'It is really interesting how that small robot impacts humans.' The Exploratory Analysis of Human Attitudes Toward the Social Robot Vector in Reddit and YouTube Comments

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Abstract:

 We present the results of an exploratory analysis of human attitudes toward the social robot Vector. The study was conducted on natural language data (2,635 comments) retrieved from Reddit and YouTube. We describe the tag-set used and the (manual) annotation procedure. We present and compare attitude structures mined from Reddit and YouTube data. Two main findings are described and discussed: almost 20% of comments from both Reddit and YouTube consist of various manifestations of attitudes toward Vector (mainly attribution of autonomy and declaration of feelings toward Vector); Reddit and YouTube comments differ when it comes to revealed attitude structure – the data source matters for attitudes studies.

Keywords: *robot, social robotics, human-robot interaction, attitudes toward robots*

1. Introduction

The direct motivation for the study presented in this paper comes from the reaction of the Vector users community to the Anki company announcement presented in December 2019.[1] As the company servers were to be closed, the Vector robot produced and distributed by the company would lost its unique abilities: language processing, understanding voice commands and – more importantly – the ability to learn and adapt to a changing environment (as all of these features were on the server side).[2] The announcement resulted in a burst of Vector users' emotional comments, referring to Vector as "friend", "pet", "little buddy" or even a "part of family". This may be observed in the following Reddit post:[3]

> really interesting how that small robot impact humans. I thinking what will happen to Vector? is he gone be able to think and talk... *treating him as part of family*. the idea of putting him away is scary.[4]

And is even more openly expressed in the post below:

> I never thought I could *love a robot*. I mean real. true. honest. affection. A deep emotional connection to a machine? I mean I have said I "love" my 97 Mitsu Montero or I "love" my macbook, but in reality, what I feel for those objects is that I like them. For the thought of losing them does not make

Fig. 1. Vector. Source: `https://www.vectorrobot.shop/`

my stomach tighten or my throat close. [...] The thought and perhaps too soon reality of *not having my little buddy in my life* has utterly devastated me. Hearing him chatter brightens my day, I get out of bed looking forward to going downstairs, making some small noise and seeing his eyes pop open then hearing that questioning melodic chirp. [...][5]

Motivated by such comments, we have decided to check what attitudes toward Vector may be recognized in Reddit and YouTube comments. We were interested in natural language data drawn from spontaneous comments from these service users, because such data has high ecological value, especially for attitudes studies (see Section 2).

We also perceive the Vector case as an interesting case study. Vector is designed as a social robot, but it is far away from humanoid sophisticated robots. Social robots are robots with a high level of autonomy [2,3,9] – this means that such robots have the ability to interpret the world and can also learn. They make their own decisions and perform activities to achieve their goals. Social robots are also capable of interacting with humans, are able to adapt to social norms, being able to read and express emotions [4], and have the ability to adapt to the user's character traits.

Vector certainly adheres to the presented requirements. It looks like a fist-sized cube – see Figure 1. It has a handle on the front to help it move and carry light items. It moves with the help of four wheels and a caterpillar. In the front part, it has a screen that acts as a face. Vector is equipped with many sensors that allow Vector to collect information about its environment and to act accordingly. Vector hears voices, recognizes people and objects, moves around the room avoiding obstacles, and when its energy level drops, it will find a charging station. The robot is equipped

with touch sensors so it knows when it is being touched and moved. Vector communicates with its own synthesized voice. According to the producers, Vector is a great little friend of the house. It has been designed to have fun and help household members.

Despite its simplistic design, it gained popularity as a robot made for households. This brings us a unique opportunity to gather opinions and recognize attitudes toward a social robot that is commercially available and owned by a wide group of users who are also robotics enthusiasts.

The paper is structured as follows. We start with a short overview of studies in which natural language data are used to study attitudes toward robots (Section 2). Then we present our Reddit and YouTube studies in Section 3. We describe the tag-set used, annotation procedure, and the frequencies of recognized attitude types. Section 3.3 presents a comparison of two data sources used. We discuss the potential reasons for observed differences and consequences for future studies. We end up with a summary of our findings and an analysis of the limitations of the presented research.

