<u>You’re hired! But by a robot?</u>

Effect of design and role on perceptions about a job interviewer robot

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Abstract

Introduction and background. More organizations and HR practitioners are exploring using robots as job interviewers instead of humans. However, they need more information to understand how implementing recruiting robots will affect their applicants. For example, job candidates may develop affective (what they feel), cognitive (what they think), and behavioural (what they would do) perceptions about the robot, the job interview, and the hiring company. These perceptions can impact the reputation of the company and the success of attracting the right talent. ***Objective.*** This study investigated how the design of a robot (humanlike vs. machinelike), and its role (decides to hire vs. helps a real HR employee to hire) affect those perceptions. The effect that contextual factors (technological affinity, robot anxiety, and pre-existent attitudes towards robots) can have on these perceptions was also studied. ***Methods.*** A 2x2 experimental between-subjects design was used to study these perceptions. A total of 87 respondents participated in an online elicitation-based experiment design, in which they watched a video about a job interview led by a robot (humanlike vs. machinelike and decision-maker or HR helper). ***Results.*** There were no statistically significant effects of robot design, robot role, or contextual factors on either of the ABC perceptions. Regardless of what robot video the participants viewed, they all evaluated the robot as machinelike. Participants all had neutral to negative perceptions about the robot, the company, and the interview***. Conclusions and recommendations.*** It may not matter what design or role the robot adopts during the interview, since the robot will be seen as machine-like and evoke neutral to negative perceptions. Job candidates seem to disagree with being interviewed by any kind of recruiting robot, and will think unfavourably of the robot, the company, and the interview. More research is needed to explore whether a robot that is perceived as human-like would turn these perceptions around. It is advised that companies refrain from implementing recruiting robots for now; or that they make the recruiting process as ‘human’ as possible to mitigate the negative perceptions that recruiting robots can cause.

Keywords: recruitment, robots, job candidates, design, decision-making

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1. Introduction

The use of technologies is transforming how Human Resources tackle recruitment processes, but more research is needed to understand how job-seekers react to these upcoming changes. Some of these technologies are the Internet, Artificial Intelligence and the advancing field of Robotics (Black & Van Esch, 2020; Gupta et al., 2018; Tsiskaridze, 2023). Combining these technologies has changed the way that both HR departments and job seekers experience the attraction, screening, and retainment processes of recruitment. For example, the Internet enabled new ways of dialogue between candidates and recruiters not available before, when outreach worked through newspapers, firm visits and employee referrals. AI-integrated robots can help the human employees cope with how the Internet opened the door to an “avalanche of digital applications” (Black & Van Esch, 2020, p.218). Whilst being in its early years of implementation, robots have the potential to visibly change recruiting. It could be the next elevated step in automating meeting and screening candidates through job interviews. However, despite promising uses, it’s been a challenge to understand how to ease job-seekers into accepting robot interviewers. This is why there is a call for academics to empirically explore and inform companies and Human Resource practitioners about the use and reception of recruiting robots.

Currently, research is trying to understand exactly how the robot’s design and role during recruitment affects the job-seeker's experience, and consequently their acceptance of the recruiting robot. Regarding design, research has shown that anthropomorphic robots generally score more positively on trust, higher perceived enjoyment, sociability, humanness, behavioural intention to interact with the robot during a job interview and likeability (Merkel, 2020; Song & Luximon, 2020). Conversely, research studying the uncanny valley phenomenon have found opposite effects because an excess of anthropomorphism and other design nuances in design can create a dissonance between what should be ‘human’ and what should be ‘machine’. Regarding the role of the robot, “Several studies have shown that people react negatively if decisions are solely made by a computer system or AI” (Köchling et al., 2022, p.2115). On the other hand, a robot can help HR be fairer because it can be designed and programmed to ignore the implicit biases that human HR recruiters can have over, for example, physical appearance, gender, age, ethnicity or emotional states. This implies that the role that the recruiting robot takes on during the job interview, -as a decision maker or HR helper,- will also affect the experience of the job-seeker. These design and role factors thus challenge the implementation of recruiting robots.

