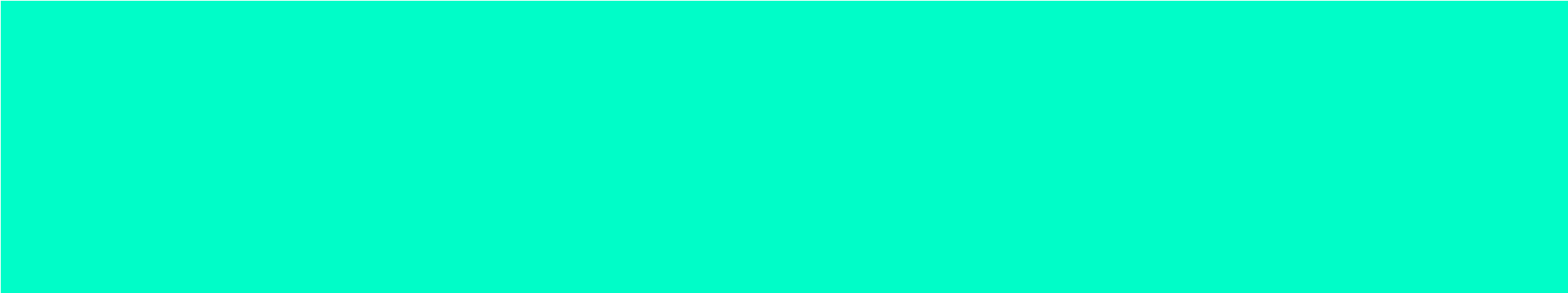
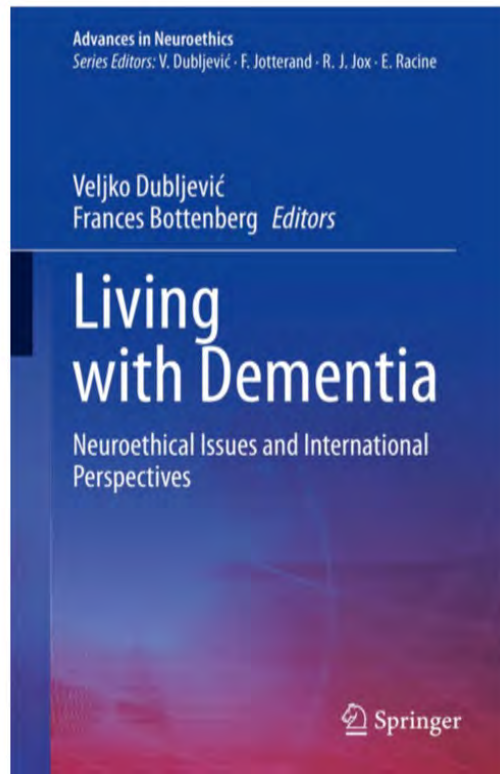


Ethical Social Robotics for Dementia Resilience

Veljko Dubljevic Ph.D., D.Phil
Contact: veljko_dubljevic@ncsu.edu



Starting off with some shameless self-promotion



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Printed book

Hardcover

Veljko Dubljević, Frances Bottenberg (Eds.)

Living with Dementia

Neuroethical Issues and International Perspectives

Series: **Advances in Neuroethics**

- Covers issues related to dementia diagnosis, treatment, support and policy
- Discusses qualitative, first- and second-person data used to develop, test or refine theoretical proposals
- Includes cutting-edge international research that highlights global innovations in philosophical and applied work

This book addresses current issues in the neuroscience and ethics of dementia care, including philosophical as well as ethical legal, and social issues (ELSI), issues in clinical, institutional, and private care-giving, and international perspectives on dementia and care innovations. As such, it is a must-read for anyone interested in a well-researched, thought-provoking overview of current issues in dementia diagnosis, care, and social and legal policy. All contributions reflect the latest neuroscientific research on dementia, either broadly construed or in terms of the etiologies and symptoms of particular forms of dementia. Given its interdisciplinary and international scope, its depth of research, and its qualitative emphasis, the book represents a valuable addition to the available literature on neuroethics, gerontology, and neuroscientific memory research.

