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Parental Responses to Aggressive Child Behavior towards Robots, Smart Speakers, and Tablets

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Abstract— **The increasing growth of robots and other technological devices in homes makes it critical to understand child-device interactions within the home, especially given the real possibility of child aggression towards these devices. To explore factors that currently and will, in the future, shape child-robot interaction in the home related to children's aggressive behavior, we conducted a 2 x 3 x 3 between-subjects crowdsourced study ($N = 332$) that examined how parents would respond and perceive their child interacting with different technological devices. Participants were shown a video clip of a person interacting with a technological device (robot, smart speaker, or tablet), exhibiting either aggressive or neutral behavior, and interacting with the device in one of three interaction modalities (audio, physical, or audio+physical). Imagining that the person in the video was their child, parents who observed aggressive behavior compared with neutral behavior indicated greater concern, a higher likelihood to intervene, distinct intervention methods, a higher perception of device mistreatment, and greater sympathy for the device. Despite hypothesizing that the robot would be seen as the most anthropomorphic, animate and, warm device, participant ratings of the robot were no different than the smart speaker, however, both devices were rated more highly on those dimensions than the tablet.**

I. Introduction

The advancement and abundance of technological devices (e.g., smartphones, tablets, smart speakers, robots) has dramatically changed how children learn, play, and engage with family members. The use of these devices in the home can greatly benefit children by, for example, providing them with access to tutoring and enhanced learning [1]–[3] and tools that can enhance social skill use in children with Autism [4], [5]. The benefits of technological devices in the home should be considered, however, in light of their potential to change a family's social dynamics [6]–[8]. The adoption of an Amazon Alexa smart speaker may, for example, have negative impacts on family dynamics by replacing some important parent-child interactions (e.g., singing lullabies, telling stories) with device-child interactions [6]. However, it is also possible for a device to have a positive influence on family interactions, for instance, families that started using a Roomba vacuum robot incorporated more family members into the cleaning process than were involved before, especially men and children [7], [8].

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When considering the incorporation of robots into homes, it is also important to examine the possibility of children behaving aggressively towards robots. The work of Brscic et al. [9] underscores the real possibility of children abusing a robot, who observed children in a shopping mall abusing a patrolling robot by obstructing its movements, calling it names (e.g., "*you idiot*"), and exhibiting physical violence (e.g., hitting the robot). Further highlighting the possibility of children expressing aggressive behavior towards devices in the home, there is growing anecdotal evidence of children expressing verbal aggression towards smart speakers [10], [11]. In response, some companies have developed politeness features for voice assistants' interactions with children (e.g., Amazon's Magic Word [12], Google's Pretty Please [13]). Although robots have similarities with more well-studied home devices (e.g., smart speakers), it is possible that a robot's distinct attributes (e.g., a human-like physical embodiment) may make child aggression towards a robot and parents' concern unique from other types of devices.

In this work, we seek to understand how parents view child aggressive behavior towards robots in the home compared with other technological devices. With the current limitations of the COVID-19 pandemic, we asked parents, recruited on a crowdsourcing platform, how they would respond to their child expressing aggressive behavior towards different devices. This study had a 2 (presence of aggression: aggressive, neutral) $\times$ 3 (device type: robot, smart speaker, tablet) $\times$ 3 (interaction modality: audio, physical, audio+physical) between-subjects design. We asked participants to watch a video clip of an adult actress interacting with a technological device, according to the experimental condition, and imagine that their child exhibited the same behavior. We assess the influence of the presence of aggression, device type, and interaction modality on parents' questionnaire responses that reveal their concern, responses to their child's behavior, and perceptions of the device.

II. Background and Related Work

Currently, researchers determine the level of closeness of technological devices to humans on the dimensions: anthropomorphism [14], [15], human-like dialogue [16], [17], reciprocity/responsiveness [18], among others. Fink [19] describes anthropomorphism as the "tendency for people to attribute human characteristics to non-lifelike artifacts." Researchers usually based the anthropomorphism of robots on their embodiment [20], [21] and conversational agents on their ability to hold a human-like conversation [18]. Humanness varies across devices, and humanoid robots are usually

Robot　　Smart Speaker　　Tablet

a)

b)

