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"Would You be Friends with a Robot?": The Impact of Perceived Autonomy and Perceived Risk

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ABSTRACT

This paper is aiming to investigate the impact of perceived autonomy and perceived risk on attitudes and opinion about two assistive robots (Paro© and Asimo©), as factors explaining the probability to become "friend" with a robot. In a large online survey conducted in France, 2 783 participants were asked to complete three questionnaires: (1) The DOSPERT scale (for Domain-Specific Risk-Taking; Blais & Weber, 2006) to assess risk attitude and perception of risks; (2) The revised version of the FQUA-R scale (for Friendship Quality- Revised; Thien, Razak & Jamil, 2012) to assess close relationships and potential friendship with a robot; (3) The PAS (for Perception of Autonomy Scale; Lombard & Dinet, 2015) to assess positive and negative attitudes towards autonomy of robots. Structural equation modelling was used to determine the relationships between all the variables for two robots (ASIMO© and PARO©).

Keywords: Empathy, Attachment, Perceived risk, Perceived autonomy, Structural equation modeling

INTRODUCTION

Many authors attempted to model and to predict the users' attitudes towards technologies by focusing on concepts such as "acceptance" (Venkatesh, David & Morris, 2007; Venkatesh, Morris, Davis & Davis, 2003) or "symbiosis" (Adelé & Brangier, 2013). But we assume that acceptance is not sufficient to explain and to understand human behaviors when these human beings interact with assistive robots (Dinet & Vivian, 2013, 2014; Klamer & Ben Allouch, 2010. As Levy said (2007), nowadays it is important to not only study utilitarian, productivity-oriented factors in the acceptance process of robots by people, but also to include affective factors to get a more complete view of which factors play an important role in the acceptance of and/or attachment to robots. Besides utilitarian use of technology, there is also a hedonic, pleasure, and attachment-oriented use of technology (Van der Heijden, 2004) specially when robots offer interaction possibilities to human beings to build long-term relationships, such as friendship and attachment, and even if this relationship is a one-way for the moment. Moreover, sometimes, emotional attachment towards a robot can generate problems (Carpenter, 2013, 2016). But emotional proximity and confidence are necessary if robots are considered as a companion, an assistant or a guide in daily and intimate activity.

It is the reason why more and more studies investigate the empathy between humans and robots (e.g., Tisseron, Tordo & Baddoura, 2014; Scasselti, 2002; Stephan, 2014). If relatedness is a precondition of empathy (Airenti, 2014), empathy needs something more. In the same way, if empathy is sufficient with robots in some cases, it is not sufficient if robots are used as a companion or an assistant or a guide in daily and intimate activity. A companion or a guide in intimate and daily becomes more than an assistant. So, in this paper, we assume that friendship is stronger than empathy.

METHOD

The main goal of the experiment presented here is to investigate the relationships between perceived risk, perceived autonomy and friendship by using a large online survey with 2 783 French participants: 936 adolescents (mean-age = 12.2 years); 1077 adults (mean-age = 33.4 years); and 770 seniors (mean-age = 71.3 years). Structural Equation Modeling (SEM) was used.

Latent Variables, Operationalization, and Material

User Experience: According to the international standard on ergonomics of human system interaction (ISO 9241-210), user experience (UX) includes the practical, experiential, affective, meaningful and valuable aspects of human–machine interaction. In this study, questioning robot familiarity and robot use assessed UX. Robot familiarity and use questionnaire was assessed by using a 13 item questionnaire that required participants to indicate their level of experience with 13 different kinds of robots on a five- point scale (0 = "not sure what it is"; 1 = "never heard about, seen or used this robot"; 2 = "have only heard about or seen this robot"; 3 = "have used or operated this robot only occasionally"; 4 = "have used or operated this frequently"). The 13 kinds of robots are related to different domains (e.g., autonomous car, domestic/toy) to explore what means "robot" for the participants.