CAUTION

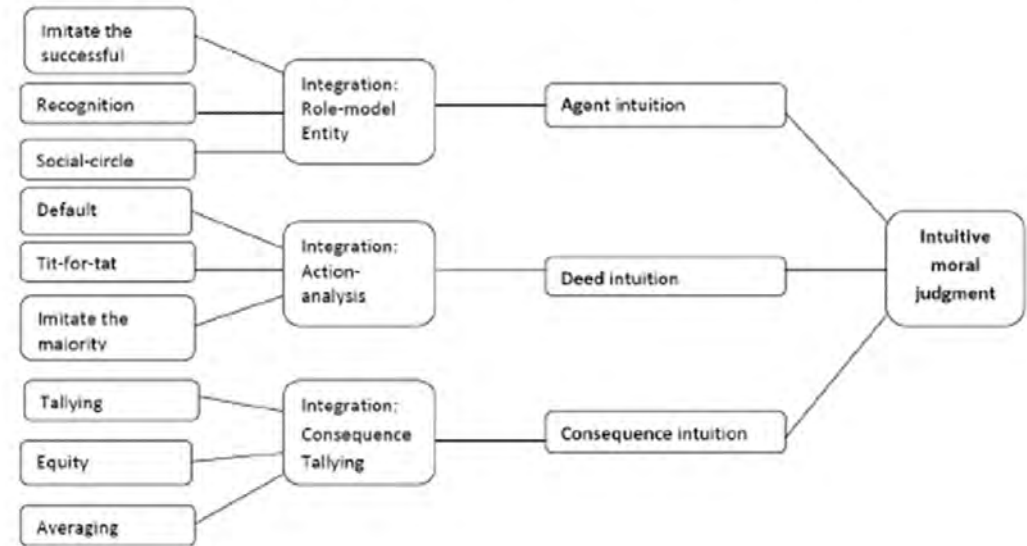


**AREA UNDER
CONSTRUCTION**



Roadmap

- Dementia and caregiving burden
- Carebots as a solution
- Prior empirical work
- Challenge: Ethical guidance functions
- Is ethics for carebots really necessary?



- ADC Model
- Empirical research corroborating the model
- Current project and way forward

Two of Global Grand Challenges for Society

- Demographic changes in aging societies accompanied by the high prevalence of Alzheimer's Disease and related dementias are an increasing burden (Cheng et al. 2013)
- 36 million people had dementia worldwide in 2010, and this number is estimated to increase to 66 million by 2030 (Batch & Mittelman 2012)
- The global cost of dementia in 2010 was \$604 billion (FCA 2016)
- In U.S. alone, 15.7 million adult family caregivers look after a person with dementia (FCA 2016)
- Widespread adoption of Artificial Intelligence (AI) risks introducing dehumanizing technologies into healthcare (Vandemeulebroucke et al. 2018)
- Advances in robotics technology, consumer electronics, and telehealth are allowing some aspects of healthcare, and especially eldercare, to be automated or delegated to AI (Charova et al. 2011, Robotics Today 2015, Szondy 2015, Aminuddin et al, 2016, Ackerman 2018, Haselton 2018, Camp 2019, McGinn et al. 2019)
- There is substantive disagreement about how to evaluate the moral risks and benefits of introducing AI or carebots into care settings (Vallor 2011)

The caregiving burden and the way forward

- Families provide 75% of dementia care (Schulz & Martire 2004)
- At \$470 billion in 2013, the value of unpaid caregiving exceeded both paid home and Medicaid spending in that year (FCA 2016)
- Over 75% of all caregivers are female, and they provide care at a significant personal cost and risk to their own psychological and physical wellbeing (Sorensen et al. 2006)
- 10% of dementia caregivers may have major depression, and 62% minor depression (Schulz & Martire 2004)
- One of the proposed solutions to these challenges is use of carebots for persons living with dementia
- 3 types of carebots are available: i) virtual AI assistive technologies (e.g., Jibo, ElliQ, Microsoft HealthBot), ii) animal-like carebot companions (e.g., PARO, AIBO), and iii) complex humanoid carebots (e.g., Pearl, NAO, Pepper)

Crucial question: which carebots have the potential to reduce the gap between the numbers of caregivers and people requiring dementia caregiving?

