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What Do Children Want from a Social Robot? Toward Gratifications Measures for Child-Robot Interaction*

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Abstract— **Social robots have, in the case of children, rarely been studied from a uses-and-gratifications perspective. As social robots differ from more traditional media, the first aim of this study was to explore the gratifications that children seek and obtain from social robots. This was investigated in a study among 87 children. The second aim was to develop and initially validate measures for those gratifications. We studied this among a sample of 24 children. The measures for hedonic and social gratifications-obtained worked reasonably well. The measures for hedonic and informative gratifications-sought seemed problematic, whereas the others were acceptable. Our measures present a first step toward enabling future research on children's gratifications of social robots.**

I. Introduction

Children's media use has often been studied from a uses-and-gratifications perspective, notably in communication research [1]–[4]. However, in the field of human-robot interaction, and more specifically child-robot interaction (CRI), the theory has received little attention to date. The basic idea of the uses-and-gratifications perspective is that individuals use media to fulfil certain psychological and social needs. The satisfaction of needs or obtaining of gratifications can, in turn, influence the subsequent motivation to use the medium and can finally result in media habits [5]–[7]. Social robots, which can be defined as robots capable of approaching human-human interaction [8], have rarely been investigated in this light (except for [9]). This is surprising because children are increasingly likely to encounter social robots, or toys with robotic technology, in their lives [10]. Social robots allow the user to communicate with the technology rather than just through the technology as is the case with other technologies [11]. Consequently, children may seek and obtain different gratifications from the use of social robots than from the use of other media [12].

Research has identified several gratifications that children or adolescents seek when using media. In general, the following set of six motivations surfaces: learning or information seeking [1]–[3], [13], passing time/ habit [1]–[3], companionship/ social interaction [1], [3], [4], [13], [14], escapism/ forgetting about things [1], [3], enjoyment/ entertainment [1], [2], [4], [13], [14], and status-gaining [1], [2], [13], [14]. However, as there is no universal set of gratifications for media use [15], empirical research is required to understand the gratifications of a new medium when it is introduced [16].

Given the interactive, playful, and potentially informative character of many social robots, at least some of these gratifications may also be valuable and informative for the study of children's gratifications of social robots. At the same time, other more robot-specific gratifications may come into play when children interact with social robots. To our knowledge, only one study has discussed children's gratifications (defined as motivations/ interests) for the use of social robots and its effect on the robot interaction [9]. The study found that children interacted longer with a robot when they looked for friendship than when they had a mechanical interest in the robot. Thus, the gratifications that children seek (i.e., gratifications-sought) and, eventually, may get (i.e., gratifications-obtained) from social robots, may influence how the interaction develops and, eventually, whether children accept a robot. However, the aforementioned study notwithstanding, little is known about whether gratifications established in the literature also surface when children interact with robots. Moreover, there are no measures for studying children's gratifications of interacting with social robots.

In this context, the aim of the first study was to explore children's gratifications of social robots. We first investigated whether the types of gratifications in the literature on children's gratifications of media (e.g., [1]–[4]) surfaced in the answers that children gave to the question why they enjoyed spending time with a social robot, and whether new gratifications appeared. The aim of the second study was to take a first step toward the development of suitable measures for these gratifications and validate those measures, with the goal to enable future investigations of children's uses-and-gratifications of social robots.

II. Overview of Studies

The two studies were approved by the Ethics Review Board of the Faculty of Social and Behavioural Sciences at the University of Amsterdam (respectively 2018-YME-8706 and 2018-YME-9551). Before conducting the studies, we received each time active written consent from children's parents or caretakers, as well as from the schools in the first study and the film and science festival in the second study. In each study, children were asked for active verbal consent.

A. Child-Robot Interaction

In both studies, children interacted once with the social robot NAO (SoftBank). The interaction took place in the presence of a female researcher, who controlled the robot

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with a laptop from a small distance (i.e., a Wizard-of-Oz set-up). Children were asked to sit in front of the robot at a comfortable distance. Right before the interaction, we explained to the children that participation was voluntary and that they could refrain from participation. When children gave their consent, the researcher started the interaction.

