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Ethical perceptions towards real-world use of companion robots with older people and people with dementia: survey opinions among younger adults

Bradwell, Hannah L.; Winnington, Rhona; Thill, Serge; Jones, Ray B.

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3 Full title: **Ethical perceptions towards real-world use of companion robots with**
4 **older people and people with dementia: Survey opinions among younger**
5 **adults**

6 Short title: **Ethical perceptions of companion robot use for older people among**
7 **younger adults**

8 Authors: Bradwell, H. L.^{1*}, Winnington, R.², Thill, S.³ and Jones, R. B.¹.

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10 ¹ Faculty of Health, University of Plymouth, Plymouth, Devon, UK

11 ² Department of Nursing, Auckland University of Technology, 90 Akoranga Drive,
12 Northcote, Auckland, NZ.

13 ³ Donders Centre for Cognition, Radboud University, Nijmegen 6525 HR, The
14 Netherlands

15

16 * Corresponding author

17 Emails: hannah.bradwell@plymouth.ac.uk, rhona.winnington@aut.ac.nz,
18 s.thill@donders.ru.nl, ray.jones@plymouth.ac.uk

19 Orcid Numbers:

20 H. Bradwell: 0000-0002-9103-1069

21 R. Jones: 0000-0002-2963-3421

22 S. Thill: 0000-0003-1177-4119

23 R. Winnington: 0000-0002-6504-2856

24 **Abstract**

25 **Background:**

26 Use of companion robots may reduce older people's depression, loneliness and
27 agitation. This benefit has to be contrasted against possible ethical concerns raised
28 by philosophers in the field around issues such as deceit, infantilisation, reduced
29 human contact and accountability. Research directly assessing prevalence of such
30 concerns among relevant stakeholders, however, remains limited, even though their
31 views clearly have relevance in the debate. For example, any discrepancies between
32 ethicists and stakeholders might in itself be a relevant ethical consideration while
33 concerns perceived by stakeholders might identify immediate barriers to successful
34 implementation.

35 **Methods:**

36 We surveyed 67 younger adults after they had live interactions with companion robot
37 pets while attending an exhibition on intimacy, including the context of intimacy for
38 older people. We asked about their perceptions of ethical issues. Participants
39 generally had older family members, some with dementia.

40 **Results:**

41 Most participants (40/67, 60%) reported having no ethical concerns towards
42 companion robot use when surveyed with an open question. Twenty (30%) had
43 some concern, the most common being reduced human contact (10%), followed by
44 deception (6%). However, when choosing from a list, the issue perceived as most

45 concerning was equality of access to devices based on socioeconomic factors
46 (m=4.72 on a scale 1-7), exceeding more commonly hypothesized issues such as
47 infantilising (m=3.45), and deception (m=3.44). The lowest-scoring issues were
48 potential for injury or harm (m=2.38) and privacy concerns (m=2.17). Over half
49 (39/67 (58%)) would have bought a device for an older relative. Cost was a common
50 reason for choosing not to purchase a device.

51 **Conclusions:**

52 Although a relatively small study we demonstrated discrepancies between ethical
53 concerns raised in the philosophical literature and those likely to make the decision
54 to buy a companion robot. Such discrepancies, between philosophers and 'end-
55 users' in care of older people, and in methods of ascertainment, are worthy of further
56 empirical research and discussion. Our participants were more concerned about
57 economic issues and equality of access, an important consideration for those
58 involved with care of older people. On the other hand the concerns proposed by
59 ethicists seem unlikely to be a barrier to use of companion robots.