Friendship Quality with Robot (FQUA-R): An adapted version of the FQUA scale (Thien, Razak & Jamil, 2012) has been developed to assess close relationships and potential friendship with a robot. As the original version, the adapted version called FQUA-R is a 6-point Likert scale, ranging from 1 (high strongly disagree), 2 (strongly disagree), 3 (disagree), 4 (agree), 5 (strongly agree) to 6 (high strongly agree). The factor structure of FQUA scale confirmed this scale as a four-dimensional construct that can be explained by a set of positive features of friendship dimensions: (1) Safety, (2) Closeness, and (3) Acceptance, (4) Help and showed its stability (Thien, Razak & Jamil, 2012).

Assessment of Perceived Autonomy (PAS): The PAS (for Perception of Autonomy Scale; Lombard & Dinet, submitted) was used to assess attitudes towards autonomy of robots. This Likert-scale is composed by 35 items, and uses a 7-point rating scale ranging from 1 ("Strongly disagree") to 7 ("Strongly agree"). Previous factorial analyses confirmed a four-factors structure of the PAS (Lombard & Dinet, submitted). So four subscales, corresponding to four types of autonomy, compose the PAS: (a) Energy autonomy, composed by with 9 items (e.g., "A robot must be able to recharge itself", "A robot must operate without interruption"); (b) Cognitive autonomy, with 11 items and corresponds to the capacities necessary to solve problem, to communicate, to search for information (e.g., "A robot must be able to analyze situations and choose the best solution", "A robot must be able to make independent initiatives"); (c) Motor-skill autonomy, with 8 items (e.g., "A robot must be able to run", "A robot must be able to drive a car or to pilot a vehicle"); (d) General autonomy, with 7 items (e.g., "An independent robot is a risk to humans", "Human must always maintain control over the robot". A global score can be computed by adding the four scores obtained with the four subscales.

Assessment of Perceived Risk: The French DOSPERT scale (for Domain-Specific Risk-Taking; Blais & Weber, 2006) was used to assess risk attitude and perception of risks for our participants. This Likert-scale is composed by 30 items, the risk-perception responses evaluating the respondents' gut level assessment of how risky each activity/behavior is, using a 7-point rating scale ranging from 1 ("Not at all") to 7 ("Extremely Risky") for five domains of life: ethical, financial, health/safety, social, and recreational risks. Item ratings are added across all items of a given subscale to obtain subscale scores, with higher scores suggesting perceptions of greater risk in the domain of the subscale.

Robots: Participants were asked to complete the four questionnaires twice: after to watch a video about the therapeutic robot Paro© (a robotic baby-seal, with an animal-like appearance) and after to watch a video about Asimo© (a humanoid, with a human-like appearance). Duration and content of these videos have been controlled.

The two videos provide a lot of information about the two robots from a very positive point of view (i.e., they interact with human beings, they are presented as being useful for elderly people or for people with physical and/or mental disabilities, and they are presented as assistant for daily activities).

RESULTS AND CONCLUSION

A separate analysis was performed for the data for each of the two robots (Paro© and Asimo©). The free graphical Structural Equation Modeling (SEM) software called Ωnyx© was used to create and estimate SEM.

The output of these analyses indicated the direct effects of each of the response's variables, and indicated the significant paths and coefficients for these variables for each robot separately (Figures 1 and 2). The outputs obtained showed similitudes for the patterns obtained for the two robots: (1) Whatever the robot (Paro©, or Asimo©), cognitive autonomy and general autonomy explain significantly the Perceived autonomy (PA) while energy autonomy is not really important; (2) User experience (UX) is mainly explained by robot familiarity, while the impact of robot use is not significant; (3) There is a significant correlation between robot familiarity and robot use; (4) Perceived risk (PR) is mainly and significantly explained by attitudes about risks in health and social domains; (5) Friendships quality with a robot (FQUA-R) is significantly explained by each the four subscales used; (6) User experience (UX) has no effect on Perceived autonomy (PA); (7) Perceived autonomy (PA) has a direct and positive effect on Friendship