The interaction consisted of an introductory chat during which the robot asked the child various questions (e.g., "How are you doing?", "Have you talked to a robot before? Or am I the first one that you have ever seen?"), after which the child and robot played a game of 'True or False'. During this game, the robot told the child various statements about its abilities (e.g., "I can dance"), after which the child had to guess whether the statement was true or false. After each guess, the robot would provide the correct answer and explain or show its functioning (e.g., dancing). Between guesses, the robot asked children some questions to prevent them from getting bored (e.g., "What is your favorite color?"). At the end, the robot and the child said goodbye.

B. Questionnaire

In both studies, a female interviewer presented the questionnaire orally to the children in a separate interview room. The interviewer read aloud each question or statement, and children had to indicate their agreement or disagreement on a five-point rating scale, with the response options ranging from "Does not apply at all" to "Applies completely". In order to facilitate children's answering, we adapted a bar chart from [17] which visualizes the degree of agreement. The bar chart does not use smileys or colors and thus avoids, as much as possible, the elicitation of socially desirable answers. After explaining the answering scale, we presented children with practice items (e.g., "I like candy") to familiarize them with the item and answering format [18]. Additionally, we explained to them that there are no right or wrong answers.

III. Study 1 – Exploration of Children's Gratifications

To analyze children's gratifications of social robots, we collected data on why they did or did not enjoy spending time with the robot. These data were part of a larger data collection with the main aim to develop and validate a set of standardized self-report measures for CRI [19]. The data have already been used for other studies on (measures in) CRI [20]–[22].

A. Sample

In total, 88 children from two Dutch elementary schools participated in our study. One child did not finish the interaction and thus no data was collected. Our final sample consisted of 87 children aged 7 to 11 (M = 9.17, SD = 0.85) of which 48 were female and 39 male.

B. Procedure

Before the interaction took place, we introduced children to the study and the social robot on a class-level (for a similar approach see [23]) by means of a presentation and a picture of the social robot. We emphasized that their participation was voluntary, that no personal information would be published, and that they were allowed to withdraw from the study at any time without providing a reason. Children could ask questions, but we only answered non-robot related questions to prevent answers affecting children's perception of the robot.

The interaction lasted approximately eight minutes and took place in a quiet room. After the interaction, the child was led to the interview room, where the questionnaire was assessed. The questionnaire included mainly closed-ended questions on children's perception of the robot, their internal states during the interaction with the robot, their appreciation of the interaction, and on their cognitive development and personality. Moreover, to give children the opportunity to elaborate on some of their answers, we included several open-ended questions.

After all children had participated, they were debriefed at class-level (for a similar approach see [24]). Through the use of a series of slides, the experimenters explained children the robot's mechanical nature, its workings, the Wizard-of-Oz paradigm, and the method of programming the robot. Additionally, to minimize the possibility of children feeling deceived, it was emphasized that the robot did and said the same things with every child. Finally, the experimenters explained some of the differences between robots and humans and answered any remaining questions the children had. To thank children, they all received a small present.

C. Data Analysis

For the investigation of children's gratifications of social robots, we analyzed children's responses to the open-ended question on enjoyment (i.e., I enjoyed spending time with NAO; And why did you [enjoy that]?). We only coded those answers that followed a positive answer to the closed-ended question (n = 83) and not the ones that followed a neutral answer (n = 4). As the questionnaire was administered after the interaction, children's answers mainly centered on gratifications-obtained rather than gratifications-sought. We analyzed their answers to the open-ended question by means of a directed content analysis [25], which means that coding starts with predetermined, theoretically based codes or categories (i.e., a deductive approach), while identifying data that cannot be coded. After this, the data that could not be coded are analyzed to see whether they represent a novel category (i.e., an inductive approach) [25].

We started coding based on categories already defined in the existing uses-and-gratifications literature. We only coded those categories that had already appeared multiple times in the literature. These categories were hedonic gratifications (e.g., for enjoyment/ entertainment; to feel good) [1], [2], [4], [13], [14], informative gratifications (e.g., to learn things; for information-seeking) [1]–[3], [13], social gratifications (e.g., for companionship, for social interaction; to not feel lonely) [1], [3], [4], [13], escapism (e.g., to escape daily life; to forget about other things) [1], [3], status gratifications (e.g., to gain status with others; to get popularity) [2], [13], [14], and passing time (e.g., to pass time, not to be bored) [1]–[3]. When answers could not be assigned to any category, we evaluated them and attempted to assign them to novel categories [25]. When a statement contained references to multiple gratifications, it was assigned to multiple categories of gratifications to avoid losing information.