60 **Keywords**

61 Robot ethics, machine ethics, companion robots, social robots, older people, aged
62 care, health and social care, stakeholders, gerontology

63 **Background**

64 Robotics may provide a technological aid in meeting the increasing demand on
65 health and social care [1], caused in part by increasing life expectancy [1-3], as
66 human function deteriorates with age [4, 5]. Companion robots such as robot pets
67 designed congruent with animal aesthetics and behaviours, have particular potential

68 in aged care [6, 7]. The most well researched example is Paro, the robot seal [8].
69 Research has suggested numerous benefits of interacting with Paro, including
70 reduced agitation and depression in dementia [9, 10], a more adaptive stress
71 response [11], reduced care provider burden [11], and significantly improved affect
72 and communication between dementia patients and day care staff [12]. Furthermore,
73 Paro may reduce psychoactive and analgesic medication use [13], and even
74 decrease blood pressure [14]. Alternatives to Paro include, amongst others, Miro,
75 Pleo, and the Joy for All devices, some of which have been used in previous
76 research [15]. Although research with alternatives is limited (due to an apparent
77 selection bias for Paro and a limited availability of comparison studies [8, 16]), we
78 previously found evidence that more affordable, less sophisticated devices may offer
79 acceptable alternatives [17], with potential for reproducing the cited benefits of Paro
80 [18].

81 That said, these reported benefits need to be considered in the context of ethical
82 concerns of robot implementation with older people [19]. In the following, we review
83 some of the relevant literature for the most commonly discussed concerns, including
84 infantilisation, deception, reduced human contact and intrusions on privacy [19-21].
85 Sparrow and Sparrow [22] assessed the reported capacity of robots to meet older
86 people's needs, particularly considering social and ethical implications. The authors
87 claim to provide "a much-needed dose of reality" [p:143], suggesting that robots are
88 unable to meet social and emotional needs in almost all aspects of care. They raise
89 the issue of potential for harm, with technological restrictions and potential dangers
90 (eg. trip hazards), removing hopes of robots aiding with personal care, mobility or
91 daily tasks. Potential for harm raises the additional issue of accountability [should
92 harm result from robot implementation [23]. However, the most ethically controversial

93 proposed role for robots appears to be that of companions for older people, the
94 concept of which is sometimes reported as “positively bizarre” [p:308] [21], unethical,
95 and “akin to deception” [p:148] [22].

96 Regarding deception, some authors feel companion robot benefits rely on delusions
97 as to the real nature of the interaction, described by Sparrow [21] as “sentimentality
98 of a morally deplorable sort” [p:306], with this deceit making robot use misguided and
99 unethical. Sparrow [21] argued robot behaviour is merely imitation: robots do not
100 possess human frailties, and thus cannot ‘understand’ human experience and
101 mortality, rendering them incapable of appropriate, genuine, emotional response
102 [22]. Thus, the extent to which a person feels cared for depends on delusions of
103 robot capabilities. In contrast, Wachsmuth [24] discussed necessity of ‘true’ care for
104 older people, suggesting the illusion of responses to feelings and suffering of the
105 care recipient would suffice, despite a robot’s qualitative experience (without
106 neurophysiological basis for consciousness) not being a ‘true’ caregiver. Sparrow
107 and Sparrow [22] would likely disagree, reporting “the desire to place [robots] in such
108 roles is itself morally reprehensible” [p:154] as robots in roles requiring care,
109 compassion and affection expresses a “gross lack of respect for older persons”
110 [p:156].

111 Sparrow [21] further suggested that if an older person treats a robot pet as living,
112 thus engaging in the delusion, we have done them a disservice. This appears likely
113 to occur: Robinson et al. [25] noted participants interacted with Paro as a live pet,
114 with some perceiving Paro as having agency despite awareness the device was
115 robotic. The issue of deceit, in particular concerning the distinction between robot
116 and live pet becomes even more problematic with the presence of dementia [26].
117 Deception is therefore a common ethical concern specific to companion robots that

118 can also be problematic for acceptability among older people's relatives. Sharkey
119 [19] suggested that, despite a vulnerable older person enjoying robot pets, and
120 perhaps not distinguishing between living and not, relatives may feel they were
121 suffering humiliation and loss of dignity through deception (although it is also
122 possible this tension would ease upon witnessing potential quality of life benefits
123 [27]).

