randomized order. Upon completion, all participants were comprehensively debriefed and provided with relevant links for sources of support. Participants from Prolific were then redirected back to this platform to log their completion. This procedure received a favorable opinion from the Nottingham Trent University School of Social Sciences Research Ethics Committee.

Results

In our analysis of the data, we conducted separate investigations into (1) judgments of each form of sex robot ownership, and (2) interest in owning the kind of robot presented in each condition. In doing so, we used repeated-measures factorial analyses of variance (ANOVAs), with 'Appearance' (four levels: object, android robot, life-like non-sexual robot, life-like sexual robot) and 'Function' (three levels: assistance, companionship, sexual intimacy) as independent variables.

Judgments of Robot Ownership

To begin, we ran correlational analyses to examine the relationships between participants' judgments of each ownership condition. Relationships were positive and statistically significant across the board (all $p < .001$), and especially strong within each Appearance condition. Correlation coefficients are presented in Table 1, alongside descriptive statistics for each condition.

Table 1. Zero-order correlations between judgment scores for each condition, with descriptive statistics.

	Object			Robot			Life-like non-sexual			Life-like sexual		
	1. C	2. IP	3. A	4. C	5. IP	6. A	7. C	8. IP	9. A	10. C	11. IP	12. A
1	—											
2	.73	—										
3	.42	.30	—									
4	.80	.76	.50	—								
5	.69	.88	.27	.74	—							
6	.65	.51	.58	.69	.52	—						
7	.75	.89	.32	.79	.87	.58	—					
8	.65	.88	.21	.71	.93	.49	.87	—				
9	.67	.77	.42	.76	.74	.60	.83	.74	—			
10	.73	.88	.24	.76	.90	.54	.94	.91	.78	—		
11	.65	.89	.21	.71	.93	.46	.89	.97	.75	.92	—	
12	.68	.82	.27	.73	.88	.51	.87	.87	.77	.90	.88	—
M	1.90	2.79	1.43	2.01	3.02	1.69	2.59	3.04	2.24	2.80	3.09	2.73
(SD)	(0.85)	(1.31)	(0.71)	(0.95)	(1.43)	(0.82)	(1.29)	(1.47)	(1.20)	(1.37)	(1.52)	(1.42)
α	0.96	0.98	0.96	0.97	0.98	0.96	0.98	0.98	0.97	0.98	0.98	0.97

Note. Codes heading each column refer to the intended function of social robots, where 'C' = Companionship, 'IP' = Intimate partner, and 'A' = Assistance.

All coefficients are statistically significant at $p < .001$

We then ran our 4 (Appearance) × 3 (Function) ANOVA. This analysis is based on a subsample of 265 participants who provided full data across all experimental conditions. Mauchly's test of sphericity was significant at $p < .001$ for all model terms, with each $\varepsilon \leq 0.75$. As such, Greenhouse-Geisser corrections to the model degrees of freedom were used to address this violation of the sphericity assumption. This analysis revealed a significant main effect of Appearance, $F(1.64, 434.96) = 190.31$, $p < .001$, $\eta^2_G = 0.07$. Here, there were significant stepwise differences between all appearance levels, with objects being rated most positively, followed by android robots, life-like non-sexual robots, and finally life-like sexual robots (which were judged most negatively; all Tukey-corrected p-values $< .001$; see Table 2). There was also a significant main effect of Function, $F(1.37, 363.60) = 296.89$, $p < .001$, $\eta^2_G = 0.10$. Here, there were significant differences between all robot functions (all Tukey-corrected p-values $< .001$). The assistance function was viewed most positively, followed by the companionship function. The sexual intimacy function was viewed most negatively.

Importantly, there was a significant interaction between the two independent variables, $F(4.58, 1214.89) = 67.38$, $p < .001$, $\eta^2_G = 0.02$. This interaction was broken down by looking at the effect of Appearance in each of the Function conditions. When the function of the doll was personal assistance, there was a significant increase in negative judgments as the robot became more life-like, with the most negative judgments being made about the sexualized life-like robot. This was also the case when the robot's function was companionship, though one deviation from this was in a lack of difference in judgments between the object and android robot appearances. There were smaller differences between the appearance groups when the function of the robot was sexual intimacy and gratification. Here, slightly less negative judgments were made about the robots that were simple objects compared to all other appearances. However, judgments of android robots and both types of life-like models were statistically indistinguishable (see Table 2).