D. Results

When it comes to children's motivations for spending time with NAO, most children mentioned hedonic gratifications (e.g., "It was just very nice" or "Everything was nice, for example shaking hands [with the robot]") (n = 42). Only two children mentioned informative gratifications (e.g., "When I was right or wrong, he would tell me the answer […]"). A small number of children (n = 11) mentioned social gratifications, mainly related to companionship (e.g., "It was very companionable" or "He [i.e., the robot] is sweet"). Three children mentioned gratifications related to escapism (e.g., "It was during school-time so now I did not have to work […]"), whereas none of the children mentioned gratifications related to status-gaining or passing time.

However, based on these five theoretically derived categories, we were unable to classify all the answers children gave. Consequently, we analyzed the remaining answers and derived two categories from them, namely "novelty" and "experiential". The novelty category resembles the novelty gratification mentioned by Sundar and Limperos [12] and centers on the newness of the robot and the experience (e.g., "I never talked to a robot before" or "It was the first time that I saw a robot […]") (n = 16). The experiential category is similar to Sundar and Limperos' [12] 'coolness' gratification and Sherry et al.'s 'fantasy' gratification (for an overview see [26]). It includes needs related to the uniqueness of the robot and the experience of dealing with a robot (n = 10). It is a stable gratification referring to exclusivity of the situation (e.g., "With kids you can play more often, but you do not often experience [this with] robots" or "[It was] nice and interesting because I almost never see a robot"). Finally, some answers could not be classified into any of these categories as they did not constitute gratifications (n = 9).

E. Discussion Study 1

Children's initial gratifications (i.e., after one interaction) to spend time with a social robot could be categorized into hedonic, informative, social, escapism, novelty, and experiential gratifications. Children did not mention informative gratifications often. Apparently, they consider social robots something to play with, even though the robot did provide the children with information about its functioning during the interaction. However, given the prevalence of informative gratifications in the literature [1]–[3], [13], it seems prudent to include this category in the second study. Additionally, children did not often mention escapism as a gratification. The children that did mention it, all referred to the fact that the interaction with the robot freed them from schoolwork, which is very context-specific and not exactly reflects traditional notions of escapism (i.e., *forget* about things in daily life, e.g. [26]), therefore we decided not to include it in our second study.

Finally, we found novelty and experiential gratifications in children's answers. However, the novelty effect of social robots is expected to quickly vanish after a few interactions [27]–[29]. Moreover, as we are interested in a stable set of measures of children's gratifications of social robots that can be applied to different contexts in the whole field of CRI, we decided not to include novelty gratifications in further measure development. Indeed, the novelty of a robot can be a motivation for initial use, but not a gratification resulting in media habits. Conceptually, experiential gratifications partly cover the novelty of the robot, but are stable and applicable to a broader context. To conclude, the measures for children's gratifications that we aimed to test in Study 2 were hedonic, informative, social, and experiential gratifications.

IV. Study 2: Measure Development and Validation

As a second step, based on existing uses-and-gratifications literature and children's answers to the open-ended questions, we developed measures for gratifications of social robots. To validate these measures, we collected data at a film and science festival in Nijmegen, in the Netherlands.

A. Scale Development

We based the categories of gratifications for the use of social robots on results from Study 1. We developed indicators of four types of gratifications, namely hedonic, informative, social, and experiential gratifications. We drew on items that have been used successfully in the uses-and-gratifications literature among children as well as on typical assertions in children's answers to the open-ended questions identified in Study 1. Given that hedonic and informative gratifications are well-established in the literature, respectively [1], [2], [4], [13], [14] and [1]–[3], [13], we largely based our measures on existing uses-and-gratifications measures for children. However, social gratifications may be different as in classical uses-and-gratifications measures they refer to social interaction with friends or other users of the media, whereas in the case of social robots, they refer to social interaction with the robot (see [11]). Finally, as experiential gratifications have not been described frequently in the literature, we based the items for these gratifications largely on children's answers to the open-questions in Study 1. For all the items, we adjusted the wording to children's language skills, as children in middle childhood may have difficulty with abstract wording (see [30]).