The reason why these factors challenge application is because, if unsuitable recruitment robots are used by a company, the subsequent experience that the job candidate undergoes may impact negatively on the success of the hiring company. It is important to understand what design and role expectations job-seekers have over the human-robot recruitment interaction because it is likely to affect what they think of the hiring company's reputation, likelihood of accepting a job offer and satisfaction over the overall recruiting process. This could mean loss of reputation as a company and loss of talent acquisition too (Köchling et al., 2022; Miles and McCamey, 2018), which translates to less economic success. Ergo, there is no consensus on what role and design recruitment robots should have to satisfy both candidate and hiring company needs and wishes. This is why more research is needed to properly inform HR practitioners on how robot design and role influence the success or failure of implementing such robots in their job interviews.

Hence, this paper aims to contribute to this exploration through the guiding question 'How does the design and role of a social robot for recruitment affect the perceptions that jobseekers have over the robot, the hiring company, and the job interview?'. To address this question, this study will conduct an elicitation-based 2x2 experiment to test how job-seeker's perceptions are influenced by the design (humanlike vs. machinelike) and role (decision-maker vs. HR helper) of a robot interviewer who leads a recorded job interview. This study aims to study affective, cognitive and behavioral perceptions that the robot-mediated job interview evokes in job-seekers. In line with Suseno et al. (2021) and Köchling et al. (2022), this study will explore 'perception' under three main over-encompassing categories, namely, affective (creepiness and likeability of the interaction and the robot), cognitive (perceived procedural justice of the recruitment procedure led by the robot, and perceived trust towards the robot), and behavioral (the perceived opportunity to perform during the interview, the social presence of the robot, and organizational attractiveness). Furthermore, this study will also explore whether covariates such as participant's previous technological innovativeness and their robot anxiety contribute to these affective, cognitive and behavioral perceptions. By investigating the relationships between these constructs, this paper hopes to inform HR-practitioners how robot design and role affects job seekers' affective, cognitive and behavioral perceptions of the robot, the hiring company, and the job interview.

2. Theoretical framework

In this theoretical background, the perceptions that a job candidate can form about a recruiting robot, the interview led by it, and the hiring company will be discussed. Contextual factors that could also affect these perceptions will be explained. Furthermore, possibilities for robot design and role will be explored, investigating how they could affect the job candidate's perceptions.

2.1. Social robots as recruiters

Social robots have been applied to various contexts, including Human Resources and tasks involving the attraction and recruitment of potential employee candidates. A social robot is defined as a robot that has communicative capabilities that let it function socially (a social interface) within a context and that has a form or chassis that enables social expression (Hegel et al., 2009). Social robots are evolving enough to become companions, friends, mates, collaborators or mediators with another human (Song et al., 2023). Because of these communicative and social skills, social robots have been applied for various uses, such as in the service sector, elderly and neurodivergent care and health care. Another implementation is in the field of recruitment, since robots can reduce hiring time and increase recruiter productivity by taking over job interviews and screening-especially when faced with a tiring quantity of applicants (Tsiskaridze et al., 2023). With these capabilities, social robots have the advantage that they can handle areas that demand human competencies and interaction, such as recruitment.

Social robots have a lot of potential, –with some already being used,- in the field of employee recruitment for organizations. There are some key benefits in which machine learning technologies, such as Artificial Intelligence and robots, can help organizations with Human Resource management. First of all, robots and virtual agents can help reduce the employee, financial and time costs/constraints of carrying out on-site recruitment interviews (Tsiskaridze et al., 2023). This increases the time and cost-effectiveness and helps the organization cope with the immense pool of qualified and unqualified applicants. Second, these technologies promise to remove the implicit biases that may affect the decision-making of human recruiters (Black and Van Esch, 2020). Visual cues such as gender, nationality and physical appearance that could cloud a human recruiter can be effectively disregarded by the new technologies (Baka et al., 2022). Third, as Li's (2015) study suggests, social robots may be preferred over virtual agents since they provide physical presence, which positively influences psychological responses and perceptions. Using robots and AI technologies in recruitment could also make candidates perceive the organization as being novel and cutting-edge (Black and Van Esch, 2020). These reasons make robots attractive for helping Human Resources during recruitment.