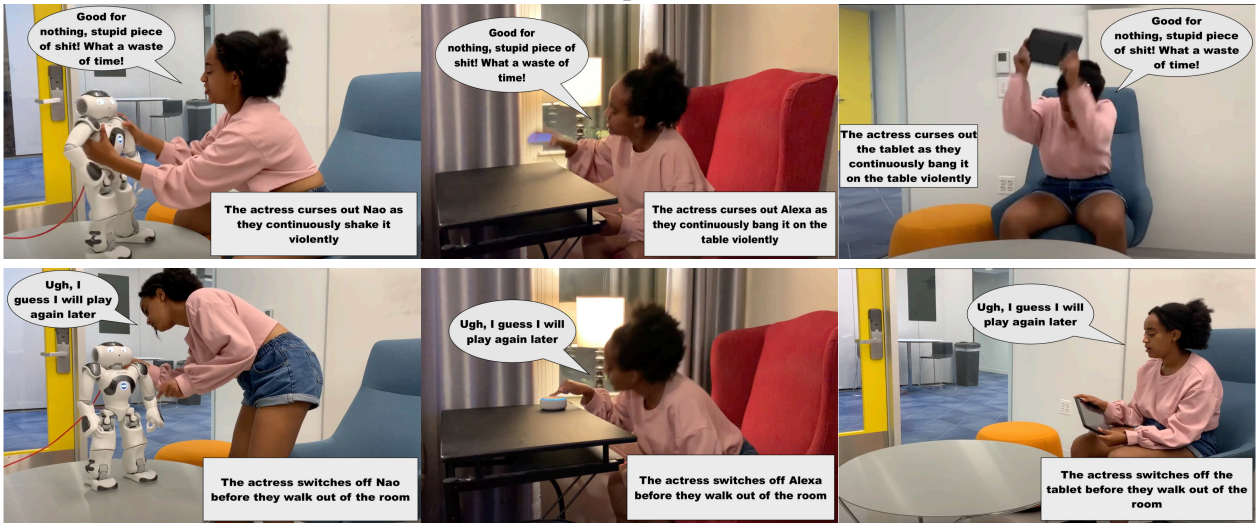

TABLE I: This work examines differences in parental reactions between aggressive (a) and neutral (b) child behavior toward three device types (robot, smart speaker, tablet). These examples showcase the audio+physical interaction modality.

the highest. Carlson et al. [22] showed that participants believed Nao had more capabilities for emotions than a laptop, and after assessing forum posts on devices on dimensions: life-likeness, emotional states, gender/personality, name, socially integrated, and metaphorical-ways, Fink et al. [23] found that people anthropomorphize robotic pet (AIBO) significantly more than a functional robot (Roomba) or a tablet computer (iPad). In addition, Kasuga and Ikeda [24]'s analysis on the dimensions of anthropomorphism, animacy, likability, and perceived intelligence revealed lower ratings for the dog-like smart speaker than humanoid robots Nao and Pepper. How anthropomorphic a device is viewed also influences how people interact with it. As device anthropomorphism increases people treat them with higher agency and display higher levels of sympathy [22] and frustration [25]. However, to the best of our knowledge, no work has investigated how the human-like nature of devices affects parents' level of concern and likelihood to intervene with a repairing action when their child acts aggressively towards the robots, smart speakers, and tablets.

When considering interactions between children and technological devices in the home with varying levels of anthropomorphism (tablets, smart speakers, and robots), it is essential to address the possibility of the children being aggressive toward such devices. In this work, we define aggression as "intentional harm to others" [26], and robot abuse as the "persistent offensive action, verbal, nonverbal or physical violence that violates the role of the robot or its human-like (or animal-like) nature" [9]. Even though people of all ages harass and abuse technological devices, for the case of robots, several HRI studies have observed that unsupervised children seem to be the most inclined to display aggression towards robots, blocking, pushing and kicking them, and speaking rudely to them [9], [27]. Anecdotally, several parents have reported their children being rude, verbally abusive, and demanding towards smart speakers: Siri, Alexa, and Google assistants in a home [10], [11]. Additionally, Parent et al. [28] noted a link between increased screen time and children's aggressive behavior. Despite increasing evidence that children do display aggressive behavior towards a wide array of technological devices, no work to our knowledge has systematically investigated differences in child aggressive behavior and parental reactions towards that behavior between several different device types.

III. Methodology

To examine how parents perceive aggressive interactions of their children with technological devices in the home, we designed an online study in which parents watched an actress interacting with these devices, imagining it was their child. We chose an online format for this study due to the limitations of the COVID-19 pandemic. The study has a 2 (presence of aggression: aggressive or neutral) $\times$ 3 (interaction modality: physical, audio, or audio+physical) $\times$ 3 (device type: robot, smart speaker, or tablet) between-subjects design. This study was approved by the University of Chicago Social & Behavioral Sciences Institutional Review Board (IRB20-1856).