For the hedonic gratifications scale, we adapted three items from [31], which are similar to the items used in uses-and-gratifications studies with children [4], [13], [14]. We adjusted an item to a specific form of use, namely playing with the robot (i.e., "…because I would enjoy playing with NAO"), to make it less abstract for children and have some variety in the items. The final set of items for the hedonic gratifications-sought was as follows: *A reason to spend time with NAO is…1) because I would enjoy that, 2) because I would have fun with NAO, 3) because I would enjoy playing with NAO.* For the hedonic gratifications-obtained the following items were used: *1) I had fun with NAO, 2) I enjoyed it, 3) I enjoyed playing with NAO.*

The items for informative gratifications were adapted from [13] and are similar to the items used by [3]. We adjusted the second item to refer to 'teaching-by-showing', given that the robot has the possibility to teach the children something in the physical space. The informative gratifications-sought items were: *A reason to spend time with NAO is…1) because NAO would show me how to do things, 2) because NAO would help me get information about things I want, 3) because NAO would teach me new things.* For the informative gratifications-obtained the following items were

included: *1) NAO taught me new things, 2) NAO helped me get information about things I want to know, 3) NAO showed me how to do things.*

As no existing measure for social gratifications was appropriate for our purposes, we based our items on children's answers from Study 1. Rubin's [3] items on companionship all focus on reducing loneliness, whereas children's data from Study 1 showed a more positive formulation in that the robot is something that could be good company. Similarly, Dhir et al.'s [13] or Wu et al.'s [4] items focus on using a medium to connect with others, whereas in the case of social robots one communicates with the medium rather than through the medium [11]. To facilitate children's answering (see [30]), we again included items on specific activities that one could potentially do with the robot (i.e., play or talk), while emphasizing being together with the robot rather than not being alone. Additionally, we added an item on the experience of being together and the companiable feeling that may bring. The following items constituted the social gratifications-sought: *A reason to spend time with NAO is…1) because we would chat with each other, 2) because we would play together, 3) because it would be companiable together with NAO.* The gratifications-obtained consisted of the following items: *1) NAO and I could play together, 2) NAO and I could chat with each other, 3) It was companiable together with NAO.*

Finally, as outlined above, experiential gratifications are closely related to Sundar and Limperos' [12] 'coolness' gratification and with Sherry et al.'s 'fantasy' gratification (for an overview see [26]). However, our conceptualization of experiential gratifications differs from 'coolness' and 'fantasy' gratifications in several ways. First, in contrast to what appears to be at the core of the 'coolness' gratification, children's interaction with social robots in Study 1 seemed to be intrinsically motivated rather than done for status-gaining. Second, the 'fantasy' category seems to refer to 'being in a different world', whereas that is not the case for experiential gratifications. Third, experiential gratifications focus on children's (expected) experience of interacting with a robot, not on the technology itself, which is the focus of the 'coolness' gratification. Accordingly, our item wording focused on the *experience* of being or playing with the robot and the potential feelings connected to that (i.e., exciting and cool) rather than on the robot itself. The gratifications-sought items were as follows: *A reason to spend time with NAO is…1) because it is cool to do, 2) because it is exciting to do, 3) because it is something special to play with NAO, 4) because playing with NAO is something particular to experience.* The gratifications-obtained items consisted of: *1) It was something special to play with NAO, 2) It was exciting to do, 3) Playing with NAO is something particular to experience, 4) It was cool to do.*

B. Sample

In total, 25 children participated in our study, which had a pre-questionnaire – robot interaction – post-questionnaire design. Two children did not immediately participate in the interaction with the robot after the pre-questionnaire. Due to a potential effect of this interruption, we excluded these children's data from the post-questionnaire. One child indicated not to understand the format of the gratifications sought-scales and showed to be an outlier in the data. We, therefore, excluded this child's data. Our final sample consisted of 24 children (nine females, 15 males), aged 7 to 11 years old (M = 9.31, SD = 1.15).

