Blueprint Personas in Digital Health Transformation

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Abstract

This paper presents a work in progress on the application of Blueprint Personas as a foundational tool for advancing the digital transformation of health and care services in an aging society. The paper presents how artificial intelligence (AI) and intelligent agents can support patients, caregivers, and healthcare professionals through customized, patient-centered care. By synthesizing detailed patient profiles, including medical, social, and personal factors, the aim is to enhance the interaction between healthcare technologies and users. Additionally, the work introduces the use of ontologies to structure knowledge in e-health systems, emphasizing the integration of a Reference Ontology of Trust to ensure the reliability and transparency of AI-driven care solutions. This ongoing research aims to contribute to a more empathetic and effective digital health ecosystem.

Keywords

Intelligent agent, Healthcare, Blueprint Personas, Ontology, Trust

1. Introduction

The preservation of autonomy and improving quality of life is a critical concern in various populations, not just the elderly, as people face numerous challenges due to cognitive or physical impairments. Although many people maintain the ability to make decisions, issues such as memory loss, disabilities, or chronic health conditions can complicate daily living. Socially Assistive Robots (SARs) [1], powered by artificial intelligence (AI), offer a promising technological solution to address these challenges by helping users manage daily tasks, encouraging social interaction, and improving overall well-being [2]. By integrating AI, SARs have the potential to reduce the user's dependency while enhancing cognitive engagement and socialization.

The goal of this project is to develop an intelligent agent capable of interacting with users and healthcare providers in a personalized manner [3]. This agent can be deployed on a cost-effective robotic platform, helping people who need assistance in their daily lives. This approach addresses the growing need for support among diverse populations, particularly in cases involving comorbidities or chronic conditions that can affect one's independence.

To maximize the benefits of robot-human interaction, it is crucial to consider how SARs can act as social catalysts, promoting interaction between individuals and their surroundings. They can serve as conversation starters, encouraging meaningful exchanges between users and their peers or caregivers. For example, models such as the Paro robot seal [4] have shown the potential to facilitate positive interactions and reduce stress in various healthcare settings. These interactions, perceived as empathetic, can foster a sense of connection and improve the user's well-being.

Empathy in robotic systems goes beyond functional assistance; it involves the ability to respond to the emotional and psychological needs of users [5]. For a robot to be perceived as empathetic, it must exhibit personalized behaviors that reflect an understanding of the user's unique circumstances, preferences, and challenges. Personalization is, therefore, critical, as it allows the robot to tailor its

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interactions, adapting communication style, tone, and responses based on the patient's individual profile. Robots can foster deeper, more meaningful interactions by integrating detailed patient information, such as medical history, social context, and personal preferences, improving the overall user experience and patient outcomes [6].

The initial step toward achieving these objectives is to develop *Blueprint Personas*, a tool designed to foster person-centered care. This approach identifies patient profiles based on diverse needs, environments, especially within home settings, and a range of health and socioeconomic characteristics. In addition, it considers the potential benefits that digital resources can provide to patients and other stakeholders, including researchers, healthcare professionals, and both formal and informal caregivers.

Ontologies will eventually be constructed to codify the structured knowledge needed for the system, following the development of personas. Personalized and adaptive care solutions will be possible thanks to these ontologies, which will capture the complexity of interactions between patients, caregivers, and AI systems. By doing this, the system will be able to comprehend customer needs, guarantee reliable communication, and promote confidence in AI-powered healthcare solutions.

2. Blueprint Personas

The European Blueprint on Digital Transformation of Health and Care for the Aging Society, funded as part of the WE4AHA project under the European Commission's digital single market strategy, reflects a shared policy vision on how innovation can transform health and care provision in our aging society. The first time it was presented was in December 2016 at the EIP on AHA Conference [7]. It was described as a shared policy vision by many stakeholders, including policymakers, civil society, professional organizations, and industry, in the first update in 2017. This marks a new strategy for securing funding and commitments for the digital transformation of health and care [8].

2.1. Why use a Blueprint persona

Personas are fictional archetypes that represent user groups based on observed behavioral variables, such as the specific goals and needs of users in particular contexts. Understanding these goals is crucial for designing user-centered products and services [9]. It is important to note that these goals cannot simply be asked about; they must be inferred from the collected data.

They are a fundamental tool for designers because they help translate research insights into practical solutions. These personas synthesize the characteristics of various user groups, allowing us to create more empathetic and user-centered experiences[10].