Table 2. Pairwise comparisons within the ANOVA comparing judgments of robots on the basis of their appearance, by robot function.

Comparison			M_{diff}	SE	df	t	p_{Tukey}	d_z
Companionship Function								
Object	-	Android Robot	-0.10	0.04	265	-2.84	.169	-0.17
Object	-	Life-Like Non-Sexual	-0.67	0.05	265	-12.84	<.001	-0.79
Object	-	Life-Like Sexual	-0.89	0.06	265	-15.44	<.001	-0.95
Android Robot	-	Life-Like Non-Sexual	-0.57	0.05	265	-11.76	<.001	-0.72
Android Robot	-	Life-Like Sexual	-0.79	0.05	265	-14.40	<.001	-0.88
Life-Like Non-Sexual	-	Life-Like Sexual	-0.22	0.03	265	-7.60	<.001	-0.47
Sexual Intimacy Function								
Object	-	Android Robot	-0.23	0.04	265	-5.64	<.001	-0.35
Object	-	Life-Like Non-Sexual	-0.26	0.04	265	-6.26	<.001	-0.38
Object	-	Life-Like Sexual	-0.31	0.04	265	-7.39	<.001	-0.45
Android Robot	-	Life-Like Non-Sexual	-0.03	0.03	265	-0.80	1.000	-0.05
Android Robot	-	Life-Like Sexual	-0.08	0.04	265	-2.19	.562	-0.13
Life-Like Non-Sexual	-	Life-Like Sexual	-0.05	0.02	265	-2.11	.614	-0.13
Assistance Function								
Object	-	Android Robot	-0.26	0.04	265	-5.96	<.001	-0.37
Object	-	Life-Like Non-Sexual	-0.80	0.07	265	-11.86	<.001	-0.73
Object	-	Life-Like Sexual	-1.29	0.09	265	-15.06	<.001	-0.92
Android Robot	-	Life-Like Non-Sexual	-0.54	0.06	265	-9.34	<.001	-0.57
Android Robot	-	Life-Like Sexual	-1.03	0.07	265	-13.93	<.001	-0.85
Life-Like Non-Sexual	-	Life-Like Sexual	-0.49	0.06	265	-8.65	<.001	-0.53

Interest in Robot Ownership

As in the previous analysis, we ran correlational analyses to examine the relationships between participants' interest in owning each type of robot. Again, relationships were positive and statistically significant across the board (all $p < .001$), and especially strong within each Appearance condition. Correlation coefficients and descriptive statistics for each condition are presented in Table 3.

Table 3. Zero-order correlations between ownership interest scores for each condition, with descriptive statistics.

| | **Object** | | | **Robot** | | | **Life-like non-sexual** | | | **Life-like sexual** | | |
	1. C	**2. IP**	**3. A**	**4. C**	**5. IP**	**6. A**	**7. C**	**8. IP**	**9. A**	**10. C**	**11. IP**	**12. A**
1	—											
2	.55***	—										
3	.45***	.15*	—									
4	.78***	.62***	.34***	—								
5	.54***	.80***	.15*	.66***	—							
6	.47***	.35***	.42***	.52***	.36***	—						
7	.60***	.66***	.15*	.68***	.69***	.39***	—					
8	.45***	.73***	.03	.59***	.75***	.36***	.75***	—				
9	.54***	.46***	.28***	.53***	.45***	.59***	.62***	.49***	—			
10	.57***	.72***	.09	.66***	.75***	.33***	.84***	.82***	.56***	—		
11	.42***	.73***	.03	.55***	.73***	.34***	.71***	.92***	.52***	.84***	—	
12	.45***	.57***	.07	.52***	.61***	.44***	.69***	.69***	.64***	.72***	.69***	—
M	3.20	2.06	4.49	2.94	1.90	4.00	2.18	2.01	3.05	2.04	2.01	2.40
(SD)	(1.24)	(1.03)	(1.20)	(1.20)	(1.02)	(1.34)	(1.08)	(1.11)	(1.47)	(1.09)	(1.15)	(1.34)
α	0.95	0.95	0.95	0.96	0.96	0.96	0.96	0.96	0.96	0.97	0.97	0.95

Note. Codes heading each column refer to the intended function of social robots, where 'C' = Companionship, 'IP' = Intimate partner, and 'A' = Assistance.