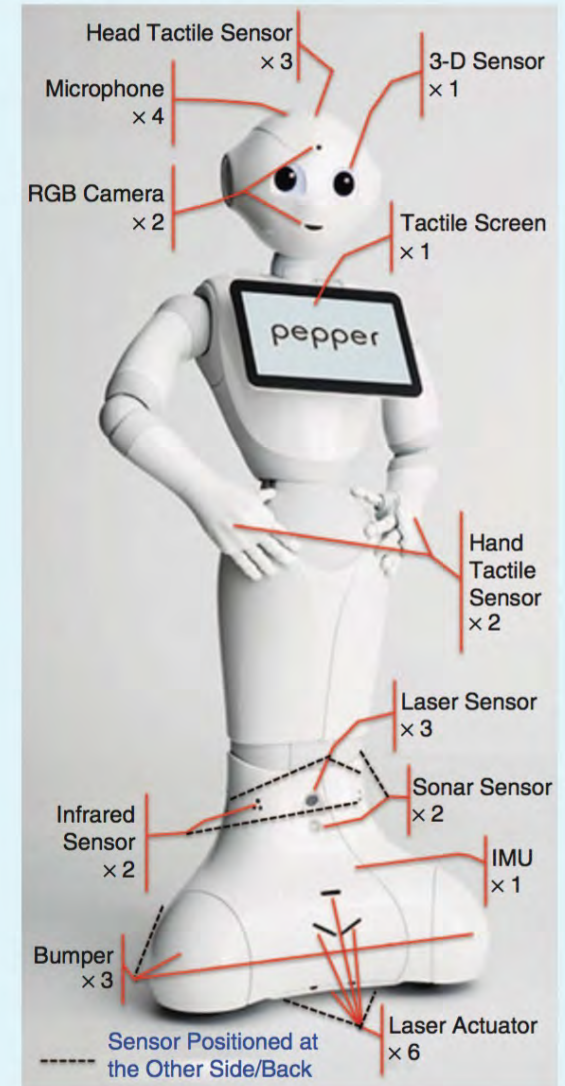
Three types of carebots

Animal-like carebot companions (e.g., AIBO) →

Desktop AI-based assistive technologies (e.g., Jibo) ↓



complex humanoid → carebots (e.g., Pepper)



Ethical issues identified in the debate on carebots

1. Objectification of the elderly as “problems” to be solved by technology

(Sparrow & Sparrow 2006).

2. The potential for carebots to either enhance or restrict the capabilities, freedom, autonomy, and/or dignity of cared-for

for (Decker 2008)

3. The potential of carebots to enhance or reduce engagement of cared-for with their surroundings

(Borenstein & Pearson 2010).

4. The potential of carebots to enhance or intrude upon the privacy of cared-for (Sharkey & Sharkey 2010).

5. The quality of physical and psychological care robots can realistically be expected to supply (Coeckelbergh 2010)

6. The potential of carebots to either reduce or enhance cared-for’s levels of human contact with families and other human caregivers

(Sparrow & Sparrow 2006)

7. The potential of carebot relations to be

inherently deceptive or infantilizing (Turkle 2006)

-
- ☐ 1 **No difficulty**, either subjectively or objectively.
 - ☐ 2 Complains of forgetting location of objects. **Subjective work difficulties.**
 - ☐ 3 Decreased job functioning evident to co-workers. Difficulty in traveling to new locations. **Decreased organizational capacity.**
 - ☐ 4 **Decreased ability to perform complex tasks**, e.g. planning dinner for guests, handling personal finances (such as forgetting to pay bills), etc.
 - ☐ 5 **Requires assistance in choosing proper clothing** to wear for the day, season, or occasion, e.g. patient may wear the same clothing repeatedly, unless supervised.
 - ☐ 6a **Improperly putting on clothes without assistance or cuing** (e.g. may put street clothes on over night clothes, or put shoes on wrong feet, or have difficulty buttoning clothing) occasionally or more frequently over the past weeks.
 - 6b Unable to bathe (shower) properly (e.g., **difficulty adjusting bath-water (shower) temperature**) occasionally or more frequently over the past weeks.
 - 6c **Inability to handle mechanics of toileting** (e.g., forgets to flush the toilet, does not wipe properly or properly dispose of toilet tissue) occasionally or more frequently over the past weeks.
 - 6d **Urinary incontinence** (occasionally or more frequently over the past weeks).
 - 6e **Fecal incontinence** (occasionally or more frequently over the past weeks).
 - ☐ 7a Ability to speak limited to approximately **a half a dozen intelligible different words or fewer**, in the course of an average day or in the course of an intensive interview.
 - 7b Speech ability limited to the use of **a single intelligible word** in an average day or **in the course of an interview** (the person may repeat the word over and over).
 - 7c Ambulatory ability lost (**cannot walk without personal assistance**).
 - 7d **Cannot sit up without assistance** (e.g., the individual **will fall over if there are no lateral rests [arms] on the chair**).
 - 7e **Loss of ability to smile.**
 - 7f **Loss of ability to hold up head independently.**
-