124 A further ethical issue commonly discussed is reduced human contact. The
125 substantial economic pressures within aged care may result in substitution of human
126 staff with robotic alternatives, which is problematic as human social contact provides
127 significant wellbeing benefits, autonomy and communication opportunities [22].
128 However, given the regrettably low standard of care provided on occasion by human
129 carers, possibly as a result of high demands including a large workload and low pay
130 [22], there is a well-documented increasing concern that older people can suffer
131 abuse and mistreatment [19]. Dignified treatment by human carers is therefore not a
132 given. In contrast, robots are unable to get angry, abuse an older person or become
133 tired and stressed. Therefore, a small reduction in human contact may be an
134 acceptable compromise for improved quality of care and interaction if robotics could
135 ease strain on human care providers. Support comes from research suggesting
136 reduced carer stress with Paro implementation [11, 28]. Furthermore, robots may
137 mediate social interaction [25], providing a conversation topic between staff, family
138 and older people, and more opportunities to engage socially [19]. Sharkey [19]
139 suggests however, despite solving negatives of human behaviour, robots also lack
140 the true positives; compassion, empathy and understanding. Sparrow and Sparrow
141 [22] argue, due to the crucial role of emotional labour and meaningful conversations
142 for wellbeing, any reduction in human contact would be indefensible.

143 A further ethical concern is infantilising, an issue also raised for doll therapy, seen by
144 some as congruent with the idea of second childhood, being dispiriting and deficit-
145 based [26, 29]. Infantilisation may damage acceptability for family members, as
146 supported by Robinson et al. [30] who reported that a care resident's son conveyed
147 their father was not the type to cuddle a soft toy. Another concern is equality of
148 access, as the current cost of companion robots may be prohibitive for people of
149 lower socioeconomic status, who would be denied the potentially therapeutic tool
150 [20, 31].

151 Whilst the literature is rich with commentary on potential ethical issues, we have
152 been researching real-world robot pet implementation with older people in care
153 homes, and to date, seen limited evidence of ethical concerns amongst older people
154 themselves. We have noted however, occasions where family members have
155 reported such concerns. Family members are key stakeholders in the care of older
156 relatives, and views of relevant stakeholders are fundamental for real-world use [32].
157 Presenting the views of relevant stakeholders is the core contribution we seek to
158 make with this paper. Successful real-world use of companion robots depends on
159 skilled and careful deployment by relatives and carers [19], thus negative ethical
160 perceptions would likely impair implementation, forming a barrier to adoption [33].

161 Some previous research has assessed perceptions of older people themselves,
162 including Wu et al. [34], whose results suggested ethical/societal issues presented a
163 potential barrier to robot use, namely privacy and reduced social contact. Pino et al.
164 [32] also conducted a survey and focus group with 25 older people and informal
165 carers, who discussed stigmatisation, privacy issues, dignity, infantilising, replacing
166 human carers, and cost being prohibitively high. Although the exploratory study
167 provided initial insight, with only seven informal carers surveyed, more research is

168 required specific to family member perceptions. A larger sample would additionally
169 allow a comparison between the highlighted concerns to identify the most significant
170 potential barriers. Furthermore, the study involved demonstration of only one robot
171 (RobuLAB 10), with PowerPoint demonstrations of other available socially assistive
172 robots, limiting participant ability to assess robot capabilities [35]. In contrast, we
173 surveyed opinions based on real-world interaction with companion robots, providing
174 informed perceptions with increased validity.

175 Views of health and social care professionals have also been reported. For example,
176 questionnaire results from 2365 trainee care professionals suggested participants
177 felt companion robots were more beneficial than monitoring or assistive robots, and
178 provided low ratings for maleficence [36]. Nonetheless, research directly surveying
179 ethical perceptions among older people's family members appears limited. Although
180 much literature debates ethics philosophically, providing a strong overview of
181 potential issues [37], fewer studies specifically assess stakeholder perceptions. Stahl
182 and Coeckelbergh [37] argued that, further to philosophical speculation, we need
183 dialogue and experimentation closer to the context of use. The authors suggest
184 academic reflection on ethics is divorced from the context of practice, with literature
185 mainly addressing what the robot ethics community "think are important ethical
186 issues" [p:154] whilst stakeholder voices remain unheard.