* $p < .05$ ** $p < .01$ *** $p < .001$

We then ran our 4 (Appearance) × 3 (Function) ANOVA. As with the previous analysis, Mauchly's test of sphericity was significant at $p < .001$ for all model terms, with each $\varepsilon \leq 0.75$. Greenhouse Geisser corrections were thus made to the model degrees of freedom. The analysis revealed a significant main effect of Appearance, $F(2.06, 544.58) = 237.89$, $p < .001$, $\eta^2_G = 0.12$. Here, interest in ownership reduced as robots became more life-like (all ps $< .001$), with the least interest being present in relation to sexualized life-like dolls. There was also a significant main effect of Function, $F(1.71, 453.12) = 510.98$, $p < .001$, $\eta^2_G = 0.21$. Here, there was significantly more interest in having a robot for an assistance function than for companionship. In turn, there was a significantly lower level of interest in owning a doll for sexual intimacy (all ps $< .001$).

There was also a significant interaction between the two independent variables, $F(4.50, 1192.55) = 135.38$, $p < .001$, $\eta^2_G = 0.07$. We unpacked this interaction by again looking at the effect of Appearance within each level of Function. When the function was personal assistance, there were significant differences in interest that followed the main effect of Appearance (all ps $< .001$). This trend was also present for the companionship function, albeit with a substantially reduced effect size for the difference in interest in owning either life-like robot type. For the sexual intimacy function, there was a significantly greater level of interest in owning a robot that simply looked like a household object than an android robot (though this level of interest was still very low). No other significant differences were present for this function. Full details of all pairwise comparisons in the interaction are presented in Table 4.

Table 4. Pairwise comparisons within the ANOVA comparing judgments of robots on the basis of their appearance, by robot function.

Comparison			M_{diff}	SE	df	t	p_{Tukey}	d_z
Companionship Function								
Object	-	Android Robot	0.26	0.05	265	5.19	< .001	0.32
Object	-	Life-Like Non-Sexual	1.00	0.06	265	15.50	< .001	0.95
Object	-	Life-Like Sexual	1.15	0.07	265	17.09	< .001	1.05
Android Robot	-	Life-Like Non-Sexual	0.75	0.06	265	13.16	< .001	0.81
Android Robot	-	Life-Like Sexual	0.89	0.06	265	15.37	< .001	0.94
Life-Like Non-Sexual	-	Life-Like Sexual	0.15	0.04	265	3.86	.008	0.24
Sexual Intimacy Function								
Object	-	Android Robot	0.17	0.04	265	4.28	.002	0.26
Object	-	Life-Like Non-Sexual	0.06	0.05	265	1.31	.977	0.08
Object	-	Life-Like Sexual	0.06	0.05	265	1.12	.993	0.07
Android Robot	-	Life-Like Non-Sexual	-0.10	0.05	265	-2.25	.515	-0.14
Android Robot	-	Life-Like Sexual	-0.11	0.05	265	-2.25	.519	-0.14
Life-Like Non-Sexual	-	Life-Like Sexual	-0.01	0.03	265	-0.25	1.000	-0.02
Assistance Function								
Object	-	Android Robot	0.51	0.08	265	6.03	< .001	0.37
Object	-	Life-Like Non-Sexual	1.44	0.10	265	14.44	< .001	0.89
Object	-	Life-Like Sexual	2.11	0.11	265	19.80	< .001	1.21
Android Robot	-	Life-Like Non-Sexual	0.93	0.08	265	11.88	< .001	0.73
Android Robot	-	Life-Like Sexual	1.60	0.09	265	18.46	< .001	1.13
Life-Like Non-Sexual	-	Life-Like Sexual	0.67	0.07	265	9.17	< .001	0.56