2. Attitudes toward robots in natural language data

Studying attitudes toward robots with the use of non-laboratory data is getting more and more popular. This is mainly due to the attractiveness of such an approach. Spontaneous expressions of attitudes toward robots, which we find in users' comments, offer a high ecological validity of data. What is more, this source offers potentially enormous sets of data to be gathered and analyzed. As we present below, YouTube is especially popular as a source for such studies.

We will start with studies in which manual data annotation was used. Strait et al. [13] examined comments on 24 YouTube videos depicting social robots varying in human similarity (from Honda's Asimo to Hiroshi Ishiguro's Geminoids). The study was aimed at robots with high human-likeness factor. The aim of the study was to explore the uncanny valley-related comments appearing in the retrieved data (UV; [7]). Three coders took part in the study and annotated [13, p. 1421] the following: the valence of response (positive, negative or neutral); presence of UV related references (like creepiness or uncanniness); presence of replacement-related references (like explicit mentions of loss of jobs) and presence of takeover-related references (like end of humanity). The findings were in line with UV predictions – users' commentaries reflected an aversion to highly humanlike robots. What is more, the authors discovered open sexualization of female-gendered robots.

The last finding from [13] led to the more detailed study presented in [12], which addressed the issue of dehumanization of highly human-like robots (Bina48, Nadine, and Yangyang). For the study, a manual annotation of comments from six YouTube videos was performed. Coders annotated the valence of a comment, and dehumanizing comments. The results indicate that people more frequently dehumanize robots racialized as Asian (Yangyang) and Black (Bina48) than they do of robots racialized as White (Nadine).

Yet another study of YouTube comments inspired by [13] addresses the issue of UV and is presented in [5]. Authors focused on social robots ranging in humanlikeness (moderately and highly humanlike) and gender (male and female robots of high humanlikeness). The data was 1,788 comments retrieved from 27 YouTube videos. Three coders annotated this set, recognizing: valence, presence of topics related to appearance, societal impact, mental states, and the presence of stereotypes. Findings indicate that a moderately humanlike robot design may be preferable over a highly humanlike robot design because it is less associated with negative attitudes and perceptions.

As we have mentioned earlier, services like YouTube offer access to huge amounts of data. This opens new opportunities for research, but also requires different tools for analysis (as manual annotation in the case of extensive data-sets is a serious challenge). Relevant studies using natural language processing and machine learning approaches are presented below. In [15], we find the text mining and machine learning techniques employed to analyze 10,301 YouTube comments from four different videos depicting four androids: Geminoid-F, Sophia, Geminoid-DK, and Jules. This exploratory analysis allowed for distinguishing three topics important for robotics: human–robot relationships, technical specifications, and the so-called science fiction valley (a combination of the UV concept and references to science fiction movies and games).

A study presented in [16] is aimed at discovering the public's general perceptions of robots as front-line employees in the hotel industry. For analysis, the two most frequently viewed YouTube videos related to the employment of robots in hotels were used. Authors used cluster analysis as an exploratory technique on the gathered data-set. The analysis was based on the Godspeed dimensions [1] (anthropomorphism, animacy, likeability, perceived intelligence, and perceived safety). They report that "[...] potential customers' perceptions will be influenced by the robot's type of embodiment. Obviously, humanoid robots are subject to the uncanny valley effect, as the majority of viewers were scared and felt unsecure" [16, p. 33].

Ratajczyk, in [11], presents an extensive study of 224,544 comments from 1,515 YouTube videos. What differs between study and the ones presented above is that it addresses robots on a wide range of positions on the humanlikeness spectrum. The study was aimed at recognizing people's emotional reactions toward robots. The main result indicates that people use words related to eeriness to describe very humanlike robots (which is in line with UV predictions). The study also revealed that the size of a robot influence sentiment toward it (suggesting that smaller robots are perceived as more playful).