Functional Assessment Staging (FAST) categories

(Reisberg 1988)

Only complex humanoid carebots have the potential to help in stages 3 and above



Wang et al. 2017

Empirical Research with Dementia Patients, Caregivers and Carebots

Study with ten older adults with mild-to-moderate dementia and difficulty completing activity steps, and their family caregivers. Older adults were prompted by the robot to wash their hands in the bathroom and make a cup of tea in the kitchen. Caregivers observed interactions.

Positive consequences include decreased frustration, stress, and relationship strain, and increased social interaction via the robot. A **negative** consequence could be decreased interaction with caregivers.

Three themes emerged:

- 1. Contemplating a future with assistive robots,***
- 2. Considering opportunities with assistive robots,*** and
- 3. Reflecting on implications for social relationships***

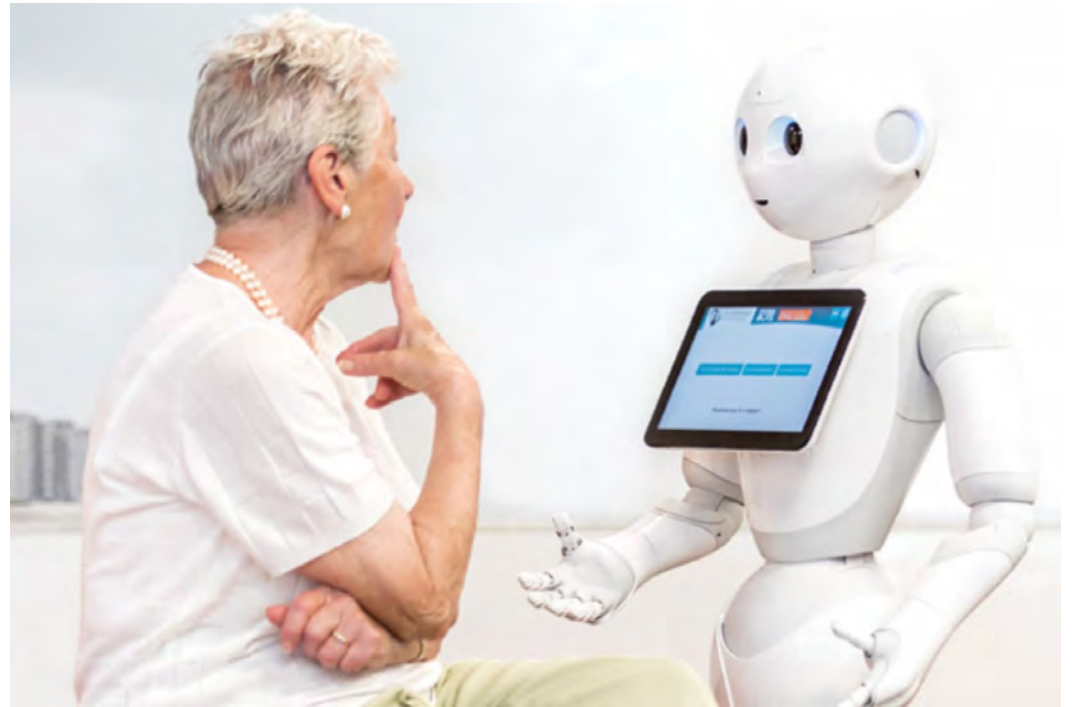
Caregivers identified numerous opportunities and were more open to robots. Several wanted a robot, if available.

Wang et al. 2017

General ethical issues in AI and Carebots

The fields of AI and Robotics have grown significantly in recent years, which has brought up a range of ethical debates, including:

1. How we can make sure that the technology implementation is fair & transparent?
2. Who should be held accountable for negative consequences?
3. How can AI be programmed to behave ethically?