C. Procedure

The procedure of this study closely resembled the procedure of Study 1. However, as we collected data at a film and science festival, each child was individually introduced to and debriefed on the study by means of a video, which contained the same presentations as mentioned above. Additionally, the robot interaction did not take place in a separate room, but in a semi shielded-off corner of a larger room.

First, children were led to a separate room where a female interviewer showed them the video of the introduction on a laptop. Similar to the first study, children were still allowed to ask non-robot related questions during this introduction. After the introduction, the interviewer showed children the picture of the robot that was also shown in the presentation, to make sure they were well visible for them. After the introduction, the pre-questionnaire was assessed in the same manner as mentioned in 'Overview of Studies' above. This questionnaire consisted of closed-ended questions on children's gratifications sought as well as two validation measures (i.e., need for cognition and epistemic curiosity). After the pre-questionnaire, children were led to the place where the CRI took place. The procedure was equivalent to the procedure described above. However, due to time constraints of the festival, the "True or False" game played in this study was a shortened version of the game played in the first study. Thus, the interaction lasted on average only six minutes.

After the interaction, children were led back to the interview room for the post-questionnaire. The post-questionnaire consisted of the gratifications-obtained scales and four validation measures (i.e., intentional acceptance, playfulness, agreeableness, and introversion). Next, the interviewer showed the children the video of the debriefing on a laptop. After the debriefing, children were shown the pictures of the robot that were also shown in the video of the debriefing presentation, again to make sure they were well visible for them. Finally, they were invited to ask any remaining questions. In this study, children did not receive a compensation for their participation as the goal of the festival was to give children the opportunity to participate in research.

D. Scale Validation

The validation of the scales followed a similar procedure as in [19], [21]. The gratifications scales were validated in four steps. First, we conducted an exploratory factor analysis (EFA) for each gratification scale separately to evaluate the dimensionality of the scales and to assess whether the indicators load on the factors. Second, we calculated Cronbach's alpha [32] in SPSS 25. We averaged the indicators to form a total score for the different gratifications, and assessed their distributions by calculating range, mean, standard deviation, skewness, and kurtosis. Third, we assessed measurement validity by calculating bivariate correlations in SPSS 25 between the newly developed

gratifications scales and concepts, which, on empirical and theoretical basis, are expected to correlate with one another [33]. Finally, to assess the degree of overlap between the scales, we calculated bivariate correlations between the gratifications-sought measures and between the gratifications-obtained measures. Because of the limited sample size in relation to the number of indicators, we could not meaningfully run exploratory factor analyses of all indicators simultaneously [34].

E. Validation Measures

To be able to assess measurement validity, we also included, as mentioned above, concepts that are expected, empirically and theoretically, to correlate with gratifications.

1) Intentional Acceptance

We expected a positive correlation between intentional acceptance of social robots (i.e., intention to use a social robot) and all categories of gratifications for social robots. The expectation and, eventually, the fulfilment of certain gratifications, leads to a higher use or intention to use in the future (e.g., [4], [35]). Empirically, this has been shown for various forms of media (e.g., [3], [13], [15]). Our measure of intentional acceptance consisted of a four-item scale developed and validated among 7- to 11-year-olds in Dutch [21]. An overall score was computed by averaging the four items (M = 4.24, SD = 0.89, α = .91).

2) Playfulness

Hedonic gratifications, both sought and obtained, were expected to positively correlate to trait playfulness. Children high in playfulness like to enjoy themselves and engage in pleasurable interactions [36]. Empirically, playfulness and humor as trait characteristics have been found to correlate to hedonic preferences in media choice [37]. Our playfulness measure consisted of a four-item scale developed and successfully used among children by Piotrowski and Kühne [38], based on the humor sub-scale of the playfulness measure by Barnett [36]. We computed an overall score by averaging the four items (M = 4.10, SD = 0.68, α = .69).

3) Need for Cognition

Informative gratifications, both sought and obtained, were expected to negatively correlate with need for cognition. People high in need for cognition have a tendency to seek out information themselves when a problem arises, whereas people low in need for cognition rather rely on others when seeking information [39]. Therefore, we expected children low in need for cognition to have a preference for informative gratifications from the robot. To measure children's need for cognition, we used a four-item scale, which was based on the Need for Cognition Scale [40], and was successfully employed in that form among children [38]. An overall score was computed by averaging the four items (M = 3.28, SD = 0.82, α = .86).