The *Blueprint Personas* serve various functions and aid in the visualization of people. They are helpful, for example, in creating digital solutions, changing the way healthcare is delivered, imparting knowledge, or getting a more detailed assessment of the requirements involving several stakeholders. They can (see the matrix of personas below) represent a wide range of various demographic divisions, conditions, and cultural settings. However, they can be completely modified to ensure that they serve your unique needs.

In this research, personas will be used to understand how to design digital healthcare tools that are aimed at the elderly and people with specific needs. Adopting Personas in the digital health sector allows for a better understanding of patients' needs, improving the personalization of services and access to digital health technologies. We will consider the pathology of chronic obstructive lung disease (COPD), also considering doctors' expectations of the agent. The choice to focus on patients with COPD profoundly influences the development of the intelligent agent, requiring specific adaptations at the level of user interface, functionality, and mode of interaction. The goal is to create a system that responds to the unique needs and challenges these patients face on a daily basis. However, it should be pointed out that the choice to focus research on this type of pathology was not guided by the specific characteristics of the pathology itself but rather by the need to limit human-robot interaction to a specific case: since it is impossible to generally speaking of "patient", a specific pathology approach is preferred in order to maximize the interaction and its benefits for the patients.

In addition to an accessible user interface, the intelligent agent must offer features specific to the management of COPD. Personalized medication reminders will help patients adhere to drug therapy while monitoring symptoms such as respiratory rate, cough, and phlegm production, which will provide valuable data for the treating physician, allowing timely interventions if needed. The agent can also provide practical advice for coping with daily challenges, such as suggestions for physical activity, stress management, and home environment adaptation. Considering the impact on mental health, emotional support through encouraging messages, relaxation techniques, and links to online support groups is critical.

The goal is not to design generically but to tailor solutions to those who will actually use them. These parameters allow us to classify and better understand users' needs in different contexts.

2.2. Development of personas

The developers of *Blueprint Personas* created twelve personas as reference models to show how a user of a certain target demographic could interact with the technologies. The 12 developed personas (Figure 1) represent various "population segments" and were classified according to age (young adults, children, working-age adults, retirees under 80, people over 80), as well as the health and care needs (good well-being, chronic conditions and/or social needs, complex needs) that correspond to each age group. The active stakeholder of the European Commission gathered data to create a comprehensive image of the various European requirements that the recognized creative best practices addressed.