Ethical AI is Necessary for Carebots

Recognizing and responding to Elder Abuse or Neglect (protecting dementia patients)

- A diagnosis of dementia has important ramifications for human dignity as it instantly and unavoidably alters social relationships
- It signals the change from full moral agency and equal standing in decision making and conversation to being cared for
- Elder abuse and neglect is far too common (Cooper et al. 2008), and some incidents are truly shocking (Phillips 2018)

Recognizing neglect/abuse is essential

Recognizing and responding to problematic/immoral behaviors in dementia patients

- Alzheimer's in late stages, and Frontotemporal dementia in early stages, cause disinhibition, social inappropriateness, personality changes, hyper-sexuality, and hyper-orality (Rascovsky et al. 2011).
- Markedly impaired socio-moral judgements (Manes et al. 2011)
- Antisocial behaviours: physical assaults, theft, paraphilia, etc. (Birkhoff et al. 2016)

Recognizing problem behavior is essential

Two Models for Ethical AI show Promise

METHAD (Medical ETHics ADvisor)

In a proof-of-concept study, Meier et al. (2022) show how an algorithm based on Beauchamp and Childress' prima-facie principles could be employed to advise on a range of moral dilemma situations that occur in medical settings

They operationalized the principles of **beneficence**, **non-maleficence** and patient **autonomy**

ADC (Agent-Deed-Consequence)

Dubljevic and Racine (2014) operationalized **virtue ethics**, **deontology** and **consequentialism**

NSF-funded work (#2043612) explores whether AI-empowered moral decision making is possible (see Dubljevic 2020), and whether and under which conditions AI can be allowed to make decisions affecting humans

Can be incorporated into a robot that can autonomously execute healthcare decisions (Pflanzer et al. 2023)

METHAD

- Uses fuzzy logic and cognitive maps
- algorithm's database consists of 69 cases
- METHAD's predictions were compared to textbook solutions and ethicists' judgments
- Principle of **Justice** omitted
- Skewed towards utilitarian responses



METHAD Training shows promise

Case Category	Number of Cases	Mean Absolute Error		Mean Binary Accuracy	
		Train	Test	Train	Test
Beginning of Life, Pregnancy and Abortion	8	0.10 ± 0.06	0.23 ± 0.10	0.97 ± 0.07	0.75 ± 0.19
Consent in Minors	11	0.10 ± 0.06	0.25 ± 0.14	0.82 ± 0.08	0.68 ± 0.28
Advance Directives and Consent in Adults	13	0.11 ± 0.07	0.22 ± 0.10	0.94 ± 0.10	0.81 ± 0.12
Patient's Refusal of Treatment	11	0.18 ± 0.14	0.30 ± 0.16	0.68 ± 0.42	0.27 ± 0.33
Request or Provision of Futile Treatment	9	0.11 ± 0.06	0.18 ± 0.11	1.00 ± 0.01	0.92 ± 0.15
Withholding or Withdrawal of Treatment	14	0.12 ± 0.07	0.32 ± 0.14	0.87 ± 0.17	0.60 ± 0.27
Mental Health	3	0.09 ± 0.07	0.17 ± 0.11	0.95 ± 0.11	0.83 ± 0.19
Total	69	0.11 ± 0.07	0.23 ± 0.12	0.92 ± 0.10	0.75 ± 0.20

ADC model

- Computations encompassing decisions about Agents, Deeds, and Consequences.
- To test this approach (mutatis mutandis for D and C), we use [A-2] to represent a strong negative designation of a particular agent; [A-1] to represent a weaker negative designation; [A0] when agent information is not available; [A+1] to represent a weaker (low-stakes) positive evaluation; and [A+2] to represent a strong positive evaluation
- We assume that AI decisions would first be instantiated only in morally unambiguous (i.e., [A-D-C-] and [A+ D+C+]) situations