4) Social Anxiety and Agreeableness

Social gratifications, sought and obtained, were expected to correlate negatively to social anxiety and positively to agreeableness. Social anxiety is a fear of social interactions, especially when confronted with new people and situations [41], [42]. Children that score high on social anxiety, are less likely to engage in social situations [41]. Uses-and-gratifications research found that introvert individuals were less likely to make use of the social functions of social media compared to extrovert individuals [43]. We thus expected that socially anxious children would be less likely to seek social gratifications from a social robot. We measured social anxiety by means of a four-item scale based on the six-item Social Avoidance and Distress subscale of the Social Anxiety scale by [41]. In line with [44], we removed the two items with a factor loading below .40. We computed an overall score by averaging the two items (M = 3.47, SD = 0.68, α = .79).

Agreeableness refers to an individual's sensitivity to others and their feelings [45], [46]. We expected agreeableness to correlate positively with social gratifications. Generally, children high in agreeableness have a more positive perception of others and are better able to maintain positive social relationships with others [47]. This has also been shown in a uses-and-gratifications perspective by [48], who found that agreeable individuals were more likely to use social media to connect and communicate with others. Agreeableness was measured by means of two items (for a justification with adults see [49]) from the 13-item agreeableness scale of the Big Five Questionnaire for Children (BFQ-C), which was developed and validated among children [45] (for Dutch items see [46]). An overall score was computed by averaging the two items. The reliability was tested by means of the Spearman-Brown coefficient, which is considered the most appropriate method for calculating reliability of two-item scales [50] (M = 4.00, SD = 0.62, Spearman-Brown coefficient = .55).

5) Epistemic Curiosity

I-type epistemic curiosity can be defined as "intellectual interest associated with the anticipation of learning new knowledge" [51, p. 542]. Children high in I-type epistemic curiosity often show novelty seeking behavior and experience an intrinsic joy when discovering new things [52]. We expected that children who seek out new experiences, would also enjoy spending time with the robot because it is currently a special experience, thus predicting a positive correlation between epistemic curiosity and experiential gratifications, both sought and obtained. Our four-item measure of epistemic curiosity was based on the five-item I-type epistemic curiosity scale by [51]. We removed the item with the lowest factor loading (i.e., item 4, .60), and reworded the items into a self-report scale for children. An overall score was computed by averaging the four items (M = 4.16, SD = 0.54, α = .72).

F. Results

1) Exploratory Factor Analyses

We conducted a separate principal axis factor analysis with oblique rotation (i.e., direct oblimin; maximum of 100 iterations for extraction) for each gratification scale. For an overview of factor loadings for the gratifications measures see Table 1. One indicator of both the hedonic (i.e., item 1) and the informative gratifications-sought scale (i.e., item 1), had a low factor loading (respectively .25 and .30). The other factor loadings of the hedonic, informative and social gratifications-sought scales ranged between .54 and .93. As for the experiential gratifications-sought scale, all items had a substantive loading on the factor (all above .67). The

percentage of variance accounted for by the factors was low to moderate, ranging from 32.85% to 56.60%.

As for the gratifications-obtained, the factor loadings were overall higher, except for one item (.49) (i.e., item 1) of the informative gratifications-obtained scale. The factor loadings of the hedonic and social gratifications-obtained scales were all above .84, whereas the factor loadings for the experiential gratifications-obtained scale were above .63. The hedonic and social gratifications-obtained factor accounted for a large amount of variance (respectively 85.15% and 81.61%), whereas the informative and the experiential gratifications-obtained factor only moderately accounted for the variance (respectively 48.94% and 58.63%).