187 Here, we therefore explore perceptions and prevalence of ethical concerns among
188 younger adults as family members of potential end-users of companion robots, and
189 compare importance of various ethical concerns for this significant stakeholder
190 category, thus contributing to robot ethics understanding for real-world
191 implementation and potential barriers to successful use. This study addresses a

192 timely topic, with real-world and research use of social robot pets increasing, and
193 their use in dementia care being explored, both in the UK and elsewhere [6-18].

194 **Methods**

195 **Design**

196 This study is a cross-sectional survey with self-completed (with assistance where
197 needed) questionnaires following on from interaction with four companion robots.
198 Previous research relied only on videos and pictures for participants to form opinions
199 [32, 35]. Ethical approval was received from the Science and Engineering ethics
200 committee at the University of Plymouth.

201 **Procedure and robots**

202 We hosted an interaction station at a Science Gallery exhibition in November 2018.
203 The overall exhibition comprised 10-15 exhibits exploring the impact of technology
204 on connection (either negative or positive). Visitors to the exhibition were therefore
205 likely to have an interest in issues such as relationships and ethical considerations of
206 technology use in this context. Our station (a room in the Gallery) provided
207 discussions on intimacy for older people, and the potential role of companion robots,
208 and thus served as a good opportunity to survey ethical concerns within context.
209 Participants had the opportunity to interact with four examples of robots and toys for
210 use with older people (Figure 1).

211

212

213 Participants interacted with devices on the table, or picked up and held devices if
214 they chose. Following interactions, attendees were invited to take part, provided
215 written informed consent, then completed a survey.

216 **Survey**

217 Based on the literature, we designed a self-completed questionnaire on both sides of
218 one sheet of paper (Figure 2). The front page asked for participant demographics,
219 which robots they liked and if they might buy one, leading to an open question asking
220 if they had any concerns around the use of robot animals for older people or people
221 with dementia. The back page asked questions based on concerns raised in the
222 literature (reduced human contact, carer's convenience, privacy, affordability,
223 deception, infantilisation, potential injury) and seeking responses using 7-point
224 Likert-type scales questioning the importance of each ethical concern. Each item
225 was scored from 1 (not at all a concern) to 7 (very much a concern).

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233 **Results**

234 Sixty-seven people interacted with the robots and then agreed to complete a
 235 questionnaire. They had an average age of 28 years (Range 18-65, SD 10.99). Most
 236 (53/67 (79%)) reported having older adult relatives, and 11/67 (16%) had a relative
 237 with diagnosed dementia.

238 Section A of the survey first gained understanding of participant device preferences,
 239 likes and dislikes, available in Supplementary File 1. It is worth noting, only one
 240 dislike referred to a potential ethical concern (reducing human contact).

241

242 **Table 1: Responses to purchasing a device for an older relative (Q3)**

Response	N (%)	Additional			
Yes	39 (58)	Paro	Pleo	Cat	Dog
		10	4	14	10
No	21 (31)	Example Reasons			
		“Too expensive” “They can decide themselves” “I don’t think they’d like it” “Not into animals” “Not yet” “They have real animals”			
None/Unsure	7 (10)				

243

244 Most participants would purchase a device for an older relative (Table 1). Many
 245 participants suggested more than one device, and the most popular option was the
 246 Joy for All cat. It is also worth noting, that of the 10 participants who reported they
 247 would purchase a Paro, four wrote an additional comment such as “if cheaper or
 248 more affordable.” Price was also a common reason for participants reporting that
 249 they would not buy their relative a device, or a deciding factor on selecting a device

250 other than Paro. This would indicate financial cost is a key deciding factor, with no
 251 ethical concerns reported as the reason for not purchasing a device.