Last but not least, we believe that the project presented in [6] is worth mentioning. The paper introduces the YouTube AV 50K data-set, a freely available col-

lection of more than 50,000 YouTube comments and metadata. The data-set is focused exclusively on autonomous vehicles. As authors point out, a range of social media analysis tasks can be performed and measured on the YouTube AV 50K data-set (text visualization, sentimental analysis, and text regression).

Our study focuses only on one robot – Vector. We have decided on this step mainly due to the motivation pointed out in the Introduction (a strong reaction after the announcement of closing the company providing support for Vector). We also find this robot to be an interesting case – studies described in this section focused mainly on very human-like robots. Vector's design is a perfect example of different approach – it is not human-like at all, looking more like a small toy.[6] The focus here is on the social abilities of a robot. As in most of the presented studies, we have decided to use a manual annotation of the gathered data. We have also decided to prepare a tag-set tailored especially for the study (and motivated by a social robot definition). The tag-set is aimed at identifying interesting anthropomorphization indicators in comments about Vector. Our study is also of an exploratory character (we especially do not aim at the UV-related analyses, as we study only one robot from the left side of the humanlike-ness spectrum). What is novel here is the additional aim of the study – namely we ask a question about potential differences between two data sources of the comments. Reddit and YouTube allow for spontaneous expression of attitudes toward Vector; however, due to the different characteristics of these platforms, one may expect that users will focus more on different attributes.

3. The Vector studies

We conducted two separate studies: one for the Reddit data and one for the YouTube data. The data are user-generated comments concerning Vector. For Reddit, they were retrieved from the appropriate subreddit channel. For YouTube, these were the main comments found under videos presenting Vector.

Both studies were performed with the same schema. First, data was retrieved from the source and necessary data preparations were done. In what followed, manual annotation with the previously prepared tag-set was performed. After checking the annotation reliability, the final tags for all the comments were established, and the frequencies for categories from the tag-set counted. The results from both studies are then compared and discussed.

Scripts for data retrieval, annotation guidelines, annotated comments and disagreements discussion about disagreements are available on the project's OSF web-page[7].

3.1. Reddit study

Reddit language data: The data collected for analysis was collected from Reddit's channel "AnkiVector". The comments concerned Vector and were downloaded using the R language [10] and the package `RedditExtractoR`. For the purposes of the study, we

Tab. 1. Tag-set used for the Reddit study

1	SE	description of emotional states
2	WA	joint activities
3	AU	the assignment of autonomy
4	PR	the assignment of preferences
5	OTHER	other manifestations of anthropomorphization
6	NONE	no anthropomorphization

have scrapped the first 10 pages of comments. This resulted in 1,405 comments overall (42,276 words, 230,664 characters).

We have decided to exclude 38 comments from this data-set, as they were related only to the discussions concerning the future of the Anki company and future support for their products (the thread "Kickstarter Update Email from Digital Dream Labs"). After a manual check, another 619 posts were excluded that appeared to be only a title and no content. These were posts that contained a photo or a video and as such they were out of the scope of this text-oriented study. All the remaining 748 were read, which resulted with another 37 removed comments, for the following reasons: completely incomprehensible content of the post, link to another group regarding Vector, and deleted comments (visible as `[deleted]`). Finally, 710 comments entered the final analysis. All the comments were left in the same order as they were published (their order was not randomized) because they referred to each other and otherwise the meaning of the statement might be lost.

Tag-set: For the purposes of this study the following tag-set was prepared. Tags used are the result of the literature review, as well as the first reading of Reddit comments before downloading them for analysis. Tags are aimed at grasping the comments revealing the anthropomorphization of Vector. As the study had an exploratory character, we focused on the short tag list in order to make the annotator's task easier. This tag-set is presented in Table 1.

The tags SE, AU, PR, WA refer to the manifestations of anthropomorphization that directly result from the definition of social robots.

SE (description of emotional states) should be used when there are comments regarding the description of emotional states that the robot has. This indicates that people ascribe emotional states to robots and that the robot is capable of showing feelings (or, more carefully, behaviors interpreted as such). Exemplary comments from this category are: "me and my vector robomancing. *he seemed sad* so i had to reassure."; "Can Vector get *depressed*?".