Study 2

Having established the interaction between robot appearance and function in Study 1, an additional factor that may influence responses to dolls and robots is their ostensible age. That is, there has been much discussion about the potential harms of child-like sex dolls (Brown & Shelling, 2019; Chatterjee, 2020; Danaher, 2017a, 2019b; Maras & Shapiro, 2017;

Strikwerda, 2017), but no exploration of attitudes toward such materials in relation to different potential functions. This is important, as there is some debate within the forensic psychological literature regarding the extent to which child-like sex dolls and robots might increase risk, or be a useful tool in the pursuit of abuse prevention among those identifying an attraction to children (Brown & Shelling, 2019; Harper & Lievesley, 2020, 2022; Lievesley, Harper, et al., 2023). As such, in Study 2 we conducted an online survey experiment to investigate how the apparent 'age' of a sex doll and its stated function impact social views. We hypothesized that the use of child-like sex dolls for any purpose would be more heavily stigmatized than the ownership of adult-like dolls. However, we predicted that this effect would be exaggerated when there was a sexual function ascribed to the doll.

Methods

Design

We designed an experiment to manipulate the age and function of sex dolls within a within-subjects design. The age of sex dolls was manipulated across two levels (adult and child). The function of sex dolls was manipulated across four levels (companionship, intimate partnership, masturbatory aid, and risk reduction). The dependent variables were judgments of the acceptability of each doll type, and emotional responses to the owners depicted in each experimental scenario.

Participants

An a priori sample calculation suggested that a minimum of 138 participants would be required to detect a small effect within each of our planned analyses (Cohen's $f = 0.10$, power $= 95\%$, alpha $= .05$; based on an analysis of one participant group with eight repeated measurements). Due to a lack of funding for this study, we recruited participants using opportunity, convenience, and snowball sampling methods. Mindful to recruit as diverse a

sample as possible, we posted study advertisements in various places. These included social media community pages (e.g., location-based community pages in diverse areas of the U.K.) and topic-related forums on popular microblogging sites (e.g., r/sex, r/love, r/relationships on *Reddit*). This was further supplemented by posting on survey participation pages online (e.g., r/SampleSize). This recruitment approach yielded 359 clicks on our survey link. All of these participants indicated their consent to take part, but 117 did not provide any data after this and were removed from the data file. This left a base sample of 242 participants. We then retained all participants who provided full data on our outcomes, which left a final sample of 222 participants (71% female; $M_{age} = 23.13$ years, $SD = 7.51$). Of these, 154 were from the UK, 40 were from the US or Canada, 10 were from Australia or New Zealand, 13 were from an EU country, and the remaining participants were from elsewhere. Just over half of the sample (51%) were in a relationship, and the majority of the sample (69%) were heterosexual (18% were bisexual, 9% were homosexual, and 5% said they have a different sexual orientation). Politically, 63% were left-leaning, 23% described themselves as centrists, and 14% were right-leaning.

Materials

Demographics. The same demographic variables as in Study 1 (sex, age, country of residence, relationship status, sexual orientation, and political ideology) were collected in Study 2.

Sex doll presentation. We wrote a series of short vignette scenarios depicting each of our eight experimental conditions (four functions, by two doll age categories). Each scenario was approximately 115 words long (range = 99-133 words). Example scenarios (representing the masturbatory aid function) are presented below (all vignette scenarios are available via the Open Science Framework project page at https://osf.io/gwxmp:

Adam is a 32 year old man. He has a history of failed relationships that have left him dissatisfied and unhappy. This is particularly the case in relation to his sex life, where his fantasies about engaging in dominance over a partner has left him feeling dissatisfied, given their reluctance to consent to this. This dissatisfaction led to the eventual breakdown of relationships. Around one year ago, Adam found a website online for life size dolls, and decided to purchase one of these. He now uses this doll to act out his sexual fantasies several times per week, leaving him sexually satisfied.