A. Video Scenario

We used Amazon's pre-existing family-friendly "Name That Animal" game as the context for studying parent reactions and perceptions of child-robot behavior. We chose this game because it could be played on all three device types (robot, smart speaker, and tablet) and provided opportunities for aggressive behavior displays after a series of incorrect guesses. We filmed video clips of a 20-year-old female, who we introduced as Rachael, playing the animal guessing game for each experimental condition (see Table I). Each video began with Rachael walking into the room and initiating the animal guessing game by switching on the device and asking the device to play the "Name That Animal" game. The device then begins giving Rachael clues, that each contains more information to aid her in guessing the correct animal. For all of the experimental conditions, Rachael receives the same four clues from the devices and answers incorrectly after each clue. After the devices start to give her the fifth clue, Rachael's behavior then changes depending on the experimental condition.

B. *Experimental Conditions*

The study examines three factors that we hypothesize will shape parent reactions to child-device interactions: the presence of aggressive behavior (aggressive or neutral), the technological device type (robot, smart speaker, or tablet), and the interaction modality (audio, physical, or audio+physical). A human actress called Rachael plays an animal guessing game with a technological device. After four incorrect animal guesses, Rachel responds with aggressive or neutral behavior in one of three interaction modalities: audio, physical, or audio and physical. In the aggressive physical modality, Rachael angrily says "*ughh!*" as she violently shakes (robot) or slams the device (smart speaker or tablet) three times before storming out of the room. In the aggressive audio modality, Rachael loudly curses at the device "*good for nothing, stupid piece of shit, what a waste of time!*" before storming out of the room. The aggressive audio+physical modality combines the aggressive physical and audio modalities. In the neutral condition, Rachael loses interest in playing. She defeatedly says "*ughh!*" as she switches off the device in the physical modality and in the audio modality, defeatedly says "*ugh, I guess I will again later*" as she walks out of the room. The neutral audio+physical modality combines the neutral physical and audio modalities.

We used the Softbank Robotics Nao robot for this study, programming it using the NAOqi Python API. We programmed the robot to make gestures while speaking and used its built-in text-to-speech. We used the Amazon Echo Dot (third generation) as the smart speaker for this study and its preexisting "Name That Animal" game. For the tablet condition, we used a Samsung Galaxy Tab A tablet and developed visual tablet screen displays for the game that included game icons, text instructions and clues, and speech button. The tablet condition utilized an online text-to-speech generator [29] with a female voice.

C. *Hypotheses*

We predict that parents would express concern (**H1a**) and be more likely to intervene (**H2a**) when imagining their child exhibiting aggressive behavior compared with neutral behavior. Supporting this prediction, anecdotal evidence demonstrates parental concern about children acting rudely towards smart speakers (e.g., Google, Alexa, Siri) [10], [11] and prior work has shown that families employ a variety of speech and language modifications in their attempts to repair communication breakdowns with devices [6], [30]. Additionally, since prior work has demonstrated that people perceive a higher level of mistreatment for a robot than a computer [22], we anticipate that parental concern (**H1b**) and intervention (**H2b**) will be highest for a robot, then a smart speaker, and lowest for a tablet.

Since Carlson et al. [22] showed that people perceive higher levels of mistreatment of and had greater sympathy for a robot compared with a computer, we predict that participants will be more likely to perceive their child's behavior as mistreatment (**H3a**) and exhibit more sympathy (**H4a**) when the child exhibits aggressive behavior, versus neutral behavior, towards the devices. Additionally, we hypothesize that participants will perceive mistreatment (**H3b**) and exhibit more sympathy (**H4b**) for the devices in the following order: robot (highest) $>$ smart speaker (middle) $>$ tablet (least).

Lastly, Carlson et al. [22] has demonstrated that people view robots with more sympathy and as more emotionally capable than a computer and Luger and Sellen [17] has shown higher ratings of anthropomorphism and animacy for a Nao robot compared with a Google Home. Therefore, we predict (**H5**) that participants will rate the devices on the dimensions of anthropomorphism, animacy, warmth, competence, and discomfort in the following order: robot (highest) $>$ smart speaker (middle) $>$ tablet (lowest).

D. *Protocol*

Participants were recruited on Prolific and directed to take a Qualtrics survey where they provided consent, viewed the video, and completed questionnaire items with interspersed attention checks. Participants first provided consent and their demographic information. Then they watched the video clip on their experimental condition, completed an attention check and answered questions specific to the video. Each participant received $1.85 for completion of the survey, which took approximately 17 minutes.

E. *Measures*

1) Demographics: We gathered participants' age, gender, ethnicity, marital status, education, how many children they take care of, the ages and genders of their children, and whether or not they live with parents or older adults.