Job candidates' attitudes and perceptions over robots as recruiters are important since they may impact the hiring company's reputation and candidates' likelihood of accepting a job offer. Job candidates may want job interviews that have a 'human touch', since robot-led interviews can feel impersonal, distant, and one-sided (Koivunen et al., 2022). The interview can feel non-reciprocal and one-sided since suggest that candidates cannot effectively evaluate the company without interacting with real human employees (Black and van Esch, 2020), -therefore robots may not be the best fit for these purposes. This is particularly the case when robot-led interviews don't allow for candidates to ask questions back to the robot about the organization. Job-seekers value getting a picture of what the organization's culture, coworkers and environment will be like. Indeed, the recruitment process shapes "the candidates' perception of the employer brand and influences the candidates' decision to continue a relationship with the organization" (Miles and McCamey, 2018, p.756). Therefore, an organization's recruitment strategy needs to create a positive experience to mitigate creating unfavourable comments from the candidate's word-of-mouth (Black and Van Esch, 2020), avoid losing desired employees, and be a fair and ethical-oriented company. As such, understanding how to make social robot recruitment interviews positive, fair, and attractive to candidates is in the best self-interest of the company.

2.2. Understanding 'perceptions' through the affective-behavioural-cognitive model of attitudes

The Affective-Behavioural-Cognitive (ABC) Model of Attitudes, which includes affective, cognitive and behavioural aspects, will be used in this study to understand candidates' perceptions over recruiting robots, the interview and hiring company. This model was chosen because it's 'attitudes' can represent the judgements made after "evaluating a particular entity with some degree of favour or disfavour" (Eagly &

Chaiken, 1993, p.1, as cited in Suseno et al., 2021). In this case, such 'entity' can mean a robot-led job interview. Currently, few studies use the ABC model regarding technology adoption, change, or robots. However, the work of Suseno et al. (2021) about organizational change readiness for AI adoption and the work of Rafferty and Jimmieson (2016) about employee resistance to organizational change have demonstrated the applicability of the ABC model to explore such subjects. The three attitudinal elements of this theory can provide a rich inspection of how job-seekers may feel about recruiting robots.

2.2.1. Affective attitudes: likeability and creepiness

Likeability

It is important to understand how candidates feel towards a recruiting robot to be able to produce a likeable robot that promotes positive attitudes or perceptions. An affective attitude can be defined as the "feelings, moods and emotions that people experience with regard to an object or subject" (Suseno et al., 2021, p.1213) which can range from positive to negative in valence. A positively valanced affective attitude can be, for example, 'likeability'. Likeability can be understood as the extent to which people produce positive impressions of a subject, based on its visual, vocal, and behavioural aspects (Suseno et al., 2021). For instance, in the context of recruitment interviews, interviewer warmth can be likeable and positively correlate with a candidate recommending the organization, organizational attractiveness, and likelihood of affecting a job offer (Farago et al., 2013). Therefore, the likability of a robot may be an important factor that shapes affective attitudes. It seems there are higher chances of developing positive affective attitudes, candidate retention, and organizational attractiveness if a candidate has an interview with a likeable robot.

Creepiness

Conversely, if the robot is creepy and produces negative affective attitudes, this could produce the opposite effect. Creepiness can be defined as "eliciting uneasy feelings and involving ambiguity" (Langer and König, 2018, p.1). Different 'creepy' situations can occur between robots, technology and humans and produce negative attitudes or perceptions, as enumerated by Langer & König (2018). For example, encounters with new technologies can be ambiguous, where people don't know how to gauge the situation or behave in it. The 'uncanny valley' phenomena, where a robot looks human enough to a disturbing extent (Gray and Wegner, 2012), can also be described as ‘creepy’. Köchling et al. (2022) found evidence that if decision-making technologies are part of the recruitment selection process, this evokes creepiness, which mediates the candidate's perception of organizational attractiveness and the opportunity to perform (the extent to which candidates think they can display their skills). These situations can evoke feelings of unease, discomfort, and uncertainty, which are all negative attitudes or perceptions. As such, there are lower chances of developing positive affective attitudes, candidate retention, and organizational attractiveness if a candidate has an interview with a creepy or unlikeable robot.