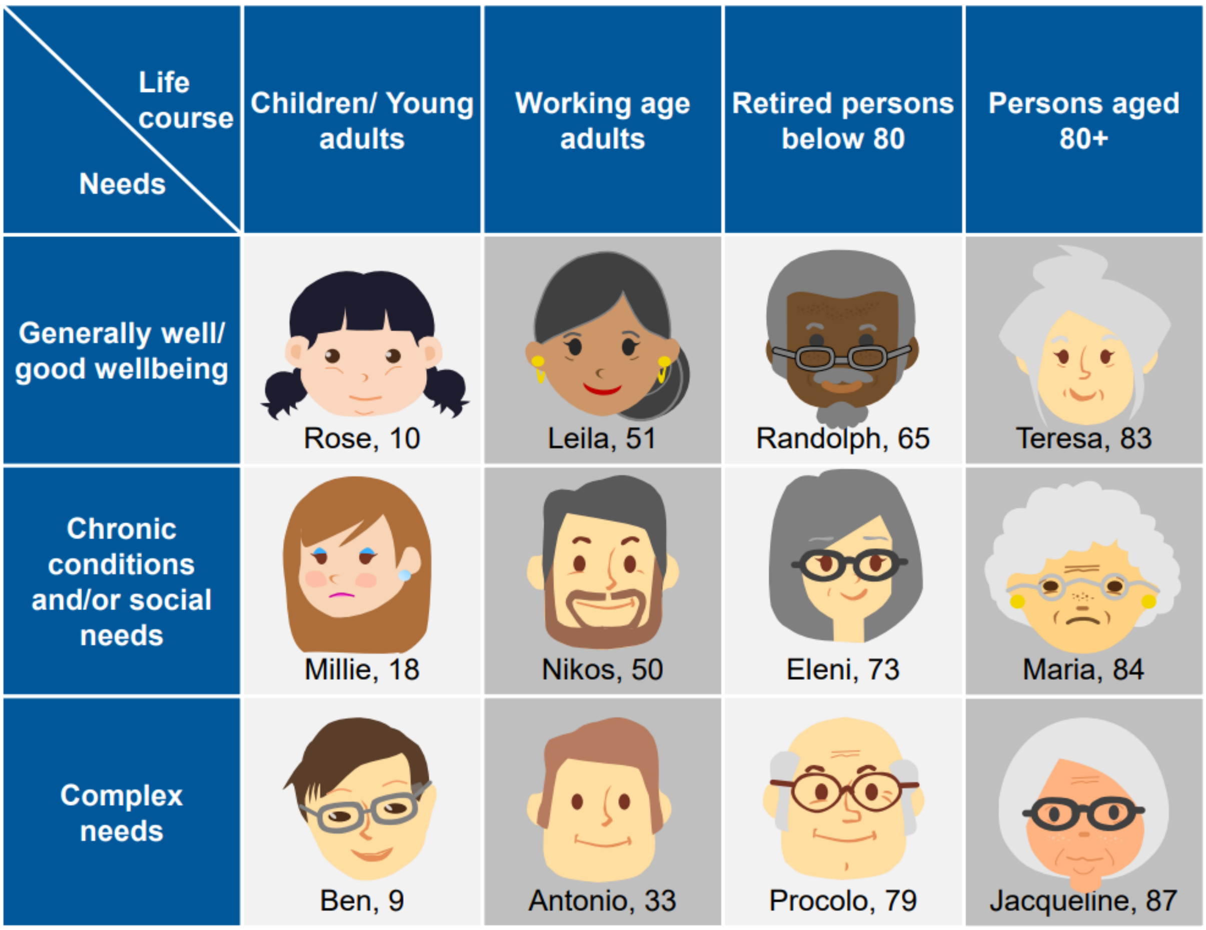

Figure 1: Matrix of Blueprint personas. Source: https://blueprint-personas.eu/.

An overview of particular traits for the persona can be found in the table of conditions addressed by the person descriptions below in Figure 2. These are some of the unfulfilled needs or parts of the characters' lives that current or upcoming digital solutions can cope with. The persona descriptions cover a broad spectrum of conditions and issues, which can be categorized based on many requirements-related factors, such as:

- health issues
- social and economic aspects
- lifestyle risks
- personality aspects
- mental issues

Based on real cases, the persona that is developed will be an example profile description under a given name that illustrates the requirements of particular groups in society. Stakeholders can relate to the individuals in question and learn what matters to them individually by developing specific but not overly complicated personas. This helps in both product design and the identification of potential ICT solutions that address those needs.

Life course / Needs	Children / Young adults	Working age adults	Retired persons below 80	Persons aged 80+
Generally well / good wellbeing	Rose, 10 Social isolation, Inappropriate food intake, Overweight Occasional aggressive behaviour Emotional eating	Leila, 51 Worsening eyesight, Light back pain, Provides support for own children and an elderly female neighbour, Due to her various family responsibilities, she may overlook her own needs, She may be experiencing "winter depression"(SAD), which is as yet undiagnosed	Randolph, 65 Worsening eyesight, Strong peer group, cares for and supports his wife (who has early stage dementia), Aware of and concerned about his wife's growing needs and wants to do something about them	Teresa, 83 Occasional joint pain Difficulty climbing stairs Heavily supporting her husband Scared of being alone and not being able to live an active life
Chronic conditions and/ or social needs	Millie, 18 Pre-diabetes, Attention deficit hyperactivity disorder -ADHD Aggressive outbursts, Obesity, Worried about being teased due to obesity, wants an independent, fulfilled life while being supported with her conditions, Asperger's syndrome, Echolalia	Nikos, 50 Metabolic syndrome (diabetes, hyper-tension), Mild chronic obstructive pulmonary disease (COPD), Unable to afford professional lifestyle support services, work routine goes against healthy lifestyle intervention, Trying to stop smoking Stressed due to economic and health issues	Eleni, 73 Hypertension, Poor medication adherence, Lives alone, lack of nearby family members Stressed due to challenges of dementia and worried about having accidents alone at home Early stage dementia	Maria, 84 Diabetes, retinopathy, Heart failure, Atrial fibrillation, Chronic kidney disease (CKD), Osteoarthritis: all currently under control but with occasional relapses. Feels isolated (no friends), Huge financial struggles, Poor adherence & hygiene Fear of being sent to nursing home and leaving family unprotected
Complex needs	Ben, 9 Cataracts, Hearing loss, Delayed motor skills, Goes to respite care centre, Unhealthy diet, eating too much, Change or unpredictability negatively affects his behaviour, visual learner Down's syndrome	Antonio, 33 Diabetes, Hypertension, Below-waist paralysis Strong support by girlfriend, Rejects social support, Heavy alcohol and tobacco use, Fear of losing his job and social connections, Depression	Procolo, 79 Sight and balance problems, Benign prostate hypertrophy, Hypertension, Diabetes, Bladder epithelium cancer, Needs attendance, Goes to work via taxi, Diet to avoid hyperglycaemia Fear of hospitals, Trust issues towards care professionals	Jacqueline, 87 Chronic obstructive pulmonary disease (COPD), Hypertension, Falls, Osteoarthritis, Osteoporosis, Incontinence, Rejects social support; only accepts support by stressed husband, Will need oxygen at home, Memory, Cognitive disorders, Hallucinations, Mixed dementia, Fears visitors, Suspects people stealing her