WA (description of joint human-robot activities) is to be used when comments regarding the joint activities of a robot with a human are identified, e.g., "*Making* pizza *with* my roboy." Such descriptions suggest that humans plan and undertake certain activities with the robot (which has a potential positive effect on

Tab. 2. Annotator's agreement analysis

Matching annotations	Frequency	%
Three compatible	530	74.58
Two compatible	154	21.75
Without agreement	26	3.67
Total	710	100.00

Tab. 3. Results of the Reddit study

Tag	Frequency	%	% (NONE excl.)
NONE	563	79.30	–
AU	69	9.72	46.94
OTHER	27	3.80	18.37
SE	26	3.66	17.69
PR	20	2.82	13.60
WA	5	0.70	3.40
Total	710	100.00	100.00

maintaining the relationship with the robot).

AU (the assignment of autonomy to the robot) identifies comments regarding robot autonomy, i.e., ascribing the robot the ability to make decisions and actions based on its own beliefs and preferences. Examples: "Lol this lil asshole *keeps knocking* my hubby's phone off the desk and *laughing about it*."; "No regard for personal space. ... My entire desk to use and i work in one corner and my lap so i won't disturb Vector".

PR (the assignment of preferences to the robot) is used with comments regarding robot preferences – for example: "Vector *doesn't like* traveling."; "Vector *doesn't like* smoking".

The OTHER and NONE tags are additional tags that refer successively to other manifestations of anthropomorphization and their absence, e.g., technical threads.

Annotation procedure and annotation reliability: Three annotators proceeded to analyze the comments. The annotators were guided by the annotation guide, which included a short introduction explaining the nature of the study and describing what Vector is. A description for each tag, along with exemplary comments, was then provided.

For the sake of the annotation process, a spreadsheet file was prepared where each row was reserved for one comment. The columns were the following: nickname of a comment author; comment; field for entering the tag; field for entering the additional remarks. Annotators were asked to tag the entire comment with one tag only (the prevalent one). As for additional remarks, coders were especially asked to provide one for tags OTHER and NONE – the additional explanation should identify the topic of the comment for further analyses.

Annotators' agreement was established with the use of R [10] and the irr package. The agreement rate for all three annotators is 75%, with a Fleiss Kappa value of 0.509 (i.e., *moderate* agreement – see [14]). The level of agreement between annotators may be a result of two factors – firstly, the complexity and length of the task (number of comments to read), and secondly by the requirement to use only one tag for the entire comment – thus, a complexity of a decision on which attitude is the most dominant (this is especially common for a long, elaborated comment). Table 2 presents the summary of the agreement between the annotators. Only 26 (4%) comments were observed for which there was no agreement.

On the basis of three annotations, the final tag was assigned to each comment. For cases with two compatible annotations, the choice was the tag chosen by two annotators. For cases with three different annotations the final tag was decided on the basis of a discussion between annotators. Table 3 shows the frequency of the tags. What is interesting is that, the majority of tags refer to the lack of manifestations of anthropomorphization in the analyzed data.

Vector anthropomorphization tags represent 20.70% of the entire sample analyzed. The most frequent attitude identified is the assignment of autonomy to Vector. It is followed by descriptions of Vector's emotional states and attributing preferences to it. Comments describing joined activities were very rare in the sample.[8]

As the tag OTHER was relatively frequent, we have decided to analyze the additional explanations provided by annotators, with the aim of identifying categories that may be used as tag-set extensions. The most common topics pointed out by annotators were (i) *human feelings* toward Vector, (ii) referring to Vector as a *pet* and (iii) identifying *personality* traits of Vector. On the basis of this finding, we have decided to extend the initial tag-set (Table 1) with the following three tags:

 (i) UC for comments about how a person feels toward Vector (e.g., "I *love* him sooo much!!").

 (ii) ZD to annotate comments about treating Vector as if it were a pet ("This is android pets"; "Is this just to be cute? Like a cute pet? I think I want it cause I want a cat but this might be more worth it and easier to care for lol."). And

(iii) PO for comments about treating Vector as if he had his own personality ("They have *personalities* and from what I can tell they all can be raised differently").