2.2.2. Cognitive attitudes: trustworthiness and procedural justice

Trustworthiness

Cognitive evaluations are also part of the overall perceptions that a candidate can have during an interview with a recruitment robot. The cognitive part of an attitude refers to the thoughts, beliefs, ideas or perceptual responses that individuals have about an object or subject, ranging from positive to negative (Suseno et al., 2021). One of the cognitive evaluations that individuals can develop from their encounters with a robot is the degree to which they trust this robot. Pinto et al. (2022) define human-robot trust as the willingness of the human to cooperate, support, engage with, and be vulnerable to the actions of the robot, and have confidence in these actions carried out by the robot. Factors that build a job-candidate's trust during a job interview can include risk perception, benevolence, and reciprocity (Pinto et al., 2022; Song et al., 2023). Perceived risk refers to the expectation of loss as an outcome of the robot-human interaction. Benevolence is about acting kindly to others, in an altruistic fashion, representing goodwill during physical and psychological interactions. Reciprocity refers to the act of exchanging and cooperating with another party. Trust is key in improving task completion and the feeling of safety during human-robot interaction because it eases the uncertainty and vulnerability of the situation. As such, trust in a robot is an important factor that affects the perceptions evoked from a (possibly vulnerable) task such as a job interview.

Procedural justice

Trust is a broad cognitive attitude that can extend from the human-robot interaction to the quality and fairness of the job interview itself. This is deemed ‘procedural justice’, which describes how fair participants think the recruitment process is in terms of the opportunity to perform, equality of conduct, the treatment job-seekers receive, the appropriateness of questions and the overall fairness of the hiring process (Köchling et al., 2022; Bauer et al., 2001). Humans tend to distrust algorithmic decision makers and may shorten their own answers when upfronted with a system (e.g. a robot interviewer) they do not trust or feel will not give them a fair chance. They also induce more privacy concerns (Langer et al., 2017) since technology can surpass comfortable levels of knowledge, transparency, and personalization (Langer & König, 2018). As such, procedural justice is also an important factor that affects the cognitive perceptions that a job-seeker will have over their interview with a recruitment robot.

2.2.3. Behavioural attitudes: opportunity to perform, social presence, and organizational attractiveness

Opportunity to perform

Behavioural attitudes are also important to consider when investigating what perceptions recruitment robots could evoke in job-seekers. Behavioral attitudes consist of the individual’s evaluations of the encounter based on past experiences and future intentions (Suseno et al., 2022). Procedural justice, as mentioned previously under ‘cognitive attitudes’, includes ‘the opportunity to perform’. “During the interview stage, applicants prefer situations that give them the opportunity to perform, enabling them to present their knowledge, skills, and abilities appropriately” (Köchling et al., 2022, p. 2113). Given that ‘performing’ is an action, this study considers (the opportunity) ‘to perform’ as an ongoing behaviour during the recruitment interview setting. As such, this study considers it to be a behavioural attitude, not a cognitive one. Participants may feel they do not have a fair chance to perform with a robot when (a) the technology used during the interview does not let them display individual strengths or characteristics, (b) does not provide nonverbal and verbal feedback and rapport, and (c) does not allow room for the interviewee’s questions (Langer et al., 2020; Köchling et al., 2022). If the interview does not offer these characteristics, the disappointed or discouraged applicant may choose to drop out of the selection process (Köchling et al., 2022). Therefore, to evoke positive behavioural perceptions, it is important that the human-robot interview and robot interaction style allows for a proper opportunity to perform.