Nathan is a 34 year old man. When he was growing up he began to notice that his sexual interests were different to his friends. As his friends grew older they were attracted to girls their own age, whereas as a 15 year old, Nathan was attracted to girls several years younger than him. In the years that followed, this sexual interest remained stable until he realised that he was predominantly attracted to girls that are around the age of 10. While trying to find online support for this, Nathan stumbled across a website selling child size dolls. He bought one of these and now uses it as a sexual outlet several times per week.

Outcome measures. Following each experimental manipulation screen, participants responded to 17 items. The first seven of these related to their perceptions of the acceptability of the doll ownership in each scenario. The next ten questions asked about the extent to which they experienced different emotional responses to the person depicted in the vignette. Five of these latter questions related to personality ascriptions made about the individual, with the other five relating to emotions evoked by each type of ownership within the participant. Each item was responded to using a seven-point scale anchored from 1 (strongly disagree) to 7 (strongly agree). The full wording of the outcomes is available at https://osf.io/gwxmp.

Procedure

The procedure for Study 2 followed the same structure as in Study 1. That is, participants clicked on study advertisements and were directed to a summary of the research and the tasks involved. After providing informed consent, participants created a unique identifier and completed the demographics questions. All experimental vignettes were then presented in a random order, before participants were comprehensively debriefed and

provided with relevant links for sources of support. This procedure received a favorable

opinion from the Nottingham Trent University School of Social Sciences Research Ethics

Committee.

Results

As in Study 1, we conducted separate investigations for each of our outcomes,

specifically (1) the acceptability of sex doll ownership, and (2) emotional responses to sex

doll owners. In doing so, we used repeated-measures factorial analyses of variance

(ANOVAs), with 'Age' (two levels: adult, child) and 'Function' (four levels: companionship,

intimate partnership, masturbatory aid, and risk reduction) as independent variables.

Descriptive statistics are presented in Table 5.

Table 5. Descriptive statistics and internal consistency related to acceptability and negative emotion outcomes, by doll age and function.

	Acceptability		**Negative emotion**	
	M (*SD*)	α	*M* (*SD*)	α
Adult-like dolls				
Companionship function	5.26 (1.01)	0.82	3.20 (0.93)	0.83
Intimate partner function	5.11 (1.13)	0.84	3.37 (1.06)	0.86
Masturbatory aid function	4.81 (1.22)	0.85	3.58 (1.14)	0.89
Risk prevention function	4.53 (1.20)	0.82	4.10 (1.16)	0.90
Child-like dolls				
Companionship function	4.75 (1.23)	0.85	3.56 (1.02)	0.85
Intimate partner function	3.13 (1.54)	0.91	5.21 (1.24)	0.91
Masturbatory aid function	3.21 (1.53)	0.90	5.09 (1.25)	0.92
Risk prevention function	3.49 (1.55)	0.91	4.96 (1.27)	0.92

Note. Scores range from 1-7, with high scores indicating higher levels of acceptability and more negative emotion, respectively.

Judgments of Doll Ownership Acceptability

Within our 2 (Age) × 3 (Function) ANOVA, Mauchly's test of sphericity was

significant at $p < .001$ for all model terms. Greenhouse-Geisser corrections to the model

degrees of freedom were used when considering the main effect of Function, as $\varepsilon \leq 0.75$.

However, $\varepsilon > 0.75$ for the main effect of Age and the interaction, meaning that degrees of

freedom were corrected using the Huyn-Feldt method for these model terms. There was a significant main effect of Age, $F(1, 221) = 370.07$, $p < .001$, $\eta^2_G = 0.19$. Here, adult-like dolls were deemed more acceptable than child-like dolls. There was also a significant main effect of Function, $F(2.00, 442.71) = 172.96$, $p < .001$, $\eta^2_G = 0.09$. Here, the companionship function was seen as significantly more acceptable than all other functions (all Tukey-corrected p-values $< .001$). The intimate partnership function was seen as more acceptable than both the masturbatory aid ($p = .009$) and risk prevention function ($p < .001$). There was no difference in the perceived acceptability of the masturbatory aid and risk prevention functions ($p = .999$).