TABLE I. PRINCIPAL AXIS FACTOR ANALYSES WITH OBLIQUE ROTATION FOR EACH SCALE OF GRATIFICATIONS SEPERATELY

Scale	EFA & reliability analyses		
	% of variance accounted for	*Cronbach's α*	*Factor loadings*
Hed.-Sought	37.21	.540	.249; .541; .872
Info.-Sought	32.85	.541	.296; .574; .754
Soc.-Sought	52.06	.729	.570; .607; .932
Exp.-Sought	56.60	.833	.666; .715; .805; .813
Hed.-Obtained	85.15	.931	.885; .926; .956
Info.-Obtained	48.94	.714	.490; .668; .885
Soc.-Obtained	81.61	.929	.839; .910; .957
Exp.- Obtained	58.63	.757	.626; .729; .828; .858

Note: Item order corresponds to item order above (see 'Scale Development')

2) Reliability Analyses and Scale Construction

The internal consistency of the hedonic and informative gratifications-sought scales was rather low (respectively α = .540; α = .541) (see Table 1 for an overview). The social and experiential gratifications-sought scales both had a good internal consistency (respectively α = .729; α = .833). When it comes to the gratifications-obtained, all scales had a good internal consistency. The hedonic and social gratifications-obtained scales had a very high reliability (respectively α = .931; α = .929), and the informative and experiential gratifications-obtained scales had a good reliability (respectively α = .714; α = .757). We calculated a mean score for every variable by averaging the indictors. Consequently, we inspected the distribution of the scales, which can be found in Table 2.

TABLE II. DESCRIPTIVE STATISTICS

Scale	Descriptives			
	M (SD)	*Min.-Max.*	*Skewness*	*Kurtosis*
Hed.-Sought	4.10 (0.55)	2.67 – 5.00	-.76	1.25
Info.-Sought	3.44 (0.61)	2.00 – 5.00	-.08	1.69
Soc.-Sought	3.86 (0.77)	2.00 – 5.00	-.42	.06
Exp.-Sought	3.79 (0.71)	2.50 – 5.00	-.05	-.87
Hed.-Obtained	4.61 (0.62)	3.00 – 5.00	-1.45	1.02
Info.-Obtained	3.26 (0.85)	2.00 – 4.67	-.05	-1.34
Soc.-Obtained	4.48 (0.71)	3.00 – 5.00	-1.31	.46
Exp.- Obtained	4.16 (0.65)	3.00 – 5.00	-.48	-.91

3) Measurement Validity

We assessed measurement validity of the gratifications scales by inspecting the bivariate correlation between the scales and the concepts with which we expected correlations. In line with our expectations, we found positive correlations between all gratification scales and intentional acceptance (see Table 3). However, for hedonic and experiential gratifications-sought, the correlation only approached significance. As for hedonic gratifications, we found a significant correlation between gratifications-sought and playfulness, but the correlation with gratifications-obtained only approached significance. There was a significant negative correlation between hedonic gratifications-obtained and need for cognition. Informative gratifications, both sought and obtained, correlated negatively with need for cognition, but not significantly. We did find significant positive correlations for informative gratifications-obtained with playfulness and agreeableness. Contrary to our expectations, we did not find significant correlations between social gratifications-sought and -obtained and agreeableness and introversion. However, we found a significant positive correlation between social gratifications-sought and epistemic curiosity and a significant negative correlation between social gratifications-obtained and need for cognition. Finally, in line with our expectations, experiential gratifications-sought and -obtained both correlated positively and significantly with epistemic curiosity.

The bivariate correlations between the gratifications-sought measures were moderate, ranging from .49 (p = .015) to .67 (p <.001). Similarly, for the gratifications-obtained measures most correlations were moderate, ranging from .54 (p = .010) to .69 (p < .001), except for the correlations between hedonic gratifications-obtained and informative and social gratifications-obtained, which were strong (respectively r = .74, p < .001 and r = .94, p < .001). These results indicate that the different gratifications mostly form distinct concepts. There is only a high overlap between hedonic and social gratifications-obtained