2) Parental Concern: We assessed parental concern by asking participants to indicate their agreement with "I would be concerned if my child acted the way Rachael did" on a Likert scale from 1 (*Strongly Disagree*) to 5 (*Strongly Agree*). If they indicated agreement (4 - *Somewhat Agree* or 5 - *Strongly Disagree*) we then asked the open-ended question, "What specifically concerned you and why?" Otherwise, we asked the open-ended question "Why?"

3) Parental Responses and Interventions: We measured parental responses by asking participants the open-ended question "If your child were to act in that same way, how would you react? Why?" We also asked them to indicate their agreement a Likert scale from 1 (*Strongly Disagree*) to 5 (*Strongly Agree*) for the following questions: "If my child acted in that same way, I would take away [the device]"

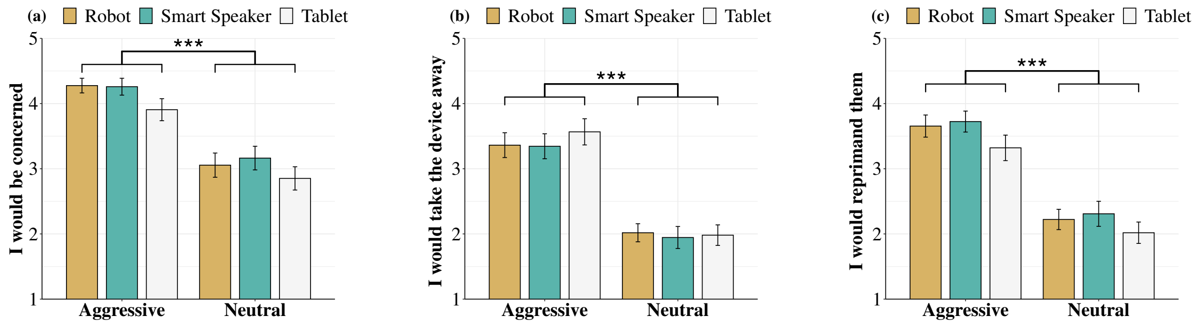

Fig. 1: Imagining that their child expressed the same behavior as what they saw in the video, participants displayed (a) higher levels of concern, (b) a greater likelihood of taking the device away, and (c) a greater likelihood of reprimanding their child when aggressive behavior was expressed, compared with neutral behavior (*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$).

and "If my child acted in that same way, I would reprimand them."

4) Perceptions of Mistreatment and Sympathy: To evaluate parent's perception device mistreatment and sympathy toward the device, we used the same measures as [22]. Parents answered yes/no to "Do you feel [the device] was mistreated?" Then on a Likert scale from 1 (*Strongly Disagree*) to 7 (*Strongly Agree*), parents rated "If mistreatment is defined as verbal or physical behavior that meant to damage, insult, or belittle another, do you feel [the device] was mistreated?" Finally, parents rated "*How sympathetic did you feel towards [the device]?*" on a 7-point Likert scale: 1 (*No Sympathy*), 3 (*Some Sympathy*), 7 (*Very Sympathetic*).

5) Perceptions of the Devices: To capture participant impressions of the device they witnessed in the video, we administered the RoSAS questionnaire [31] to assess the devices' perceived warmth, competence, and discomfort using a 7-point Likert scale. We also assessed participant's views of the device using the anthropomorphism and animacy components of the Godspeed questionnaire [32] with a 5-point Likert scale.

F. Participants

To determine our sample size, we conducted an a-priori power analysis using G*Power and the reported effect size of $\eta_p^2 = 0.06$ (computed from [22]'s results of the interaction between agent and presence of aggressive behavior on the perception of mistreatment using the operational definition) and a power of 0.95, resulting a target sample size of 296 participants (16.4 participants / condition). Anticipating lower data quality using a crowdsourcing platform, we decided to recruit approximately 20 participants for each of our 18 conditions, totaling 360 participants.

We recruited a total of 370 participants on Prolific who satisfied the following criteria: live in the U.S., speak fluent English, have a stable internet connection to watch the video, children, and a minimum approval rating of 95% on the platform. We discarded the responses of 38 participants who did not have children between ages 3 and 12 years. Among the 332 remaining participants, there were between 17 and 22 participants in each condition, with an average of 18.44 participants per condition ($SD = 1.54$). Participants ranged in age from 20 to 68 years ($M = 34.34, SD = 6.80$). 159 were female, 170 male, and 3 were non-binary/other genders. 215 participants indicated ownership of the device they viewed.

IV. Results

We examined participant impressions of the actor's interaction with a technological device as influenced by the presence of aggressive behavior by the actress (aggressive or neutral), the type of technological device (robot, smart speaker, or tablet), and the interaction modality (audio, physical, or audio and physical). We analyzed the data using an analysis of variance (ANOVA) examining each of independent variables of interest (presence of aggressive behavior, interaction modality, and type of technological device), their 2-way interactions, and a set of covariates (gender, ethnicity, and whether or not the participant owns the device type they witnessed in the video) as fixed effects. Pairwise comparisons were evaluated using Tukey's honest significant difference tests and the effect size of each ANOVA is reported as partial eta squared (η_p^2).