Legend: Health issues · Social & economic aspects · Lifestyle risks · Personality aspects · Mental issues

Figure 2: An overview of personas' issues and conditions, classified into five categories . Source: https://blueprint-personas.eu/.

3. The Questionnaire Survey

Surveys are essential research tools for gathering data from a specific population [11, 12, 13]. They help researchers collect valuable information about human behaviors, opinions, and experiences. In healthcare, surveys are particularly useful for understanding the perspectives of patients and caregivers, assessing quality of life, and identifying trends in healthcare practices that are not captured in medical records. Questionnaires, the main method for collecting quantitative data, provide a structured way to ensure data consistency and alignment with study goals. It is crucial to clarify the questionnaire's purpose and how the results will be applied from the outset.

Surveys can be descriptive or analytical in nature [14]. Descriptive surveys aim to characterize a population, whereas analytical surveys explore relationships between variables. They are versatile, allowing researchers to investigate various topics, from patient satisfaction to healthcare provider decision-making.

One of the key strengths of surveys is their ability to capture important qualitative outcomes to patients and their families, such as pain levels, functional ability, and overall satisfaction with care. This information can complement traditional clinical measures and provide a more comprehensive understanding of treatment outcomes.

There are different types of surveys [15] (multiple choice questions, rating scale questions, Likert scale questions, matrix questions, dropdown questions, open-ended questions, etc.), and each can produce different levels of detail, precision, and commitment of respondents.

Multiple-choice and matrix questions will mainly be used in the survey. The most common type of question is the multiple-choice question. They let your respondents choose from a list of responses that you specify one or more possibilities. They offer mutually exclusive options, are intuitive, and aid in producing data that are simple to evaluate. Your respondents find filling out the survey easier because there are set-response alternatives. Multiple-choice questions can be found in a variety of forms. Single-answer multiple-choice question is the simplest type. Respondents can select only one response to a single-answer question using the radio button format, which uses circular buttons to represent possibilities in a list. They work well with nominal scales, rating questions, and binary inquiries.

Matrix questions contain a series of Likert or rating scale questions arranged in a grid or matrix format. Multiple questions are given identical response categories. The questions are arranged so that they form a matrix with a series of questions on the side and response categories on the top. This makes effective use of the responder's time and page space.

3.1. Proposed Methodology

The questionnaire for our research will be structured into several sections (demographic data, habits, pathology and technological support, and expectations from the intelligent agent) to ensure a complete collection of the necessary information and will be key to creating Blueprint Personas. The goal is to use the collected data to define profiles of COPD patients that reflect their specific needs, expectations, and interactions with the intelligent agent. Each section is designed to capture different dimensions of the participants' experiences and needs.

Demographic Data: This section aims to understand the environmental context in which the individuals live. Questions in this category collect information on age, gender, occupation, education level, and geographic location. This demographic information provides a foundational understanding of the population being studied and helps to identify patterns and trends between different groups.

Habits: This category includes questions about the participants' daily routines, dietary habits, and physical activities. Understanding their habits allows for a deeper insight into their lifestyle choices and how these may impact their health and well-being. For example, questions about the type of diet followed, and the frequency of sports or exercise can reveal important aspects of their health behaviors.

Pathology and Technological Support: Participants are asked about their specific health conditions and how technology or technological support could help them manage their disease. The questions are designed to explore their experiences with their pathology, the challenges they face, and their openness to using technological solutions. This information is crucial for identifying the needs and preferences for technological interventions.