Social presence

The perceptions evoked from a human-robot interview may also depend on the realism of the encounter, -the extent to which applicants perceive it as a real social interaction,- represented as the robot's social presence. If participants do not perceive the robot-human encounter as a real social interaction, they may not engage or behave as they normally would in a recruitment interview with another human (Langer et al., 2020). Social presence helps an individual to "perceive the same or similar feelings as when interacting with a real human" (Chen et al., 2023, p. 4). When situated to the robot-led job interview context, social presence can include, being attentive to the robot and vice-versa (attention allocation), the robot manifesting interactive expressions, understanding each other's speech, intention and vice-versa (information understanding), understanding each other's 'emotional' cues, and the perceived degree of interaction between parties (Chen et al., 2023). In this way, social presence is important to gauge the behavioural perceptions that that interviewee may develop about their encounter with the recruitment robot.

Organizational attractiveness

Behavioural attitudes include future intentions, ergo why organizational attractiveness is a perception relevant to predict whether the interview made the job-seeker satisfied enough to accept a possible job offer in the future. Organizational attractiveness "reflects the overall assessment of the recruitment process and the organization" (Köchling et al., 2022, p. 2114). The connections and exchanges made between the job candidate, the organization parties involved in the hiring process (such as the robot) and the organization's recruitment process shape the perceptions formed during the interview experience. In turn, this affects the organization's reputation either positively or negatively (Miles and McCamey, 2018). If it was a negative experience, the desired candidate may opt out of the process and work for a competitor (Köchling et al., 2022; Miles and McCamey, 2018). The candidate may even damage the organizational reputation through word of mouth and social media

(Köchling et al., 2022; Miles and McCamey, 2018). On the other hand, a positive experience can enhance the likelihood that the desired talent will accept the job offer, increasing engagement and productivity (Aiman-Smith et al., 2001; Singha and Singha, 2023). Consequently, it can be understood that the valence of the affective, cognitive and behavioural perceptions mentioned earlier will impact the overall organizational attractiveness, which includes willingness to collaborate with the organization in the future.

2.3. Contextual factors that affect the ABC perceptions

A limitation of the Affective-Behavioural-Cognitive Model of Attitudes is that it does not consider contextual or environmental factors, such as past experiences, attitudes, and encounters. This shortcoming can be countered through the complementation of the Social Cognitive Theory (SCT). Through the SCT it can be understood that, when performing a behaviour, humans are influenced by the outcomes they expect as a result of the behaviour (personal and performance-wise), their self-efficacy at carrying it out, their liking for the behavior and the anxiety or other emotions that performing the behaviour may evoke (Compeau and Higgins, 1995; Suseno et al., 2021; Venkatesh et al., 2003). The SCT has been applied in various studies within the context of technology acceptance and adoption (Suseno et al., 2021; Venkatesh et al., 2003), showing the relevancy of recognizing these contextual factors as part of the attitudes that affect technology-human behaviours. Therefore, perceptions arising from an encounter with a recruiting robot will be shaped by the outcomes individuals expect from interacting with a robot, whether they've interacted with one before, whether they feel anxiety or other emotions due to it, and whether they feel capable of handling robot interactions.

Technological innovativeness

‘Self-efficacy’ and ‘liking for a behaviour’ can affect the perceptions formed about an encounter between a recruitment robot and the candidate. These factors can be explained through technological innovativeness. Technological innovativeness is a construct used to identify individuals who are likely to adopt a technological innovation earlier than others (Agarwal and Prasad, 1998). It includes a “person’s learned and enduring cognitive evaluations, emotional feelings and action tendencies towards adopting new information technologies" (Schillewaert et al., 2005, p. 326), such as robots. Individuals who do not have high technological innovativeness are less prone to accepting and adopting new technologies, such as AI and social robots (Camilleri, 2024; Davis, 1989; Pan, 2020). In general, older people also tend to be less technologically innovative than younger people (Tams & Dulipovici, 2022). Therefore, technological innovativeness is a pre-existent contextual factor that can affect how affective-cognitive-behavioural attitudes develop during a human-robot encounter.