A. Parental Concern

Parents ratings of concern about their child's behavior, imagining their child to have acted in the same way as the actress in the video, revealed a significant main effect for the presence of aggressive behavior ($F = 74.84, \eta_p^2 = 0.20, p < 0.001$), see Figure 1(a). Participants that observed aggressive behavior expressed a significantly greater level of concern ($M = 4.15, SD = 1.04$) than those who observed neutral behavior ($M = 3.02, SD = 1.34$), **supporting H1a**.

Additionally, we discovered a significant main effect for the interaction modality on parental concern ($F = 3.28, \eta_p^2 = 0.02, p = 0.039$) and a marginally significant main effect for the type of technological device on parental concern ($F = 2.90, \eta_p^2 = 0.01, p = 0.057$). However, pairwise comparisons did not reveal statistically significant differences between either interaction modalities or device types. For example, although participants indicated higher concern in interactions with both the robot ($M = 3.69, SD = 1.28$) and the smart

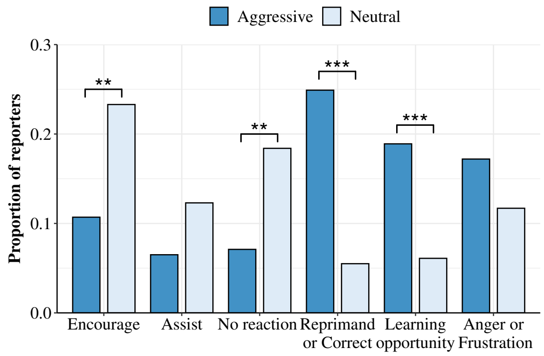

Fig. 2: Participants indicated significant differences in their responses to their child exhibiting aggressive versus neutral behavior towards the devices (**$p < 0.01$, ***$p < 0.001$).

speaker ($M = 3.73, SD = 1.29$) than compared with the tablet ($M = 3.37, SD = 1.37$), pairwise comparisons did not reveal significant differences between the three device types. Therefore, **H1b was not supported**.

For the 214 participants who indicated concern (4 - *somewhat agree* or 5 - *strongly agree* to "I would be concerned if my child acted the way the person in the video clip did"), we examined their responses to the open-ended question, "what specifically concerned you and why?" We coded participant responses into 7 categories of concern, verified by an independent coder on an overlap set of 20/214 responses with an average inter-rater reliability Cohen's kappa value of 0.78 across all categories. We found the following types of concern to be the most commonly mentioned by parents: concern about the lack of patience and perseverance (29.4%), concern about the lack of emotional control (24.3%), concern about the display of aggressive or rude behavior (23.8%), and concern about the use of inappropriate language (13.6%).

B. Parental Reactions and Interventions

Analysis of participants' indication to intervene by taking away the device reveal a significant main effect for the presence of aggressive behavior ($F = 102.40, \eta_p^2 = 0.23, p < 0.001$), see Figure 1(b). Participants indicated a higher likelihood to take away the device in response to aggressive behavior ($M = 3.42, SD = 1.45$) than neutral behavior ($M = 1.98, SD = 1.14$), **supporting H2a**. Additionally, we found a significant interaction between the device type and interaction modality on participants' likelihood to intervene ($F = 2.56, \eta_p^2 = 0.03, p = 0.039$), however, pairwise comparisons did not reveal any statistically significant differences between specific combinations of device types and interaction modalities. There was also no significant main effect for device type, indicating no difference in the likelihood to take away the robot ($M = 2.71, SD = 1.42$), smart speaker ($M = 2.66, SD = 1.52$), and tablet ($M = 2.77, SD = 1.53$), demonstrating **a lack of support for H2b**.

Similarly, intervening by reprimanding their child indicated a significant main effect for the presence of aggressive behavior ($F = 97.99, \eta_p^2 = 0.22, p < 0.001$), see Figure 1(c). Parents indicated a higher likelihood to reprimand their child if they were aggressive ($M = 3.57, SD = 1.32$) than if they reacted neutrally ($M = 2.18, SD = 1.26$), further **supporting H2a**. We also found a marginally significant main effect for the type of device on participants' likelihood to reprimand their child ($F = 2.60, \eta_p^2 = 0.01, p = 0.075$), however, pairwise comparisons did not reveal any significant differences between the robot ($M = 2.96, SD = 1.41$), smart speaker ($M = 3.04, SD = 1.50$), and tablet ($M = 2.66, SD = 1.47$), showing further **lack of support for H2b**.