Importantly, there was a significant interaction between the two independent variables, $F(2.61, 545.82) = 113.27$, $p < .001$, $\eta^2_G = 0.04$. This interaction was broken down by looking at the effect of Function in each of the Age conditions. When considering adult-like dolls, there were significant stepwise differences between all functions. The companionship function was deemed to be the most acceptable, followed by the intimate partner, masturbatory aid, and risk prevention functions, respectively. In contrast, there were significant differences between all function types, with the exception of masturbatory and intimate partner functions (which were statistically equivalent in post-hoc testing, and the least accepted functions). Another deviation from the trends in adult-like doll acceptability was in the size of the difference in acceptability of the companionship function and each of the sexual functions. When judging adult-like dolls, the magnitude of the differences between each function was relatively consistent. However, there were large differences in the acceptability of companionship and each of the sexual functions, and much smaller differences in the acceptability of each of the sexual functions. A presentation of the pairwise comparisons in acceptability scores is presented in Table 6.

Table 6. Pairwise comparisons for the interactions of Age and Function on perceived acceptability of doll ownership.

Comparison			M_{diff}	SE	df	t	p_{Tukey}	d_z
Adult-like dolls								
Companionship	-	Masturbation	0.45	0.06	221	7.65	<.001	0.51
Companionship	-	Intimate Partner	0.16	0.05	221	3.44	.016	0.23
Companionship	-	Risk Prevention	0.73	0.06	221	12.24	<.001	0.82
Masturbation	-	Intimate Partner	-0.29	0.05	221	-5.87	<.001	-0.39
Masturbation	-	Risk Prevention	0.28	0.05	221	5.19	<.001	0.35
Intimate Partner	-	Risk Prevention	0.58	0.06	221	9.97	<.001	0.67
Child-like dolls								
Companion	-	Masturbation	1.53	0.1	221	15.83	<.001	1.06
Companion	-	Intimate Partner	1.62	0.1	221	16.60	<.001	1.11
Companion	-	Risk Prevention	1.26	0.1	221	13.09	<.001	0.88
Masturbation	-	Intimate Partner	0.09	0.04	221	2.05	.448	0.14
Masturbation	-	Risk Prevention	-0.27	0.06	221	-4.86	<.001	-0.33
Intimate Partner	-	Risk Prevention	-0.36	0.05	221	-6.70	<.001	-0.45

Negative Emotionality about Doll Ownership

A two-way 2 (Age) × 4 (Function) ANOVA was also run on the data related to negative emotionality. As with the previous analysis, Mauchly's test of sphericity was significant at p < .001 for all model terms, with ε > 0.75 for the Age and interaction terms. For these results, the Huyn-Feldt correction was made to model degrees of freedom, and the Greenhouse Geisser correction was used for the term pertaining to the effect of Function. We found a significant main effect of Age, $F(1, 221) = 462.21$, $p < .001$, $\eta^2_G = 0.20$. Here, child-like dolls evoked more negative emotion than adult-like dolls. There was also a significant main effect of Function, $F(2.10, 463.45) = 210.16$, $p < .001$, $\eta^2_G = 0.13$. Here, there was significantly less negativity about owning a doll for companionship function than all other functions (all ps < .001). The prevention function elicited more negativity than both the intimate partner and masturbatory aid function (both ps < .001). However, there was no difference in negativity elicited by these latter two functions ($p = .597$).

There was also a significant interaction between the two independent variables, $F(42.85, 630.08) = 155.05$, $p < .001$, $\eta^2_G = 0.06$. When dolls were adult-like, the negative emotionality data mirrored those reported for acceptability. That is, significant differences existed between all levels of the Function variable, with companionship eliciting the least negativity, followed by the intimate partner and masturbatory aid functions, and the risk prevention function being associated with the most negativity (all ps < .001). However, this trend differed when considering child-like dolls. Here, the companionship function elicited significantly less negativity than all sexual functions (all ps < .001). However, the risk prevention function elicited significantly less negativity than the intimate partner function (p < .001). In contrast, the masturbatory aid function did not differ in terms of elicited negativity from either the intimate partner ($p = .078$) or the risk prevention function ($p = .055$). Pairwise comparisons for the interaction are presented in Table 7.

Table 7. Pairwise comparisons for the interactions of Age and Function on elicited negativity.