TABLE III. BIVARIATE CORRELATIONS BETWEEN THE GRAITIFCATIONS AND VALIDATION MEASURES

Scale	Bivariate Correlations, *r* (*p*)					
	1	*2*	*3*	*4*	*5*	*6*
Hed.-Sought	.383 (.078)	**.450 (.036)**	-.143 (.504)	.313 (.156)	.362 (.097)	.253 (.233)
Info.-Sought	**.521 (.013)**	.292 (.187)	-.290 (.170)	.202 (.368)	.291 (.188)	.277 (.191)
Soc.-Sought	**.455 (.033)**	.304 (.169)	-.310 (.140)	.355 (.105)	.331 (.132)	**.443 (.030)**
Exp.-Sought	.397 (.067)	.301 (.174)	-.209 (.326)	.231 (.301)	.237 (.289)	**.715 (>.001)**
Hed.-Obtained	**.781 (>.001)**	.406 (.061)	**-.456 (.033)**	.248 (.266)	.042 (.854)	.247 (.269)
Info.-Obtained	**.563 (.006)**	**.548 (.008)**	-.226 (.311)	**.425 (.049)**	.283 (.201)	**.419 (.052)**
Soc.-Obtained	**.726 (>.001)**	.269 (.227)	**-.466 (.029)**	.199 (.375)	.117 (.603)	.252 (.258)
Exp.-Obtained	**.691 (>.001)**	.405 (.062)	-.116 (.608)	.193 (.388)	.383 (.079)	**.540 (.009)**

Note: 1 = Intention to Use, 2 = Playfulness, 3 = Need for Cognition, 4 = Agreeableness, 5 = Introversion, 6 = Epistemic Curiosity; Expected correlations marked in grey; Significant correlations marked in bold

V. Discussion

The first aim of this study was to explore children's gratifications of social robots and identify categories of gratifications. We based the search for categories of gratifications both on children's answers as well as on previous uses-and-gratifications literature. We found that, in general, there were four categories, namely hedonic, informative, social, and experiential gratifications. Although the focus of the child-robot interaction was not just on play, children did not mention informative gratifications often, in contrast to hedonic gratifications, which were most often mentioned. This prevalence of enjoyment is not unique to our study and common in uses-and-gratifications research on media use (see [26]). The experiential gratifications that surfaced in the data, however, seem to be more generic to interactions with social robots.

It is important to note that the cross-sectional nature of our study presents a boundary condition to the selection of gratifications. For longitudinal research, other gratifications may become important. Moreover, the gratifications presented in this study heavily depend on the current state-of-the-art of robots. When social robots become more common in children's lives and develop further, different gratifications are likely to surface in children.

The second aim of this study was to take a first step toward developing suitable measures for the gratifications identified in the first study and initially validate them. The results of the measure validation should be interpreted carefully and should be regarded as initial exploratory evidence on gratifications in CRI, given the small statistical power on which they are based. The results suggest that especially the hedonic and informative gratifications-sought measures are problematic, whereas the measures for hedonic and social gratifications-obtained seem to work reasonably well. The other measures seem acceptable. In general, the measures of gratifications-sought seem to be less valid than the measures of gratifications-obtained. An explanation may be that currently most children have no experience with social robots. As a result, it may have been difficult for them – even though we introduced the robot to them by means of a picture – to envision the capabilities of social robots and thus the needs that they may gratify. This may have led to unstable responses to the gratifications-sought items.

The bivariate correlations between the gratifications-sought and gratifications-obtained measures showed that there was moderate overlap between the measures, except for the hedonic gratifications-obtained, which correlated strongly to informative and, very strongly, to social gratifications-obtained. An explanation may be that we included 'playing' in many of the items as we wanted to avoid "use" in our items as children in middle childhood struggle with abstract wording [30]. However, this wording choice may have decreased the distinctness of the items, which may cause cross-loadings across factors. Finally, when it comes to measurement validity, all of the correlations were in the right direction, but some failed to reach statistical significance. Nevertheless, some of these correlations were strong, suggesting that the lack of statistical significance may partly be due to the small sample size.

Our findings lead to at least three recommendations for future research First, future studies, should replicate the measure validation with a larger sample to test whether our pattern of results holds in a sufficiently powered sample. Second, additional attention should be paid to ensuring that items that measure different gratifications are distinct enough. The prevalence of enjoyment in media gratifications is already high [26]. Thus, using items that refer to play should be limited to hedonic gratifications. Third, currently it is unrealistic to assume that children have a stable perception of what an interaction and the robot will be like, prior to interacting with a social robot. Therefore, future research should try to find ways of introducing knowledge about social robots such that children are able to answer questions about social robots meaningfully before they actually interact with them.

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