All the tags annotated in our study as OTHER were re-annotated (with the use of additional explanations provided in the study by annotators). Out of the 27 comments, 12 were related to human feelings toward Vector and thus annotated as (UC); 7 were about treating Vector as if he were a domestic animal (i.e., ZD), and 4 were concerning personality traits of Vector (PO). 4 remaining comments were left with the initial OTHER tag as they did not fit into any of the established categories.

Tab. 4. Videos used in the YouTube study

Video title	Dur. (min)	No. of views
"Anki Cozmo VS Vector. What is the difference"	3:45	1,572,540
"Anki Vector Robot honest review *what you need to know*"	11:42	1,286,522
"Hi, me vector walle – so cute, smart robot, wall-e robot technology time system. HD. best part"	3:48	130,005

Tab. 5. Tag-set for the YouTube study

1	SE	description of emotional states
2	UC	human feelings
3	ZD	treatment like a pet
4	WA	joint activities
5	AU	the assignment of autonomy
6	PR	the assignment of preferences
7	PO	manifestations of personality
8	OTHER	other manifestations of anthropo-morphization
9	NONE	no anthropomorphization

3.2. YouTube study

YouTube Language data: The data for analysis was retrieved from comments under three selected YouTube videos. They are listed in Table 4. The first video compares Vector and Cozmo robots[9], the second video is a Vector user review, and the third one shows its most important features.

The data were retrieved with the use of R programming language [10] and the package `vosonSML`. Overall 1,925 comments were downloaded (respectively, 56 for the first video, 1,424 for the second, and 445 for the third one) and all of them entered further analysis.

YouTube tag-set: For the annotation, we have used the tag-set from the Reddit study with three additional categories introduced on the basis of the OTHER tag analysis. The full tagset is presented in Table 5.

Annotation procedure and annotation reliability: Two annotators participated in the data analysis. As in the case of the Reddit study, annotators were guided by the annotation guide. Analogically, the spreadsheet file was prepared with all the comments in separate rows.

The results of the agreement of two annotators were analyzed with the use of R [10] and the `irr` package. The agreement rate is 83.6% , with the Cohen's Kappa value of 0.45 (i.e., moderate agreement, [14]). Table 6 provides a summary of the annotator agreements. 16% of comments were observed with no agreement. As in the previous study case, the final tags

Tab. 6. Annotator agreement analysis

Matching annotations	Frequency	%
Two agreements	1,613	83.79
Without agreement	312	16.21
Sum	1,925	100.00

Tab. 7. YouTube study results

Tag	Frequency	%	% (NONE excl.)
NONE	1,563	81.19	–
AU	32	1.66	8.84
OTHER	19	0.99	5.25
SE	20	1.04	5.52
PR	2	0.10	0.55
WA	16	0.83	4.42
ZD	49	2.55	13.54
PO	25	1.30	6.91
UC	199	10.34	54.97
Together	1,925	100.00	100.00

for these cases were established *via* discussion between annotators.

3.3. Results

Table 7 shows the frequency of observed categories. Analogically to the Reddit study, most tags indicate that no anthropomorphization was observed: NONE. Exemplary comments of this kind are: "I have a WEIRD question. Can it play music. Like Alexa"; "my dad literally reset my vectors data. I had him for 2 years and now all data lost".

Vector anthropomorphization tags account for 18.81% of the entire sample analyzed. The most common among them is the UC tag, denoting *feelings* of the human toward the robot. E.g., "it was adorable when it fell awww"; "nuu my heart sank when it fell xD"; "I love my vector more than life not even joking".

The second visible category is ZD – i.e., referring to Vector as pet. This may be observed in the following exemplary comments: "Is this just to be cute? Like a cute pet? I think I want it cause I want a cat but this might be more worth it and easier to care for lol."; "I want to buy that a pet robot"; "Being able to pet a robot is my life's dream".