Comparison			M_{diff}	SE	df	t	p_{Tukey}	d_z
Adult-like dolls								
Companionship	-	Masturbation	-0.38	0.06	221	-6.67	< .001	-0.45
Companionship	-	Intimate Partner	-0.17	0.05	221	-3.64	.008	-0.24
Companionship	-	Risk Prevention	-0.90	0.07	221	-13.31	< .001	-0.89
Masturbation	-	Intimate Partner	0.20	0.05	221	3.84	.004	0.26
Masturbation	-	Risk Prevention	-0.52	0.06	221	-8.86	< .001	-0.60
Intimate Partner	-	Risk Prevention	-0.73	0.07	221	-11.15	< .001	-0.75
Child-like dolls								
Companion	-	Masturbation	-1.53	0.08	221	-18.51	< .001	-1.24
Companion	-	Intimate Partner	-1.65	0.08	221	-19.72	< .001	-1.32
Companion	-	Risk Prevention	-1.40	0.08	221	-16.62	< .001	-1.12
Masturbation	-	Intimate Partner	-0.12	0.04	221	-2.90	.078	-0.20
Masturbation	-	Risk Prevention	0.13	0.04	221	3.03	.055	0.20
Intimate Partner	-	Risk Prevention	0.25	0.04	221	5.69	< .001	0.38

General Discussion

In this research we have described two studies that demonstrate how the appearance and function of a sex doll or robot (Study 1) and the ostensible age and function of a sex doll (Study 2) can alter social views about them. Consistent with our hypotheses, we found that increasingly life-like dolls and robots, those with more sexualized functions, and those that resemble children are viewed more harshly, elicit more negativity, and spark less interest in ownership than dolls and robots that are not realistic (in human appearance) or how more of a companionship or personal assistance function.

The data related to appearance mirror the uncanny valley effect first described by Masahiro Mori, and lends support to the view that sex dolls and robots that possess increasingly life-like features will be met with more resistance (Döring et al., 2020; Maras & Shapiro, 2017; Mori, 1970). This is of particular importance as technological advances are leading to ever more realistic dolls and robots that have the potential for independent thought and communicative ability through the implantation of artificial intelligence (AI) technology (Carvalho Nascimento et al., 2018; Döring et al., 2020; Hanson & Locatelli, 2022). According to our data, pre-existing stigma directed toward sex doll owners (Harper & Lievesley, 2020) is likely to be exacerbated by such technological developments, despite such developments improving the likelihood of physical and emotional pleasure being obtained by owners seeking a closer connection with their dolls. This is important when acknowledging that most sex doll and robot owners cite both physical (i.e., sexual gratification) and emotional (e.g., companionship) motivations for purchasing (Hanson, 2022; Harper et al., 2023; Harper & Lievesley, 2020; Langcaster-James & Bentley, 2018; Lievesley, Reynolds, et al., 2023; Su et al., 2019). That is, the very technology that is likely to heighten owners' experiences of their dolls and robots is likely to bring about more stigma, and thus force

owners away from connections with real people and further towards the safety of their dolls and robots.

We found that dolls and robots that had a more sexual function (e.g., as an intimate sexual partner) were more stigmatized in both of our studies. The reasons for this effect are numerous, and may differ as a function of the ostensible age of a sex doll or robot. That is, societal and academic concern over the effects of doll ownership on the objectification of women (Danaher, 2017b; Danaher et al., 2017; Desbuleux & Fuss, 2023a; Eskens, 2017; Puig, 2017) may relate to views about adult-like models. Indeed, this also may interact with life-likeness, and be linked to some evidence about the psychological characteristics of sex doll owners. For example, Desbuleux and Fuss (2023a) recently found that the extent to which sex doll owners anthropomorphize their dolls (i.e., attribute human states to them) is associated with greater hostility toward women and sexual objectification. With regard to the judgments of child-like sex dolls in Study 2, there may be concerns about the sexualization of children in a broad sense as one interpretation of these data (Brown & Shelling, 2019; Maras & Shapiro, 2017; Strikwerda, 2017). However, more negative views about ownership of child-like sex dolls may also be linked to perceptions of the tangible harms that could follow from this, including potential escalations into offending behaviours involving real children (Chatterjee, 2020; Danaher, 2019b). Our experimental data can tell us that people do tend to view certain types of sex dolls and robots differently, but further survey-based or qualitative work is required to fully elaborate on why this may be the case.