Expectations from the Intelligent Agent: This includes questions on the functionalities they deem essential, their desired level of interaction with the agent, and any specific features they believe would significantly aid them in managing their health. Understanding these expectations helps tailor the intelligent agent to better meet the users' needs and enhance their overall experience. In this case, the correct definition is Personal Assistant Agent (PA). The PAs will be equipped with detailed and anytime-evolving knowledge of the user's needs, preferences, and expectations. This specific type of social robot is designed to interact with people socio-emotionally during interpersonal interaction [16].

The survey questions, divided into their respective categories, will be partly constructed ad hoc, partly taken and adapted from existing surveys such as PANAS [17] and SMART-Q [18].

4. Ontologies

Originally a philosophical concept, ontologies have become the cornerstone in computer science to structure knowledge within specific domains. In philosophy, ontology concerns itself with the nature of being, categorizing what exists and the relationships between these entities [19]. This idea has been adapted into the realm of knowledge engineering, where an ontology is defined as a formal, explicit specification of a shared conceptualization of a domain. More specifically, in computer science, an ontology serves as a structured representation of knowledge that can be used by humans and machines to communicate, reason, and infer new information from existing data [20]. A typical ontology includes a formalized vocabulary that describes entities within a specific domain, their attributes, and their relationships.

Blueprint Personas can be effectively used as a model for developing an ontology in AI systems designed for e-health that support caregivers and patients by capturing the complexities of their roles, behaviors, and needs. In this context, the ontology would formalize the roles of caregivers and patients, categorizing their various activities, health conditions, and the resources they use. Several studies have already shown how ontologies can be used effectively in increasingly dynamic and digitized healthcare environments [21]. For example, it can model caregiver tasks such as administering medication, scheduling medical appointments, managing patient behavior, and responding to emergencies. The system can also include representations of different patient profiles, associated symptoms, and specific care needs, such as sensory sensitivity or communication challenges. Each of these elements, whether a caregiver task, patient condition, or medical intervention, can be treated as a class or instance within the ontology, allowing the AI system to understand the relationships between these entities and infer logical connections that may not be explicitly stated in the raw data.

The advantage of using an ontology-based on *Blueprint personas* is that it enables one of the most important elements that artificial intelligence can exponentially improve in medicine: personalization [22]. By integrating this structured knowledge, the system can tailor its interactions to the specific needs of caregivers and patients. For example, it can prioritize interventions based on the workload of a caregiver or the current health condition of a patient, send reminders about critical tasks (for example, medication schedules), and offer real-time advice during crisis situations. The system could also provide insights based on data patterns, such as recognizing early warning signs of patient distress and suggesting appropriate care actions based on historical and real-time data.

Moreover, such an ontology allows the e-health system to facilitate communication and coordination between multiple stakeholders, including caregivers, healthcare providers, and family members. By having a standardized, shared understanding of the patient's condition and care requirements, the AI system can ensure that all parties involved are aligned, reducing the risk of errors or miscommunication [23]. This also enables better integration with electronic health records (EHRs), ensuring that information is consistently updated and shared between platforms.

A key benefit of this ontology-driven approach is the AI system's ability to reason and make inferences. For example, if a caregiver is unavailable, the system could infer which other caregivers are qualified to step in based on their roles and skill sets, automatically adjusting care plans accordingly. The efficient reasoning element and transparency of a system based on symbology also offer the possibility to modify in a targeted way any system elements, offering the patient an even more personalized experience[24]. Additionally, the system can manage incomplete information by drawing logical conclusions from known facts, ensuring that it can still provide useful advice or actions even when certain data points are missing.

4.1. The Reference Ontology of Trust

An ontology, by its nature and flexibility, is well suited to integration with other ontologies that may, to some extent, improve their efficiency. For this reason, the reference model used is the Reference Ontology of Trust (ROT) [25], which will eventually be integrated in later stages.

The Reference Ontology of Trust, as presented in the paper, aims to provide a structured, formal understanding of trust that can be used across various domains, particularly to enhance communication between humans and machines. Trust is framed as a complex mental state which involves a set of beliefs that the trustor (the one who trusts) holds about the trustee (the one being trusted). These beliefs revolve around key elements such as the trustee's abilities (capabilities), weaknesses (vulnerabilities), and intentions. The purpose of this ontology is to standardize the concept of trust by distinguishing its different forms and nuances, enabling it to be accurately comprehended and modeled in different contexts, such as in human interactions, organizational relationships, and interactions with autonomous systems.