252

253

254 **Table 2: Responses to open question on general feelings towards companion**
 255 **robots for older people (Q4)**

Response	N (%)	Example Evidence
Positive	44 (66)	<p>“it would be very therapeutic for them”</p> <p>“I think it would be very successful in providing comfort to my relative with dementia, particularly the dog, for nostalgic purposes”</p>
Mixed	10 (15)	<p>“I struggle with the concept of replacing care with robotics but in neurodegenerative diseases such as AZ dementia it can be harder on family members sometimes and if it stimulates/soothes them then maybe”</p> <p>“A good idea, the problem would be making the robot responsive enough without it being too expensive”</p>
Negative	5 (7)	<p>“I would have thought it was a bit ridiculous”</p> <p>“I would be slightly worried of infantilising the person, the person may get upset or see it as a trick”</p>
None	8 (12)	

256

257 Table 2 demonstrates that the majority of participants felt positively when surveyed
 258 on general feelings towards companion robots for older people. Within the

259 participants with a mixed response, negative feelings are often justified based on
 260 potential benefits. A very small minority provided a completely negative response.
 261 Further example evidence can be found in Supplementary File 1.

262 **Table 3: Responses to open question on ethical concerns of companion robot**
 263 **use with older people (%) (Q5)**

Response	N (%)	Examples		
Concern	20 (30)	Concern	N	
		Batteries	2	“Emotional distress if the batteries ran out”
		Malfunction	1	“What happens if they malfunction?”
		Human Contact	7	“Might encourage people to be distant from the elderly”
		Robustness	1	“Toughness, can they withstand a fall?”
		Deception	4	“They could become confused as to whether the robot was real or not”
		Privacy	1	“Should not be connected to net (privacy)”
		Danger	2	“Tripping/falling”
		Dignity	2	“They may try to feed or walk them, potential embarrassment”
		Infantilisation	1	“May feel patronised, belittled with a fluffy toy”
No Concern	40 (60)	“No” “None” “No, it seems very safe”		
Unsure	2 (3)	“I don’t know” “Not sure”		
No Response	5 (7)			

264

265 Most (40/67) reported having no ethical concerns (Table 3). A further five left the box
 266 empty, perhaps also indicating a lack of concerns to report, or alternatively reflecting
 267 a lack of understanding. This would suggest that prevalence of instinctual ethical
 268 concerns is low. The concerns raised by 20 of the 67 participants are summarised in
 269 table 3, demonstrating that deception and reduced human contact were the most
 270 prevalent concerns noted by participants upon unprompted questioning of ethical
 271 issues. While prevalence was low, the examples do provide some support for the
 272 ethical issues reported in previous literature. However, the concerns around battery
 273 life, malfunctioning and robustness relate better to the performance of the robot,
 274 rather than ethical concerns. Some further examples are available in Supplementary
 275 File 1.

276 **Table 4: Potential ethical issues scored on Likert-scales based on level of**
 277 **concern (1= not at all a concern – 7=very much a concern).**

Potential Issue	Median	Mode	Mean	SD
Socioeconomic Status – Equality of Access	5	6	4.72	1.75
Robots for Carer Convenience	4	5	3.98	1.58
Infantilising	4	4	3.45	1.70
Deception	4	4	3.44	1.61
Reduced Human Contact	3	2	3.06	1.68
Injury or Harm	1	2	2.38	1.67
Privacy	2	1	2.17	1.54

283 Table 4 demonstrates that participants felt the most concerning factor related to
 284 equality of access to devices through socioeconomic factors. This concern received
 285 the highest mean score, but also the highest median and mode, meaning this issue
 286 was most commonly scored as of more concern. The second most concerning issue
 287 appears to be robots being used for carer convenience. The least concern was seen

288 for reduced human contact, privacy issues, and potential for injury of harm, all
289 receiving means, modes and medians below the midpoint of 3.5. Infantilising and
290 deception mean scores sit just below the midpoint, whilst the median and mode are
291 just above, demonstrating some concern.

292 Finally, we acknowledge a possible concern with our participant sample. That is,
293 despite the obvious participant interest in robotics as they attended this exhibition,
294 we recognise 14 out of the 64 participants did not report having an older relative. We
295 therefore analysed (crosstabs and Fisher exact tests) our data from our three key
296 reported outcomes for statistical difference between participants without an older
297 relative, with an older relative and with a relative with dementia. We found no
298 difference between the three groups for the three outcomes we assessed; decision
299 to buy/not buy (table 1) (.320, n=60, p=.925), general perceptions (table 2) (1.390,
300 n=59, p=.618), and ethical concerns (table 3) (5.897, n=62, p=.051). This would
301 suggest the default views of potential future stakeholders is congruent with actual
302 stakeholders.