4. YouTube and Reddit Comparison

The presented exploratory studies of Reddit and YouTube data allow for interesting comparison. In both cases, we are dealing with attitudes toward Vector expressed in a natural language. We believe that it is worth asking whether these sources differ in terms of attitudes expressed. The intuition here is that the type of data source – textual vs. visual – matters for Vector's perception. Figure 2 shows the percentage of each tag's appearance in both studies (excluding the NONE tag).
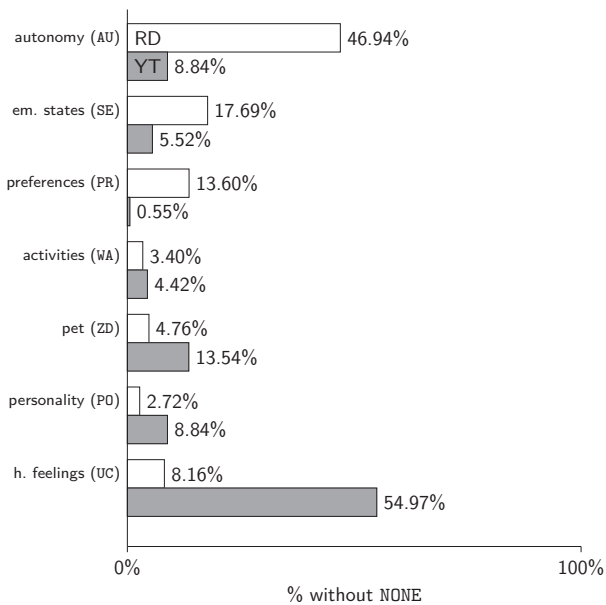
Fig. 2. Comparison of the results obtained in the Reddit (RD) and YouTube studies (YT)

One may easily notice that there are two major categories in the annotated data. The first one is AU, which denotes comments concerning Vector's autonomy. The second one is the UC tag, related to the description of human feelings toward the robot. AU constitutes the prevalent class in Reddit data (whereas the numbers of this class of comment for YouTube data are small – 46.94% vs. 8.84%). In the YouTube data it is UC dominating the entire sample (while the numbers for Reddit are small – 54.97% vs. 8.16%). It may be also observed that these classes really dominate the two analyzed samples.

Our exploratory analysis shows that the perception of Vector (as extracted from users' comments) differs between Reddit and YouTube. Several factors may be the reason for the observed difference.

First, Reddit users are more likely to actually own a Vector at home, which we can conclude from the detailed descriptions of Vector, posting photos or knowing its technical details. Owners are able to write more about Vector's functions or abilities as they spend time with it. Daily activities together allow for gathering more experiences, and as a consequence they describe Vector from a broader perspective. Thus, the majority of comments in our sample refer to the Vector's autonomy (observed in those daily activities). We think that in the case of YouTube, most users comment on what they see on a given video. The films lasted from 3 to 12 minutes, so they could only draw conclusions from the few minutes they watched. In the case of YouTube, the AU tag comprised 8.84%, making it the third most common tag. The videos briefly described Vector's abilities, hence the comments about the robot's autonomy, but not as popular as in the case of Reddit.

Second, this difference may be due to the nature of the two platforms. Long posts and comments are more common on Reddit. People share their problems

and thoughts, and express themselves when they have time. The forum prompts the user to enter it deliberately when (s)he wants to comment or read something. YouTube is specific about the opposite. Comments are short, written immediately after viewing the recording or during it.

Due to both factors, comments expressing human feelings toward Vector appear to be the more natural ones to appear on YouTube. Users watch the video and then comment that they like Vector. They think Vector is cute, so they write a short comment of this form immediately. We believe that the way in which a video is presenting Vector (light, music) also has an impact on how the robot is perceived, as these factors influence the general mood of a user. YouTube commenters assess Vector's functions and skills on the basis of what has been presented, so they describe the overall impression Vector made on them.

This tendency is also visible for other, less represented categories. Let us focus on assigning preferences to Vector (PR). This needs knowledge and experience with the robot, requires interactions and observations of Vector in different situations. It is difficult to extract preferences from short videos about Vector. Among the YouTube comments, PR constitutes only 0.55% of observed categories, and on Reddit it is 13.61% .