Before starting, it is necessary to express the relationship between Blueprint Personas, the survey and ROT. The integration of these elements creates a structured approach to building a personalized and trustworthy AI system. In the initial phase of the research, the questionnaire is used to gather detailed insights about patients' needs, behaviors, and preferences. This data shapes the Blueprint Personas, modeling personas that accurately represent the specific challenges and expectations of these patients. This approach ensures that personas are grounded in real-world data, setting a strong foundation for the intelligent agent design and subsequent interactions with COPD patients. Once modeled, these personas are integrated with the Reference Ontology of Trust (ROT), which provides a framework for calibrating trust in the AI interactions with users. By embedding ROT, the system can assess and adapt trust signals, such as transparency in recommendations and consistency in support, based on the personas' characteristics.

Focusing on the ROT's specifics, it describes in detail the mechanisms by which a person (or entity), called **Trustor**, decides to place trust in another entity, known as a **Trustee**. The most important elements of the model are briefly presented below.

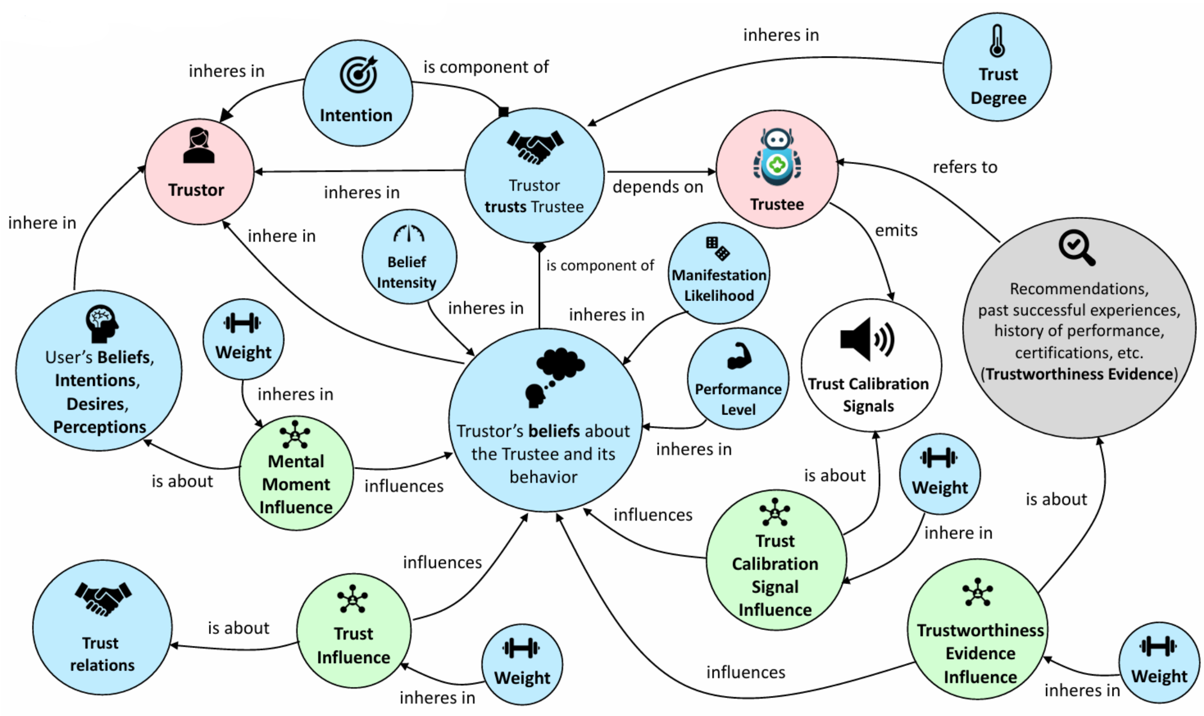

Figure 3: ROT

The Trustor is the one who chooses whether or not to trust the Trustee. Their decision is not random but depends on their beliefs, intentions, desires, and perceptions. These elements combine to form a kind of "mental framework" that helps the Trustor evaluate the Trustee. However, not all these elements have the same weight; in fact, the ontology emphasizes that each factor has a "weight" that determines its relative importance in the decision-making process. These weights may vary according to the psychological moment of the Trustor, described here as Mental Moment Influence.

A crucial point in the ontology is represented by the **Trustor's beliefs** about the behavior of the Trustee. The Trustor develops these beliefs based on several factors. In particular, its expectations of the Trustee are based on reliability tests, called **Trustworthiness Evidence**. These may include recommendations from other people, past positive experiences with the Trustee, certifications or attestations of competence.