303 **Discussion**

304 **Ethical concerns of stakeholders differ from those raised in the literature**

305 We have demonstrated ethical concerns highlighted during philosophical debate of
306 companion robot use [19-23, 26] may differ from those voiced by real-world target
307 groups. The majority of our participants would purchase a companion robot for an
308 elderly relative, suggesting any ethical concerns were not prohibitive to intention to
309 buy. As such, although an awareness of potential issues is evident, they do not
310 appear to weigh strongly enough to act as barriers to successful real-world

311 implementation. In particular, no specific ethical concerns were reported as a reason
312 for not purchasing a device.

313 The difference we have noted between robot ethics literature and real-world
314 stakeholders is an interesting result: speculative concerns raised in the literature [37]
315 appear mismatched with the priorities of family members within a real-world context.
316 It is of course possible that the lack of significance placed on debated issues by a
317 key stakeholder group may in fact point to a need to increase awareness of these
318 concerns. As such, we have identified a need for further reflections, in the ethics
319 literature, on the implications of a real-world stakeholder group not sharing the same
320 concerns as those raised by the robot ethics community. Whilst stakeholders have
321 demonstrated ethical concerns in previous, mainly qualitative research with small
322 samples [32, 38], re-evaluation may be required in light of these more empirical
323 findings.

324 **Economic cost is an important factor**

325 Interestingly, economic cost of companion robots presented itself as a continual
326 theme throughout our results, for example as a common reason for not wishing to
327 purchase a device for an older relative further to lack of interest in animals, or limited
328 requirement for such a device. Further support for the central role of the cost barrier
329 comes from participant comments on Paro. Although ten participants suggested they
330 would purchase Paro for a relative, four added the condition “if cheaper.” Financial
331 output is clearly a key deciding factor, and whilst others [39] have demonstrated the
332 cost-effectiveness of Paro as a psychosocial wellbeing activity for older people, the
333 initial expenditure appears prohibitive for family members, a stakeholder group likely
334 to be responsible for purchasing such devices for older relatives. The issue of cost

335 was repeated throughout responses to various questions in our study, including a
336 participant suggesting the challenge faced in companion robot development is
337 “making the robot responsive enough without it being too expensive.” The idea of
338 “responsive enough” is therefore a topic for further exploration [17, 18]. The younger
339 demographic of the sample could also help explain this result, as cost may be less
340 important among a sample of stakeholders already paying for elder care.

341 **A minority are concerned about reduced human contact and deception**

342 When surveyed with an open question on ethical concerns, most participants
343 reported no concerns. The concerns highlighted by 20/67 (30%) participants
344 however, were congruent with the previous literature. The issues highlighted most
345 often were reduction in human contact, and deception. Companion robots may
346 mediate social contact [25], and reduce care provider burden [11, 28], potentially
347 improving quality of care, therefore further research may be required to directly
348 assess impact on social contact of real-world companion robot implementation,
349 based on both quantity and quality of subsequent human interaction. In the
350 meantime, as suggested by Chiberska [20], we must ensure this technology is
351 applied appropriately. Furthermore, the potential benefits [9-14] make it harder to
352 justify avoiding companion robot use based on ethical concerns [19-23, 26] that do
353 not appear to be a particular concern among family members as real-world
354 stakeholders. It has for example been suggested [27] that family members may
355 justify concerns such as deceit upon witnessing benefits of interaction for their
356 relative. This is supported in our results (Table 2): participants presented conflicted
357 opinions, beginning with an ethical concern and often justifying the issue so long as
358 interactions were beneficial in stimulating or soothing relatives, or eased challenges
359 faced by family members.