This leads to the following prediction, *H1: There will be a positive relationship between technological innovativeness and affective, cognitive, behavioural perceptions. Namely, people who are more technologically innovative will score higher on ABC perceptions than those who are less technologically innovative.*

Pre-existent attitudes about robots

The SCT states that humans are influenced by the outcomes they expect from a behaviour (personal and performance-wise), in this case an interaction with a recruitment robot. The way humans perceive outcomes depends on their expectations, which develop from both long-term and short-term (or contextual) experiences (Dogge et al., 2019). Therefore, affective-cognitive-behavioural perceptions about a robot may be strongly coloured by the expectations and outcomes of such interaction that are informed by pre-existent attitudes. As such, past experiences with a previous robot and pre-existent attitudes about robots in general can influence what job candidates expect from an interview with a 'new' robot and thus the perceptions they form about it. The Robotic Social Attributes Scales (RoSAS) has been used in research to explore people's judgements about social attributes of robots (Carpinella et al., 2017). It measures warmth, competence and discomfort towards robots. It has also been used to test familiarity with robots, evidencing that continued exposure to a robot makes the robot appear less discomforting and emotionally warmer (Pan et al., 2018). In such way, pre-existent attitudes about robots can affect the subsequent affective-cognitive-behavioural perceptions that job candidates develop from a job interview with a robot.

As such, *H2: There will be a positive relationship between pre-existent attitudes about robots and affective, cognitive, and behavioural perceptions. Namely,* *people with positive pre-existent attitudes will score higher on ABC perceptions than those with negative pre-existent attitudes.*

Robot anxiety

Another contextual factor that can be considered when exploring the perceptions of a robot-human encounter is the participant's pre-existent (robot) anxiety. Robot anxiety can be defined as "the emotions of anxiety or fear preventing individuals from interaction with robots" (Nomura et al., 2006, p.3), and is therefore similar to technophobia, the "fear, dislike or avoidance of new technology" (Oxford English Dictionary, n.d.). It may occur due to the fear that robots will replace humans as workers, information processors and decision-makers (Suseno et al. 2021). Furthermore, robot anxiety has been found to predict the quality of a robot-human interaction and the intention to use social robots (Naneva et al., 2020). As such, robot anxiety is a personal contextual factor that can affect how affective-behavioural-cognitive attitudes develop during a robot-led job interview.

In this way*, H3: There will be a negative relationship between robot anxiety and affective, cognitive, behavioural perceptions. Namely, people with more robot anxiety will score lower on ABC attitudes than those with less robot anxiety.*

2.4. The role of robots in recruitment interviews: decision-making or helper

HR practitioners may be more willing to accept recruiting robots given the advantages, but the perceptions that job candidates have about a robot's role during the job interview can be an obstacle for their implementation. For example, despite AI promising to be less biased, Köchling et al. (2022) maintain that human decisions are perceived as more trustworthy and fairer than AI-based decisions. There have been cases where such algorithmic technologies have been discriminatory, which negatively impacted public perception of these HR-implemented innovations. For example, Amazon's recruitment algorithm favoured men because it was trained on the resumes that the company had received over a 10-year period, which reflected and reinforced the historical male dominance over the technological industry (Dastin, 2018). Other research has supported the idea that humans react negatively to decisions made solely by algorithms, AI, and computers (Hiemstra et al., 2019; Langer et al., 2019). Moreover, "humans may think that [...] AI makes judgments based on different key figures and does not consider qualitative information into account that are difficult to quantify" (Köchling et al., 2022, p.2113). As such, robots may face reproach from candidates if they are regarded as the sole decision-makers during the recruiting process. This can translate to loss of talent and reputation.

Given how robots who are not the main decision-makers are preferred over those who are, the following can be expected:

H4a: A robot with an HR helper role positively influences affective perceptions (as compared to a decision-maker robot). These positive affective perceptions include positive correlations with 'likeability' and negative correlations with 'creepiness'.