Another important element that affects the beliefs of the Trustor is the **Trust Calibration Signals**, which the Trustee issues through their behavior or communication. These signals help the Trustor to understand whether the Trustee is acting reliably. These signals also have a specific weight, as not all signals are perceived similarly; some may seem more relevant or credible than others.

The Process of Trust is the heart of this system, the process by which the Trustor decides to trust the Trustee. This process is influenced by various factors, such as the **Belief Intensity** that the Trustor has about the Trustee. The stronger the belief that the Trustee will behave in a correct and reliable manner, the greater the confidence placed. In turn, these beliefs are linked to the intention of the trustor to trust and its willingness to do so. All this leads to the concept of **Trust Influence**, representing the set of external or internal influences that shape the confidence level. These influences may stem from past experiences, behavioral signals, or even immediate circumstances in which the trustor is found. The trust that the Trustor places in the Trustee depends largely on his likelihood of manifesting reliable behavior, described here as **Manifestation Likelihood**. In practice, the Trustor assesses the probability that the Trustee will behave as expected and judges it on the basis of its performance level. The Trustee also issues trust signals, which can help the Trustor to understand whether the Trustee is indeed trustworthy.

Ultimately, all this leads to an overall level of trust, called **Trust Degree**. This is the result of all the influences and weights described above: the beliefs of the Trustor, the signals emitted by the Trustee, the reliability evidence, and the mental condition of the Trustor. It is a dynamic process that can change over time, as new signals or new information may alter the degree of confidence.

In terms of applications, the ROT is designed to be widely used in domains from interpersonal relationships to trust in artificial intelligence and autonomous systems. It offers a clear framework for conceptualizing trust for both human understanding and computational models, making it suitable for designing trustworthy systems, defining legal and governance frameworks, and fostering interoperability between different trust-related applications.

It was decided to take as a reference model a formalization of trust because it makes it possible not only to implement trust models in AI systems, supporting tasks like risk management, decision making, and explainability in autonomous agents, but also because of the importance that this construct has in the field of health and caregiving. For example, in healthcare contexts, ROT can be used to ensure that AI systems are trusted by users and professionals, with mechanisms for transparency, accountability, and trust calibration built into the design of such systems.

5. Conclusion & Future Work

Although still in development, the use of *Blueprint Personas* in this digital health initiative highlights the potential for improved personalization in healthcare. By constructing personas that are representative of various patient demographics and conditions, we aim to tailor healthcare solutions to individual needs, particularly for populations with complex health profiles, including neurodivergent subjects.

Incorporating ontologies offers a promising approach to specifying, understanding, and structuring interactions between caregivers, patients, and intelligent agents, improving real-time decision-making and patient support. The advantage of ontologies is, as is well known, that they are readable and

”understandable” by both humans and machines. Thus, they constitute a useful means of exchange of knowledge. As the project progresses, the integration of trust modeling via the Reference Ontology of Trust will play a key role in ensuring that AI systems are both reliable and transparent. Although this research is ongoing, it lays the groundwork for a future where personalized AI-driven healthcare solutions can significantly improve the quality of care for diverse populations.

To fully realize the potential of AI-based healthcare solutions, several future challenges must be addressed. Integrating intelligent agents with existing healthcare systems, such as electronic health records (EHRs), telemedicine platforms, and hospital management systems, is essential for holistic and coordinated patient care. In addition, developing more sophisticated AI algorithms is crucial to enhance the system's ability to analyze complex data, learn from user feedback, and further personalize care. Ethical considerations also play a significant role, as the application of AI in healthcare raises complex issues, including accountability for system decisions, algorithm transparency, equitable access and use of data, and potential discrimination. Addressing these challenges will be key to advancing personalized AI-driven healthcare solutions and improving the quality of care for diverse populations.

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References

[1] D. Feil-Seifer, M. J. Matarić, Socially assistive robotics, IEEE Robotics & Automation Magazine 18 (2011) 24–31.

[2] D. O. Johnson, R. H. Cuijpers, J. F. Juola, E. Torta, M. Simonov, A. Frisiello, M. Bazzani, W. Yan, C. Weber, S. Wermter, et al., Socially assistive robots: a comprehensive approach to extending independent living, International journal of social robotics 6 (2014) 195–211.

[3] L. Ragno, A. Borboni, F. Vannetti, C. Amici, N. Cusano, Application of social robots in healthcare: Review on characteristics, requirements, technical solutions, Sensors 23 (2023) 6820.