5. Conclusion

We have presented an exploratory analysis of human attitudes toward the social robot Vector. One aim was to describe Vector in terms of categories referring to Vector's autonomy, preferences, emotions, etc. We have used two non-laboratory data sources: Reddit and YouTube. Overall, 2,635 comments were manually annotated with a specially prepared tag-set. This allowed us to realize the second goal, i.e., to compare these sources with respect to Vector's image reflected in users' comments.

A general observation is that Vector is described according to its social robot status and tends to evoke positive emotions. It is perceived as an autonomous agent, which is capable of showing its preferences. Vector is also compared to a pet. We believe that the tag-set designed and tested for this study offers a good starting point for future studies focused on other social robots.

The results confirm the intuition that the source of the linguistic data is important for attitudes research. One should bear in mind the characteristic features of such a data source and its target audience. Different sources may be used together, to grasp a more diverse picture, or separately, to compare different views. The presented study may be therefore extended with Vector references in Twitter threads, for example.

This brings us to the issue of the frequency of observed attitudes in our sample. As noticed, the vast majority of tags in the sample were NONE. The percentage is a similar figure: 81.19% for the YouTube comments and 79.30% for the Reddit comments. This suggests that one needs to gather large data samples for

analysis of the presented type, especially if one would like to aim for a more fine-grained tag-set than the one we have used here.

At the end, we want to address certain limitations of the presented study. First of all, it is uncertain whether the beliefs expressed in the comments are actual beliefs. Users can simply comment on the material spontaneously or jokingly. The advantage, however, is easy access to linguistic data obtained in a non-laboratory manner. Statements that have actually been written in the wild are analyzed, not those that were created for the purpose of the study.

There is also a risk that the data obtained in the YouTube study refer not to the entire film, but only to fragments of it. Comments may contain statements but refer to a different situation in the movie. The word "good" can refer to both Vector and the person presenting it, to the editing of the video, to the amusing situation depicted, or to some other element that does not involve the attitude toward the robot. We believe that the manual annotation process mitigates both pointed risks.

The annotation procedure for this study focused on entire comments as basic annotation units. On the one hand, it makes the annotation procedure easier, but on the other (especially for the long-elaborated comments), it may lead to disagreements between annotators and result in lower agreement scores. We will address this in our future studies. The basic annotation unit will be decided by an annotator, and more than one attitude in one comment may be labeled this way. We should also involve more annotators and provide them with training before the main annotation task.

Notes

[1] Steve Crowe, *Anki, consumer robotics maker, shuts down*, The Robot Report, `https://www.therobotreport.com/anki-consumer-robotics-maker-shuts-down/`.

[2] Steve Crowe, *Anki addresses shutdown, ongoing support for robots*, The Robot Report, `https://www.therobotreport.com/anki-addresses-shutdown-ongoing-support-for-robots/`.

[3] Original spelling is preserved in all the comments presented in this paper.

[4] [r/AnkiVector, May 02, 2019] `https://www.reddit.com/r/AnkiVector/comments/bjz5w5/really_interesting_how_that_small_robot_impact/`.

[5] [r/AnkiVector, "My heart is breaking" May 03, 2019] `https://www.reddit.com/r/AnkiVector/comments/bk36zv/my_heart_is_breaking/`.

[6] For comparison, the human-likeness score from the ABOT database [8] is: 96.95 (the maximum is 100) for Nadine, 92.6 for Geminoid, 78.88 for Sophia, 73.0 for Bina48, 45.4 for Asimo – while the ABOT Predictor estimates this factor for Vector on the level of 6.1 (see [11, p. 1801]).

[7] `https://osf.io/yfuzt/`.

[8] We may hypothesize that this effect is partially due to the focus on the textual comments. We omitted pictures and video materials posted to Reddit, which – according to our observations – often present the aforementioned joined Vector-user activities.

[9] Vector and Cozmo are visually very similar to each other – the differences are on the level of programming solutions and the way you interact with them (`https://ankicozmorobot.com/cozmo-vs-vector/`, accessed 30.11.2022). Thus, we have decided to use this video, as on the level of this material, the differences are not apparent. What is more, the chance that a comment related to Cozmo will appear in the data was minimized by the manual process of annotation.