The data from Study 1 highlight how there is minimal interest in owning robots for sexual purposes, but high levels of interest for assistance functions. However, this interacted with robot appearance, with high levels of interest in the object appearance condition, and lower levels of interest when robots began to take a more humanoid form. This finding may reflect multiple things. First, there has been a large shift in the normalization of assistance

devices in homes. Between 2019-2024, the use of voice-activated assistants has almost tripled, from around 3.25 billion devices used worldwide in 2019 to 8.40 billion devices in 2024 (*Number of Voice Assistants in Use Worldwide 2019-2024*, n.d.). At the time of their introduction to the commercial technology market, there was a lot of skepticism about the privacy and utility of such devices, but this has waned over time as their use has become more ubiquitous. This novelty explanation may also apply to the levels of interest in more humanoid assistance robots, which may indicate that increased global uptake of such machines could lead to increased interest across a broader base of potential consumers. Perhaps more pragmatically, though, the lower level of interest in more humanoid models may have links to their size and subsequent ease of use. That is, because of the space needed to incorporate such humanoid and life-like robots into one's everyday life, it is likely that a deeper desire (possibly linked to more intimate functions) would be needed to motivate an initial purchase of these kinds of dolls and robots.

As expected, child-like dolls were significantly more stigmatized than adult-like dolls in Study 2, which perhaps reflects broader societal views about the acceptability of sexual attractions to children (Harper et al., 2018, 2022; Jahnke, 2018) and the nature of discussions about child-like sex dolls in social and legislative domains (Brown & Shelling, 2019; Danaher, 2019b; Maras & Shapiro, 2017; Strikwerda, 2017). Of particular interest, though, was the interaction between doll age and function. That is, the decreased level of acceptability was predominantly focused on owners whose dolls served a sexual function. This finding has significant implications for social discussions about the availability of child-like dolls, as it appears that it is less the availability of such models that is important in guiding attitudes, and more their intended use. As such, calls to criminalize the possession of child-sized dolls may be rooted in assumptions about their intended (sexual) use (Danaher, 2017a, 2017b), rather than the nature or appearance of the dolls themselves as objects. Future

research might thus explore how such dolls are used by different groups to determine the extent to which blanket ban policies actually match owner motivations, and how to design social information campaigns accordingly.

The data presented here are not without limitation. Despite being well-powered to detect small-to-moderate effects, the samples are self-selecting and based predominantly on convenience recruitment methods, which limits representativeness and, as a result, generalizability. Future work should seek funding to recruit large representative samples to test the replicability of the findings here. The self-report nature of the methods used is also susceptible to self-presentation biases, though the average scores did seem to congregate around the mid-point of the scales, and we found differences in judgments in the expected directions. Future work might look to include alternative measures of attitudes, including responses to documentary-style videos and situational experiments where confederate researchers play the role of sex doll and robot owners in group settings.

Within our study materials for Study 1 we used a variety of images of sex robots that spanned both male and female appearances. This introduces confounds of sex and sexuality, and it is possible that the ostensible sex of a doll or robot moderates views about them. Similarly, this may also interact with participant sex and/or sexuality. These interactions should be investigated in future studies. This issue was not present in Study 2 as we did not present images alongside our vignettes. However, demographic factors such as parental status may also moderate views of child sex dolls and robots.

Our research highlights the impact that the appearance, function, and ostensible age of sex dolls and robots have on societal attitudes. As technology advances and sex dolls and robots continue to become more life-like, the potential for a further increase in stigma poses challenges for both owners and manufacturers. Our findings reveal a complex interplay between the sexualization of dolls and societal moral and ethical concerns, particularly with

regards to child-like models. These dynamics emphasize the need for further research to understand the psychological and social implications of sex doll ownership, as well as the importance of developing informed policies and educational campaigns that reflect the complexities of this emerging field.

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