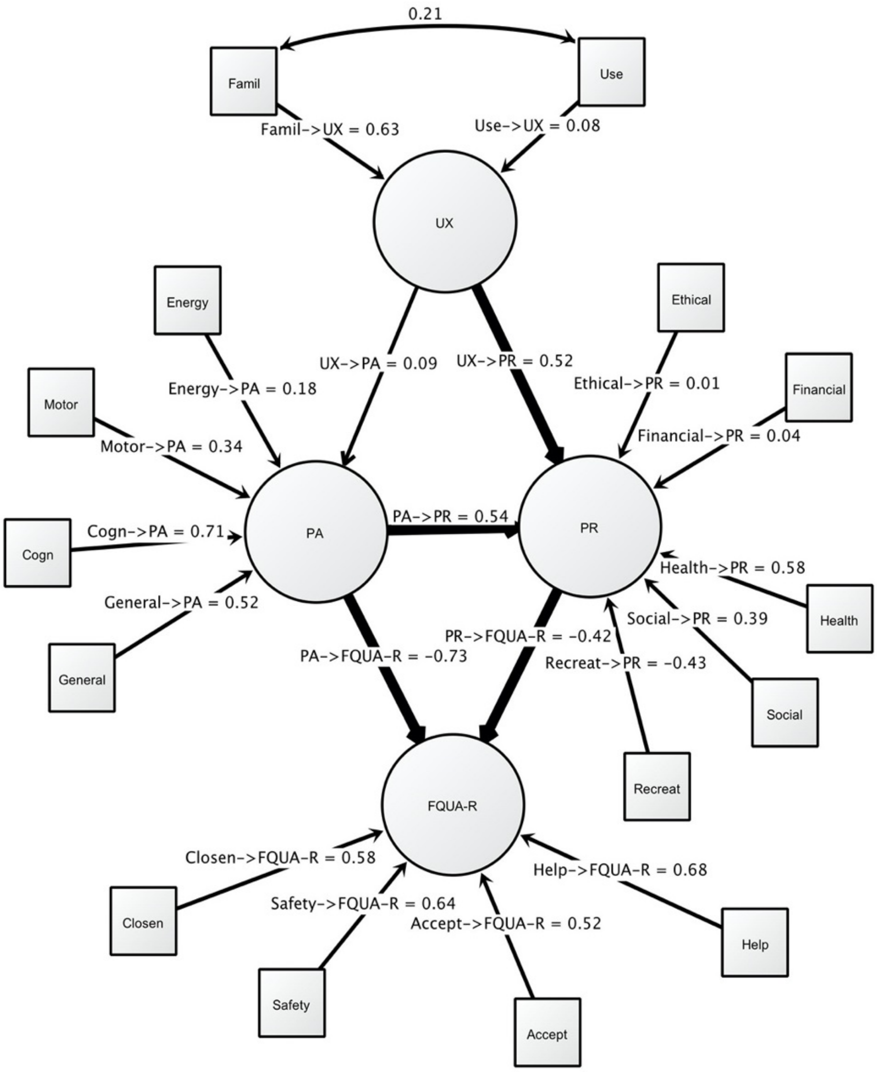

Figure 1: The structural equation modelling for ASIMO©.

quality with a robot (FQUA-R); (8) Perceived autonomy (PA) has a direct and positive effect on Perceived risk (PR).

But the outputs showed some differences between the two robots: (1) The perception of motor autonomy has a direct and positive effect on Perceived autonomy (PA) only for Asimo©. This result seems evident because Paro© is a baby-seal and cannot move alone, while Asimo© is displayed during autonomous activities; (2) User experience (UX) has a direct and positive effect on Perceived risk (PR) only for Asimo©; (3) Perceived risk (PR) has a direct and negative effect on Friendship quality with a robot (FQUA-R) only for Asimo©; (4) User experience (UX) has a direct and positive effect on Perceived risk (PR) only for Asimo©.