To further understand how participants would respond if their child acted in similar ways to the actress in the video, we examined responses to the question "if your child were to act in that same way, how would you react? why?" We coded participant responses into the following categories: provide encouragement, provide assistance with the game, use the situation as a learning opportunity, express anger and frustration at child's reaction, reprimand or correct the child, and no reaction. These codings were verified by an independent coder on 21 of the 332 responses with an average inter-rater reliability Cohen's kappa value of 0.96 across all categories. Analysis of this data revealed the presence of aggressive behavior to be the largest determinant of the reactions participants listed (Figure 2). Participants who watched a video where the person displayed *neutral* behavior were significantly or marginally significantly more likely to say they would respond by providing encouragement ($F = 10.56, \eta_p^2 = 0.02, p = 0.001, agg = 10.7\%, neu = 23.3\%$), providing assistance with the game ($F = 3.46, \eta_p^2 = 0.01, p = 0.064, agg = 6.5\%, neu = 12.3\%$), and providing no reaction ($F = 10.14, \eta_p^2 = 0.03, p = 0.002, agg = 7.1\%, neu = 18.4$). In contrast, participants who watched a video where the person displayed *aggressive* behavior were significantly more likely to say that they would respond by using the situation as a learning opportunity ($F = 12.55, \eta_p^2 = 0.04, p < 0.001, agg = 18.9, neu = 6.1\%\%$) and reprimanding or correcting the child ($F = 24.87, \eta_p^2 = 0.08, p < 0.001, agg = 24.9\%, neu = 5.5\%$). And while more participants in the aggressive condition than the neutral condition reported that they would respond by expressing anger and frustration at the child's reaction ($F = 1.94, \eta_p^2 = 0.01, p = 0.165, M_{agg} = 0.17, SD_{agg} = 0.38, M_{neu} = 0.12, SD_{neu} = 0.32$), the difference was not statistically significant. These responses highlight the different methods parents use to help their children in frustrating situations, and how these methods differ based on the level of aggression in the child's behavior.

C. Perceptions of Mistreatment of and Sympathy

Participants' perceptions of device mistreatment indicated a significant main effect for the presence of aggressive behavior ($F = 198.19, \eta_p^2 = 0.38, p < 0.001$), see Figure 3(a), where participants had a higher perception of mistreatment in the aggressive condition ($M = 0.72, SD = 0.45$) than in neutral condition ($M = 0.12, SD = 0.33$), **supporting H3a**. We also found a significant main effect for device

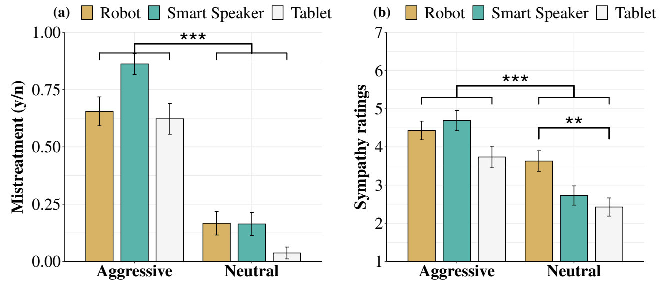

Fig. 3: Parents (a) perceived greater device mistreatment and (b) felt more sympathetic towards the devices when aggressive behavior was exhibited (**$p < 0.01$, ***$p < 0.001$).

type on perceptions of mistreatment ($F = 7.16, \eta_p^2 = 0.04, p < 0.001$), where participants viewed the smart speaker as the most mistreated ($M = 0.52, SD = 0.50$), then the robot ($M = 0.42, SD = 0.50$), and lastly the tablet ($M = 0.33, SD = 0.47$). Pairwise comparisons revealed only a significant difference between the smart speaker and tablet ($p < 0.001$), thus, **H3b was only partially supported**. Additionally, there was a significant interaction between device type and interaction modality on perceptions of mistreatment ($F = 2.51, \eta_p^2 = 0.03, p = 0.042$), where pairwise comparisons revealed that the tablet-audio condition ($M = 0.15, SD = 0.36$) had significantly lower perceptions of mistreatment than both the robot-audio+physical ($M = 0.44, SD = 0.50, p = 0.010$) and the smart speaker-audio+physical conditions ($M = 0.61, SD = 0.50, p < 0.001$). Finally, there was also a significant interaction between the presence of aggression and interaction modality ($F = 3.77, \eta_p^2 = 0.02, p = 0.024$), where within the aggressive/neutral conditions, the only significant pairwise comparison was between the aggressive-audio ($M = 0.61, SD = 0.49$) and aggressive-audio+physical conditions ($M = 0.85, SD = 0.36, p = 0.008$).