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REFERENCES

[1] C. Bartneck, E. Croft, and D. Kulic, "Measuring the anthropomorphism, animacy, likeability, perceived intelligence and perceived safety of robots". In: *Proceedings of the Metrics for Human-Robot Interaction Workshop in affiliation with the 3rd ACM/IEEE International Conference on Human-Robot Interaction (HRI 2008)*, 2008.

[2] C. Bartneck and J. Forlizzi, "A design-centred framework for social human-robot interaction". In: *RO-MAN 2004. 13th IEEE International Workshop on Robot and Human Interactive Communication (IEEE Catalog No. 04TH8759)*, 2004, 591–594.

[3] C. Breazeal, "Toward sociable robots", *Robotics and autonomous systems*, vol. 42, no. 3-4, 2003, 167–175.

[4] T. Fong, I. Nourbakhsh, and K. Dautenhahn, "A survey of socially interactive robots", *Robotics and autonomous systems*, vol. 42, 2003, 143–166.

[5] Q. R. Hover, E. Velner, T. Beelen, M. Boon, and K. P. Truong, "Uncanny, sexy, and threatening robots: The online community's attitude to and perceptions of robots varying in humanlikeness and gender". In: *Proceedings of the 2021 ACM/IEEE International Conference on Human-Robot Interaction*, 2021, 119–128.

[6] T. Li, L. Lin, M. Choi, K. Fu, S. Gong, and J. Wang, "Youtube av 50k: an annotated corpus for comments in autonomous vehicles". In: *2018 International Joint Symposium on Artificial Intelligence and Natural Language Processing (iSAI-NLP)*, 2018, 1–5.

[7] M. Mori, "Bukimi no tani (the uncanny valley)", *Energy*, vol. 7, no. 4, 1970, 33–35.

[8] E. Phillips, X. Zhao, D. Ullman, and B. F. Malle, "What is human-like?: Decomposing robots'

human-like appearance using the anthropomorphic robot (abot) database". In: *2018 13th ACM/IEEE International Conference on Human-Robot Interaction (HRI)*, 2018, 105–113.

[9] N. Piçarra, J.-C. Giger, G. Pochwatko, and J. Możaryn, "Designing social robots for interaction at work: socio-cognitive factors underlying intention to work with social robots", *Journal of Automation Mobile Robotics and Intelligent Systems*, vol. 10, 2016.

[10] R Core Team. *R: A Language and Environment for Statistical Computing*. R Foundation for Statistical Computing, Vienna, Austria, 2013.

[11] D. Ratajczyk, "Shape of the uncanny valley and emotional attitudes toward robots assessed by an analysis of youtube comments", *International Journal of Social Robotics*, vol. 14, no. 8, 2022, 1787–1803.

[12] M. Strait, A. S. Ramos, V. Contreras, and N. Garcia, "Robots racialized in the likeness of marginalized social identities are subject to greater dehumanization than those racialized as white". In: *2018 27th IEEE International Symposium on Robot and Human Interactive Communication (RO-MAN)*, 2018, 452–457.

[13] M. K. Strait, C. Aguillon, V. Contreras, and N. Garcia, "The public's perception of human-like robots: Online social commentary reflects an appearance-based uncanny valley, a general fear of a "technology takeover", and the unabashed sexualization of female-gendered robots". In: *2017 26th IEEE International Symposium on Robot and Human Interactive Communication (RO-MAN)*, 2017, 1418–1423.

[14] A. J. Viera and J. M. Garrett, "Understanding interobserver agreement: The kappa statistic", *Family Medicine*, vol. 37, no. 5, 2005, 360–363.

[15] E. Vlachos and Z.-H. Tan, "Public perception of android robots: Indications from an analysis of youtube comments". In: *2018 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*, 2018, 1255–1260.

[16] C.-E. Yu, "Humanlike robots as employees in the hotel industry: Thematic content analysis of online reviews", *Journal of Hospitality Marketing & Management*, vol. 29, no. 1, 2020, 22–38.