Even if several definitions exist to determine what are robots, the concept of robot is not a first but a second order category, and, in accordance to

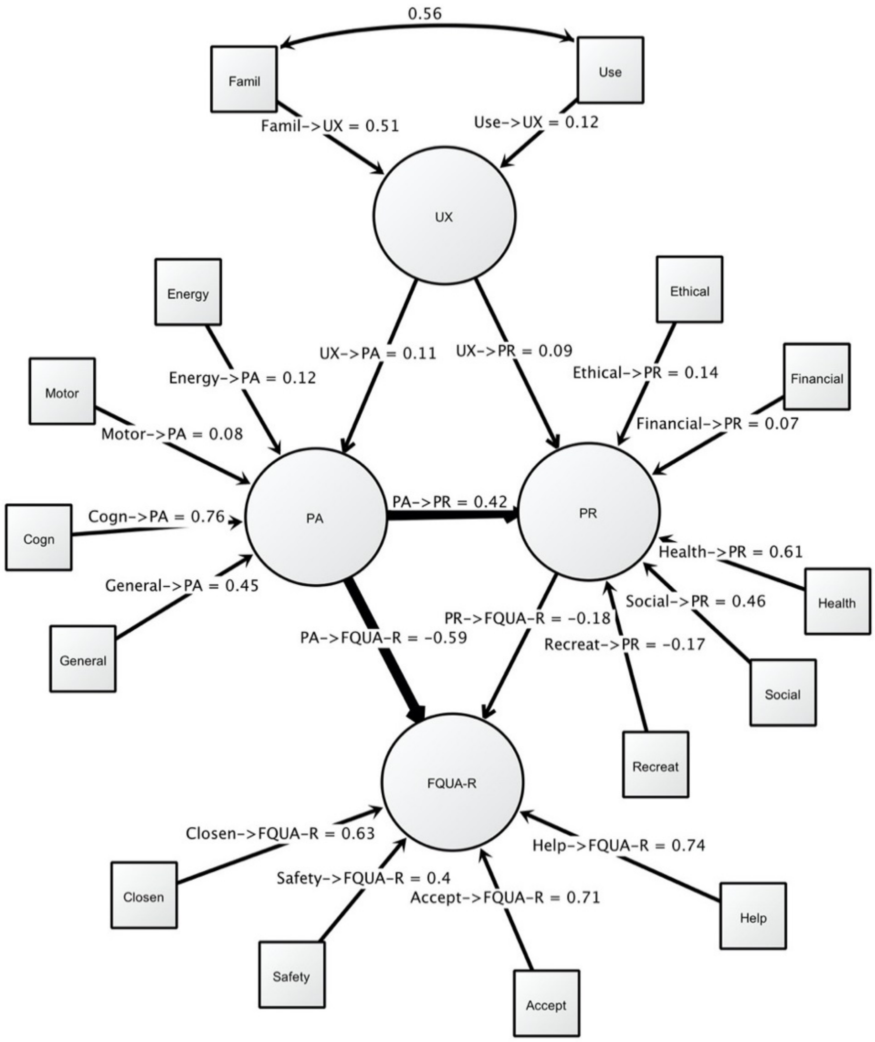

Figure 2: The structural equation modelling for PARO©.

Capurro (2020) and Dinet & Vivian (2013, 2014), to see an artificial device as a robot depends on the social and cultural perception in which it is embedded). Because relationships between human beings and robots will be go beyond acceptance, the initial question addressed in this paper was: "Would you be friends with a robot?". But maybe we can go further to ask some questions such as "Would you fall in love to a robot?", "Would you get marry with a robot?", "Would you adopt a robot?", "Would you be adopted by a robot?".

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