360 The issue of deception is more difficult to mitigate. Whilst real-world companion robot
361 implementers can be mindful of complementing human contact, rather than
362 substituting entirely, ensuring a lack of deception is more difficult when working with
363 individuals with dementia [26]. Older people with dementia may indeed perceive
364 robots as social agents and engage with them as such [18, 21], which is reported
365 within the literature as unethical and problematic [21]. However, with only 4/67 (6%)
366 participants reporting this concern, prevalence is low. This contrasts the specific
367 suggestion that relatives may themselves feel that their family member was suffering
368 humiliation and a loss of dignity through deception [19]. Thus, it does appear that
369 philosophical debate on ethical concerns differs from the priorities of a real-world
370 stakeholder group. As previously noted [37], there is a requirement in the literature to
371 complement the speculative debate with dialogue within the context of use, providing
372 a voice to stakeholders. Our study would suggest family member concerns on
373 deception are unlikely to form a major barrier to real-world use.

374 Of further interest from the open question on ethical concerns, was that three of the
375 concerns raised (Table 3) related to performance of the device rather than moral
376 ethical concerns. This would suggest these participants did not hold moral concerns
377 around the use of companion robots with older relatives; rather, they wanted to
378 ensure their reliable and successful use.

379 **Perceived importance of ethical concerns when prompted**

380 The Likert-scales also produced interesting results (Table 4). As we used a 7-point
381 scale, a midpoint would be 3.5. When looking at the means received by each issue,
382 only two were scored above the midpoint of 3.5, and thus suggesting some level of
383 concern: use of robots for carer convenience and inequality of access through

384 socioeconomic status. This provides further support for the impact of high economic
385 cost on the real-world uptake of companion robots, and furthers the argument that
386 the ethical concerns commonly debated [19-23, 26] hold little impact and relevance
387 to family members, as key stakeholders in their older relatives care. Although
388 reduced human contact, privacy issues, infantilisation, deception and potential for
389 injury are commonly debated in robot ethics literatures [19-23, 26], all received
390 means below the midpoint of 3.5, suggesting little prevalence of concern among
391 younger adult family members. Infantilising and deception did receive modes of 4,
392 suggesting some concern, but were still scored of lower concern than carer
393 convenience and equality of access.

394 **Negative views demonstrate that the suitability of companion robot is not** 395 **universal**

396 The small number of participants in our survey with negative views towards the
397 robots would suggest these devices are not suitable for everyone, and that there will
398 be incidences of negative response, as seen in previous research [18, 30]. Similar
399 incidences were seen in our survey, such as a participant reporting the idea of
400 companion robots “was a bit ridiculous,” importantly, however, negative views
401 accounted for only 5/67 (7%) responses to the open question on general feelings
402 towards companion robots for older people (Table 2).

403 **Limitations and strengths**

404 This research has provided important insight into the ethical perceptions of the
405 stakeholder group of younger adult family members, a group that have been shown
406 in previous research to hold impactful opinions towards the real-world use of
407 companion robots [30], and who have been identified as a key stakeholder group to

408 be consulted on ethics [19, 20, 32]. However, a limitation of this study is that there
409 remains a requirement for further dialogue with additional stakeholder groups (older
410 people themselves, care providers, robot designers), to further previous work with
411 small samples and mainly qualitative focus [32, 34] and build a clearer picture of
412 prevalence of ethical concerns within the context of real-world use, as we have. Pino
413 et al. [32] noted that informal carers were less sensitive to privacy concerns than
414 older people with cognitive impairments, who were concerned surveillance
415 applications could damage their privacy. Carers were more positive towards the risk-
416 prevention applications. It is therefore possible that the family members in our
417 research felt more positively about certain ethical aspects than older people would
418 themselves, identifying the importance of further and continuing ethical research with
419 the wider stakeholder groups. Establishing prevalence of ethical concerns is
420 particularly important in the context of 'real-world' use, as highly prevalent issues are
421 likely to form barriers to adoption and would signal the requirement for further
422 considerations.