[4] A. Sharkey, Robots and human dignity: a consideration of the effects of robot care on the dignity of older people, Ethics and Information Technology 16 (2014) 63–75.

[5] S. Costantini, P. Dell'Acqua, A. Dyoub, A. Monaldini, Towards empathetic care robots (2022).

[6] K. Liu, D. Tao, The roles of trust, personalization, loss of privacy, and anthropomorphism in public acceptance of smart healthcare services, Computers in Human Behavior 127 (2022) 107026.

[7] C. E., European innovation partnership on active and healthy ageing, https://ec.europa.eu/eip/ageing/home_en.html, 2024. Accessed: 2024-09-23.

[8] E. Commission, Blueprint for digital transformation of health and care in an ageing society, https://digital-strategy.ec.europa.eu/en/library/blueprint-digital-transformation-health-and-care-ageing-society, 2024. Accessed: 2024-09-23.

[9] E. Turk, V. Wontor, C. Vera-Muñoz, L. Comnes, N. Rodrigues, G. Ferrari, A. Moen, Human-centered integrated care pathways for co-creating a digital, user-centric health information solution, Journal of Integrated Care 30 (2022) 296–309.

[10] Blueprint Personas, Blueprint personas, https://blueprint-personas.eu/, 2024. Accessed: 2024-09-11.

[11] P. M. Nardi, Doing survey research: A guide to quantitative methods, Routledge, 2018.

[12] S. Gürbüz, Survey as a quantitative research method, Research methods and techniques in public relations and advertising 2017 (2017) 141–62.

[13] S. Roopa, M. S. Rani, Questionnaire designing for a survey, Journal of Indian Orthodontic Society 46 (2012) 273–277.

[14] L. I. Kelley-Quon, Surveys: Merging qualitative and quantitative research methods, in: Seminars in pediatric surgery, volume 27, Elsevier, 2018, pp. 361–366.
[15] SurveyMonkey, Survey question types - matrix, https://www.surveymonkey.com/mp/survey-question-types/#Types, 2024. Accessed: 2024-09-25.
[16] C. Breazeal, Designing sociable robots, MIT press, 2004.
[17] D. Watson, L. A. Clark, A. Tellegen, Development and validation of brief measures of positive and negative affect: the panas scales., Journal of personality and social psychology 54 (1988) 1063.
[18] F. V. Ferraro, C. Scuotto, S. Ciccarelli, L. Aruta, F. I. Ambra, A. Mantovani, S. Di Michele, M. L. Iavarone, Reliability and validity of the italian smart questionnaire (smart-q), ITALIAN JOURNAL OF HEALTH EDUCATION, SPORT AND INCLUSIVE DIDACTICS 6 (2022).
[19] C. M. Bittle, The Domain of Being: Ontology, BoD–Books on Demand, 2022.
[20] E. F. Aminu, I. O. Oyefolahan, M. B. Abdullahi, M. T. Salaudeen, A review on ontology development methodologies for developing ontological knowledge representation systems for various domains (2020).
[21] F. Okikiola, A. Ikotun, A. Adelokun, P. Ishola, A systematic review of health care ontology, Asian J Res Comput Sci 5 (2020) 15–28.
[22] B. K. Myskja, K. S. Steinsbekk, Personalized medicine, digital technology and trust: a kantian account, Medicine, Health Care and Philosophy 23 (2020) 577–587.
[23] S. K. Shahzad, D. Ahmed, M. R. Naqvi, M. T. Mushtaq, M. W. Iqbal, F. Munir, Ontology driven smart health service integration, Computer Methods and Programs in Biomedicine 207 (2021) 106146.
[24] A. MONALDINI, Neuro-symbolic approach for tantrum monitoring and prevention in individuals with autism spectrum disorder: A protocol for virtual agents, HHAI 2024: HYBRID HUMAN AI SYSTEMS FOR THE SOCIAL GOOD (2023) 394.
[25] G. C. M. Amaral, T. P. Sales, G. Guizzardi, D. Porello, N. Guarino, Towards a reference ontology of money: Monetary objects, currencies and related concepts (short paper), in: International Workshop on Value Modeling and Business Ontologies, 2020. URL: https://api.semanticscholar.org/CorpusID:213190497.

Authorship Declaration As non-English native speakers, the authors occasionally used ChatGPT (https://chat.openai.com) and Grammarly (https://grammarly.com) tools to improve the readability of the text. After using the tools, the authors reviewed and edited the content as needed and took full content authorship responsibility.