When mistreatment was defined as damage, insult, or belittling, participants' ratings for mistreatment of the device indicated a significant main effect for the presence of aggressive behavior ($F = 251.22, \eta_p^2 = 0.43, p < 0.001$), where participants had higher ratings of mistreatment in response to aggressive behavior ($M = 5.43, SD = 1.66$) than neutral behavior ($M = 2.56, SD = 1.67$), **supporting H3a**. We also found a significant main effect for device type on ratings of mistreatment ($F = 3.92, \eta_p^2 = 0.02, p = 0.021$), where participants viewed the smart speaker as the most mistreated ($M = 4.28, SD = 2.30$), then the robot ($M = 4.109, SD = 2.17$), and lastly the tablet ($M = 3.67, SD = 2.10$). Pairwise comparisons revealed only a significant difference between the smart speaker and tablet, showing **partial support for H3b**. Finally, we found a significant main effect for the interaction modality on perceptions of mistreatment ($F = 3.37, \eta_p^2 = 0.02, p = 0.036$), where pairwise comparisons revealed that precipitants viewed the device as more mistreated in the audio+physical modality ($M = 4.32, SD = 2.27$) than the audio modality ($M = 3.78, SD = 2.18, p = 0.035$).

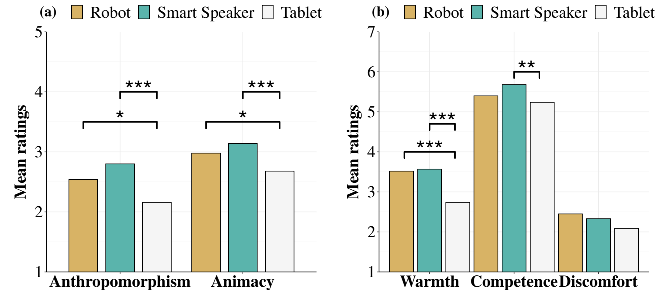

Fig. 4: Participants rated the three device types on (a) anthropomorphism and animacy, and (b) warmth, competence, and discomfort (*$p < .05$, **$p < .01$, ***$p < .001$).

No pairwise comparisons with the physical modality ($M = 3.96, SD = 2.14$) were statistically significant.

Responses for feeling sympathetic towards the devices revealed significant main effect for the presence of aggressive behavior ($F = 47.57, \eta_p^2 = 0.13, p < 0.001$), see Figure 3(b), where participants felt more sympathetic when aggressive behavior was displayed ($M = 4.30, SD = 2.01$) compared with neutral behavior ($M = 2.93, SD = 1.92$), **supporting H4a**. We also found a significant main effect for the device type on device sympathy ($F = 8.28, \eta_p^2 = 0.04, p < 0.001$), where pairwise comparisons revealed that participants had significantly less sympathy for the tablet ($M = 3.07, SD = 2.01$) than both the robot ($M = 4.04, SD = 1.95, p < 0.001$) and smart speaker ($M = 3.73, SD = 2.17, p = 0.019$). There was no significant difference between sympathy towards the robot and smart speaker, thus **H4b was only partially supported**. We also observed a interaction effect between the presence of aggression and device type on device sympathy ($F = 3.13, \eta_p^2 = 0.02, p = 0.045$), where pairwise comparisons within the aggressive and neutral behavior types reveal a significant difference between the robot-neutral condition ($M = 3.63, SD = 1.96$) and the tablet-neutral condition ($M = 2.43, SD = 1.74, p = 0.004$), where all other pairwise comparisons were not statistically significant.

D. *Perceptions of the Devices*

We analyzed participant ratings of the devices' attributes of anthropomorphism, animacy, warmth, competence, and discomfort (Figure 4). Participants' ratings of *anthropomorphism* revealed significant main effect for the type of device ($F = 11.45, \eta_p^2 = 0.08, p < 0.001$), where they rated the tablet ($M = 2.16, SD = 1.00$) as significantly less anthropomorphic than both the robot ($M = 2.54, SD = 1.17, p = 0.013$) and smart speaker ($M = 2.80, SD = 1.16, p < 0.001$), with no significant difference between the robot and smart speaker. Participants' ratings of *animacy* also exhibited significant main effect for the type of device ($F = 7.23, \eta_p^2 = 0.05, p < 0.001$), where they rated the tablet ($M = 2.68, SD = 1.01$) as significantly less animate than both the robot ($M = 2.98, SD = 0.98, p = 0.045$) and smart speaker ($M = 3.14, SD = 1.04, p < 0.001$), with no significant difference between the robot and smart speaker.