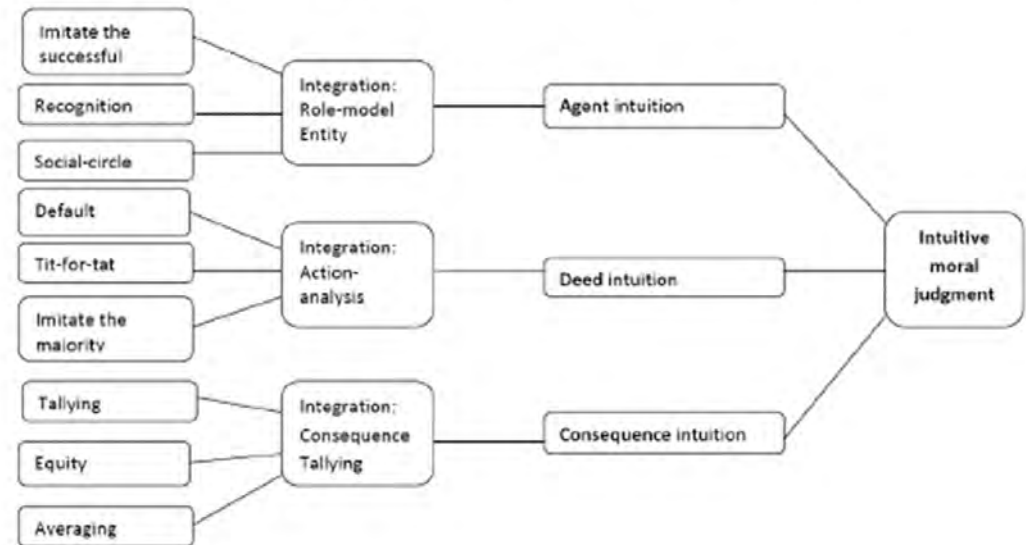


Table 3. Effects of A, D & C Manipulations for Vignette in Figure 4

	(1) Evaluation_A	(2) Evaluation_D	(3) Evaluation_C	(4) Evaluation_M
A	-0.215*** (-4.19)	-0.180** (-3.20)	-0.055 (-0.96)	0.202*** (5.30)
D	-0.693*** (-13.56)	-0.684*** (-12.13)	-0.539*** (-9.22)	0.683*** (17.88)
C	-0.224*** (-4.38)	-0.292*** (-5.19)	-0.396*** (-6.85)	0.224*** (5.85)
Observations	154	153	151	305
Adjusted R ²	0.604	0.524	0.508	0.557

Standardized beta coefficients; *t* statistics in parentheses
 * $p < 0.05$, ** $p < .01$, *** $p < .001$

Testing the ADC Model (and PPIMT)

- Via textual input in large-scale surveys (Dubljevic, et al. 2018) and
- Multiple stakeholder groups in more than one language (Sattler, et al. 2023)
- However, real-world scenarios don't come with neat text-based descriptions (Brantley & Dubljevic 2022)
- We created and tested immersive virtual reality experiences (Eskander et al. 2022)

Establishing **cross-cultural human agreement** on the evaluation of the specific sub-components of moral decision-making (A,D,C) in **audiovisual representation** of morally salient situations is necessary before implementation

Factor	1: PPIMT Virtue ethics		2: PPIMT Deontology		3: PPIMT Consequentialism	
	A	B	A	B	A	B
Sample						
have good or bad intentions	0.833	0.811	0.195	0.132	0.032	0.282
have good or bad goals	0.837	0.805	0.147	0.200	0.159	0.210
have good or bad aims	0.866	0.860	0.143	0.152	0.115	0.185
have good or bad motives	0.900	0.867	0.141	0.193	0.053	0.189
have good or bad interests	0.638	0.783	-0.051	0.261	0.190	0.225
respect or do not respect certain obligations	0.068	0.197	0.851	0.793	0.086	0.199
respect or do not respect certain rules	0.099	0.169	0.776	0.814	0.049	0.141
respect or do not respect certain responsibilities	0.212	0.216	0.822	0.842	-0.074	0.140
respect or do not respect certain duties	0.221	0.219	0.862	0.870	0.015	0.083
respect or do not respect certain norms	0.071	0.087	0.788	0.854	-0.080	0.105
make somebody end up worse or better off	0.014	0.267	0.026	0.123	0.861	0.778
cause happiness or suffering	0.140	0.255	-0.095	0.118	0.861	0.805
are helping or harming	0.177	0.327	0.054	0.159	0.772	0.715
cause benefits or costs	0.006	0.197	0.110	0.277	0.886	0.615
cause pleasure or pain	0.171	0.242	-0.090	0.190	0.826	0.710
Proportion of explained variance	23.7%	26.1%	23.3%	25.6%	24.3%	19.9%
Cronbach's α	0.87	0.92	0.90	0.91	0.88	0.84

N = Number of observations. Kaiser-Meyer-Olkin Measure_A = 0.78; Kaiser-Meyer-Olkin Measure_B = 0.92.

<https://doi.org/10.1371/journal.pone.0204631.t002>

Creating new vignettes was hard work

Sample low-stakes vignette (Syphilis):

After stepping on a bloody needle, a man is examined by a doctor. During his medical examination, the doctor tells the man he suspects that the man has syphilis. This is a potentially life-threatening but curable blood-borne and sexually transmitted disease. The doctor takes a blood sample for further testing.