423 A limitation of our sample is possible distance between our participants and their
424 older relatives, due to the potential participants were not currently directly involved in
425 care of older relatives. It is possible results would differ among a sample of informal
426 carers as stakeholders. Historically, however, family members such as emerging
427 adults (18-25), adolescents and younger children have been neglected from
428 inclusion as stakeholders in older relatives care, despite care involving a whole
429 family system, not only a spouse or older adult child [40]. The lack of similar studies
430 available currently would suggest this neglect is still occurring, highlighting the value
431 of our work and relevance of our participants. Furthermore, younger adults may
432 experience additional impact through the burden experienced by their parents, who

433 may be caring for a grandparent [40]. Expanding our understanding of 'stakeholder'
434 could have additional positive implications and acknowledging younger adults as
435 secondary, or perhaps more distant stakeholders could provoke more research into
436 the experiences of this group, and their potential in supporting with the ever-
437 increasing burden of disability associated with the aging population.

438 We also acknowledge the relatively small sample, but, as noted by others [37], the
439 traditional approach to ethics literature for healthcare robots has mainly involved
440 philosophical reflection, creating a strong requirement for studies that report
441 participant dialogue on ethical concerns acknowledged as limited within the
442 literature. Therefore, our findings are of strong relevance to the social robot and
443 gerontological community in providing interesting data and insight into a previously
444 understudied area. This study also provides the basis for further research, and
445 prompts further ethics studies reporting stakeholder perceptions. An important
446 implication of our work is that it creates further questioning in this area, and should
447 provoke more exploration into a potential misalignment between stakeholders and
448 ethicists, further to investigations into reasoning. Whilst our study does not address
449 the mismatch in full, it does begin the process of endeavour in this area. Future
450 research may also look to develop methodologically, perhaps with video scenarios of
451 specific instances of ethical concerns. Future research might also consider the
452 ethical perceptions of alternative forms of socially assistive robots, such as Pepper
453 [41] that are currently too expensive for widespread use. We chose to focus on robot
454 pets as these devices are currently starting to be deployed across a greater number
455 of situations in real-world implementation, as they are more affordable and
456 accessible.

457 **Conclusion**

458 We have found interesting differences between the robot ethics community and real-
459 world stakeholders regarding priority concerns for ethical use of companion robots
460 with older adults, which can inform further dialogue in the ethics community. We
461 have further identified a need for ethical literature reflecting on the implications that
462 stakeholders appear not to share the concerns commonly debated in literature.
463 Issues such as infantilisation and deceit appear less relevant to stakeholders of such
464 devices than equality of access due to prohibitively high costs of currently available
465 companion robots. The finding that cost is a primary influential factor is an important
466 outcome of this study, rarely discussed in previous literature, providing an important
467 consideration for robot developers and implementers targeting aged care end-users.
468 A further implication for those working in aged-care is that implementation of such
469 devices is unlikely to encounter many ethical barriers among relatives, despite
470 previously reported concerns.

471 **List of Abbreviations**

472 Not applicable

473 **Declarations**

474 *Ethics approval and consent to participate*

475 Ethical approval was received from the Faculty of Science and Engineering ethics
476 committee at the University of Plymouth and participants provided written informed
477 consent.

478 *Consent for publication*

479 Not applicable

480 *Availability of data and materials*

481 Additional data used and/or analysed during the current study are available in the
482 supplementary file.

483 *Competing interests*

484 The authors declare that they have no competing interests.

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493 *Authors' contributions*

494 All authors read and approved the manuscript.

495 HB designed the study, performed data collection, analysed and interpreted results
496 and lead on producing the manuscript.

497 RW supervised the project, provided expertise and advice towards the study
498 conception and design, discussed results and substantively revised the manuscript.

499 ST supervised the project, provided expertise and advice towards the study
500 conception and design, discussed results and substantively revised the manuscript.

501 RJ supervised the project, provided expertise and advice towards the study
502 conception and design, discussed results and substantively revised the manuscript.

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629

630 **Figure Legends**

631 **Figure 1: From left, Paro, Pleo, Joy for All dog, Joy for All cat.**

632 **Figure 2. The questionnaire.**

633