Warmth ratings showed significant main effect for the type of device ($F = 11.93, \eta_p^2 = 0.08, p < 0.001$). Participants also rated the tablet ($M = 2.74, SD = 1.63$) as significantly less warm than the robot ($M = 3.52, SD = 1.49, p < 0.001$) and the smart speaker ($M = 3.57, SD = 1.56, p < 0.001$), with no significant difference between the robot and smart speaker. *Competence* ratings indicated statistical significance main effect for the type of device ($F = 4.63, \eta_p^2 = 0.03, p = 0.010$), where participants rated the smart speaker ($M = 5.68, SD = 0.97$) and the robot ($M = 5.40, SD = 0.97$) as more competent than the tablet ($M = 5.24, SD = 1.31$), however, only the pairwise comparison between the tablet and the smart speaker was significant ($p < 0.01$). Additionally, we found a significant interaction between the presence of aggression and device type on competence ratings ($F = 4.53, \eta_p^2 = 0.03, p = 0.012$), where pairwise comparisons revealed that when aggressive behavior is displayed, participants see the smart speaker as significantly more competent ($M = 5.93, SD = 0.70$) than the tablet ($M = 5.08, SD = 1.41, p < 0.001$). All other pairwise comparisons were not statistically significant. Lastly, parents ratings of *discomfort* did not indicate any significant main effects or interaction effects.

Taking all of the device perception ratings together, we had hypothesized that the robot would be highest in anthropomorphism, animacy, warmth, and competence and lowest in discomfort. Instead, we observed similar ratings between the smart speaker and robot, where both were viewed as more anthropomorphic, animate, and warm than the tablet. Thus, we **do not have support for H5**.

V. Discussion and Conclusion

In this work, we examined the influence of the presence of aggression (aggressive or neutral), the type of device (robot, smart speaker, or tablet), and the interaction modality (audio, physical, or audio and physical) on reported parent responses if their child displayed that behavior and parents' perceptions of the technological device. Confirming our predictions, our results indicate that parents have greater concern, are more likely to intervene, and perceive the device as mistreated and attribute more sympathy to it after imagining that their child exhibited aggressive behavior.

We also observed differences in how parents reported they would respond if their child exhibited the same behavior they saw in the video. Parents who watched a video where the actress displayed neutral behavior were more likely to respond by encouraging their child to keep trying and by providing assistance in the game. On the other hand, parents who watched a video where the actress displayed aggressive behavior were more likely to respond by treating the situation as a learning opportunity and reprimanding or correcting their child. These results demonstrate that parents intervene and assist their children differently depending on the severity of the aggressive behavior displayed by their child.

Although our results showed strong support for parents' concern and likelihood to intervene when aggressive behavior is displayed, we did not find results supporting a higher level of parental concern and intervention when the device was a robot compared with the smart speaker and the tablet. It is possible that the lack of difference in parental concern and intervention between the robot and the other two device types could be driven by the lack of perceived differences between some of the device types. While participants viewed the robot and smart speaker as being more anthropomorphic, animate, and warm when compared with the tablet, we did not observe significant differences between the robot and smart speaker on these dimensions. We were surprised by this lack of distinction between the robot and smart speaker, because we had hypothesized that the increased human-like physical appearance of the robot would result in higher ratings of sympathy, anthropomorphism, animacy, and warmth; and therefore, also result in a higher amount of parental concern and likelihood to intervene when aggressive behavior is displayed toward the device. Although we did control for whether or not the participant owned the device they viewed in the video in our statistical analysis, it is possible that the greater use and exposure to smart speaker devices in the United States, compared with robots like Nao, could have led to similar ratings between robots and smart speakers. It is also possible that if the robot had more human-like movement, anthropomorphism and animacy ratings might have been higher for the robot than the smart speaker.

Additionally, it is important to recognize that there could be differences between A) parents watching their children acting aggressively toward a robot in-person and B) watching a video of an actress acting aggressively toward a robot and imagining their child exhibited the same behavior, as we implemented in this work. Prior work has demonstrated significant differences in how people respond to a physical robot embodiment compared with a telepresent or virtual robot embodiment [33].While we were not able to explore in-person parental reactions to aggressive child behavior towards robots due to the COVID-19 pandemic, future work is needed to ascertain whether parental reactions are similar, as our results suggest, between child aggressive actions towards different devices in the home.

The increased incorporation of tablets, smart speakers, and robots into the home are changing family interactions and leading to instances of aggressive child behavior towards these devices. This work underscores the importance of critically examining the causes and potential types of aggression children might have towards different types of devices to inform design decisions that can encourage fewer instances of aggressive behavior from children and help parents mitigate any instances of child aggression towards home devices.

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