During the past couple of years, the man has been [A-: cheating on | A+: loyal to] his wife. After returning from the doctor's appointment, he decides to [D-: lie to her this time | D+: tell her the truth] about the doctor's prognosis. Two weeks later, the doctor informs him that he is [C-: ill and his wife has the first symptoms of syphilis | C+: healthy and it was a false alarm].

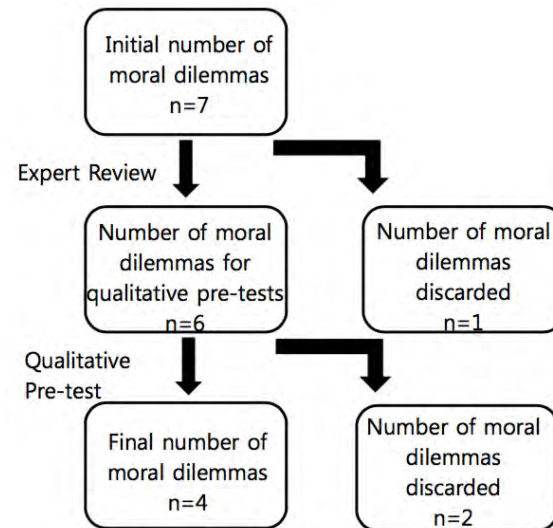


Figure 2. Process of Moral Dilemma Elimination

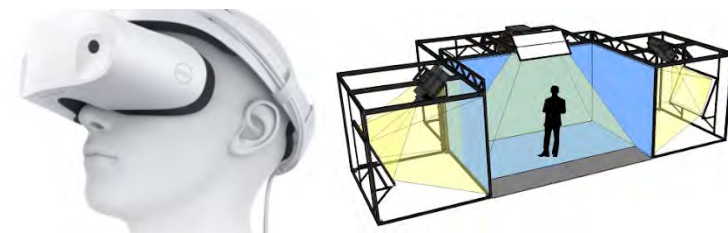
- Experts were asked to comment on, amongst other things:
 - The validity of the measures;
 - The plausibility of the situations;
 - The clarity of the language.
- At the end of this process, six moral dilemmas,
- six qualifying adjectives and three overall moral evaluation
- measures were selected based on experts' comments.
- The formulation of the dilemmas was modified as needed.

RISF Project: Large collaborative grant

- Purchase one Pepper unit (“Mass Produced Sociable Humanoid Robots” Pandey & Gelin 2018) to implement ADC
- Pepper fosters empathetic connections by understanding and responding to human emotions.
- The platform, by design, supports creating and running various apps, which can be developed for domains such as health care
- Easy to add language functions (e.g., Spanish) for equitable care
- Running experiments to support/enable patient activities based on FAST
- Developing textual moral scenarios for dementia eldercare to be assessed by bioethicists and members of the public in English and Spanish
- Developing virtual reality moral scenarios in Unity to be assessed by caregivers
- Conducting interview studies with dementia patients and caregivers (about Pepper robot interactions).



The same scenario can be displayed across a range of devices.



Further funding targets

Federal funding:

NIH National Institute of Aging

- NOSI: Dementia Care Research: Programs and Services for persons with dementia (NOT-AG-21-046; relating to PAR-22-093 [R01] and PAR-22-094 [R21])
- Pragmatic Trials for Dementia Care and Caregiver Support R61/R33 (PAR-21-308)
- Dementia Care and Caregiver Support Intervention Research R01 (PAR-21-307)

Non-government funding:

- Templeton Foundation:
Open Funding Track or *Science of Virtue*
(<https://www.templeton.org/grants/grant-calendar>)
- Greenwall foundation:
Making a Difference in Real-World Bioethics Dilemmas (<https://greenwall.org/making-a-difference-grants>)
- Industry funding?

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Thank you.

Contact:

Veljko Dubljević, Ph.D., D.Phil.

Associate Professor of Philosophy, and
Science Technology and Society,
North Carolina State University,
453 Withers Hall,

101 Lampe Dr, Raleigh, NC 27607,

Phone: +1 919.515-6219

E-mail: veljko_dubljevic@ncsu.edu

NeuroComputational Ethics Research Group Webpage:

<https://sites.google.com/view/neuroethics-group/team-members>