H4b: A robot with an HR helper role positively influences cognitive perceptions (as compared to a decision-maker robot). This includes positive correlations with 'trustworthiness' and positive correlations with 'procedural justice'.

H4c: A robot with an HR helper role positively influences behavioural perceptions (as compared to a decision-maker robot). This includes positive correlations with 'opportunity to perform', positive correlations with 'social presence', and positive correlations with 'organizational attractiveness'.

2.5. The design of a robot in recruitment interviews: anthropomorphism and animacy

Anthropomorphism

When designing a robot to look 'humanoid' (resembling a human), there are certain design choices to be made, one of them being anthropomorphism. Anthropomorphism is defined as "the attribution of a human form, human characteristics, or human behavior to nonhuman things such as robots, computers, and animals" (Bartneck et al., 2008, p. 4). Studies have shown that people in general favour anthropomorphic chassis, a 'human form', in robots over mechanical appearances. For example, a robot with a humanlike face display was preferred over one with a silver face display, finding the latter eerie and less amiable (Broadbent et al., 2013). Positive relationships have been found linking robot anthropomorphism to higher levels of robot trust (Natarajan and Gombolay, 2020; Onnasch and Laudine, 2021, Song and Luximon, 2020), better mitigation of negative feelings that occur when disagreeing with a robot (Gittens et al., 2022), robot competency (Stroessner &

Benitez, 2018), higher emotional arousal and robot likeability (Song and Luximon, 2020). However, not all anthropomorphic appearances are successful at fulfilling these positive effects (Song and Luximon, 2020). Rather, they have found that the following anthropomorphic features make a robot appear more trustworthy: eyes that are large, round and brown, a direct gaze, short noses, upturned mouth, having a color cue, and luminance. Song et al. (2021) have also added that baby schema features (e.g., large eyes) enhance positive perceptions of robots. In such way, anthropomorphism creates more positive perceptions than mechanical robots, with certain designs being even more successful than others.

Indeed, whilst some anthropomorphic appearances encourage positive perceptions, other designs can be ‘too human’ and evoke aversive reactions. There is a fine line where a robot is ‘too human’ that, if crossed, tends to create the phenomenon called ‘the uncanny valley effect’. This effect shows that as the robot's human likeness increases, so does the likeability up to a point, after which the robot looks overly human and becomes unnerving (Gray and Wegner, 2012). It causes people to rate robots as less trustworthy, less reliable, and distracting (Onnasch and Laudine, 2021) and people are less willing to accept them (Pinney et al., 2022). Ergo, anthropomorphism can only get so far in respect to acceptance of robots.

Animacy

The other design choice that influences how humanoid a robot looks or behaves is animacy. Animacy involves the extent to which something is animated to appear lifelike, ergo behave lifelike, such as with movements and facial gestures similar to that of an alive human. Research has shown that robot facial expressions and robot gaze can convey emotional states effectively enough, similar to a human (Lombardi et al., 2023). Direct gaze design, enjoyment smiles and head nodding for positive emotions are animacy features that make the robot more trustworthy (Song & Luximon, 2020). Overall, animacy is also correlated with perceived intelligence of the robot (Bartneck et al., 2009). In this way, animacy features and anthropomorphic designs work together to make humanoid robots preferred over mechanical-looking robots.

Given how humanoid-robots seem to be preferred over mechanical looking ones, the following can be expected:

H5a: A humanoid-looking robot positively influences affective perceptions (as compared to a mechanical-looking robot). These positive affective perceptions include positive correlations with 'likeability' and negative correlations with 'creepiness'.

H5b: A humanoid-looking robot positively influences cognitive perceptions (as compared to a mechanical-looking robot). This includes positive correlations with 'trustworthiness' and positive correlations with 'procedural justice'.

H5c: A humanoid-looking robot positively influences behavioural perceptions (as compared to a mechanical-looking robot). This includes positive correlations with 'opportunity to perform', positive correlations with 'social presence', and positive correlations with 'organizational attractiveness'.

When considering what effects of robot design and robot role could both have on job candidates' perceptions, their interaction effect can be expressed as follows:

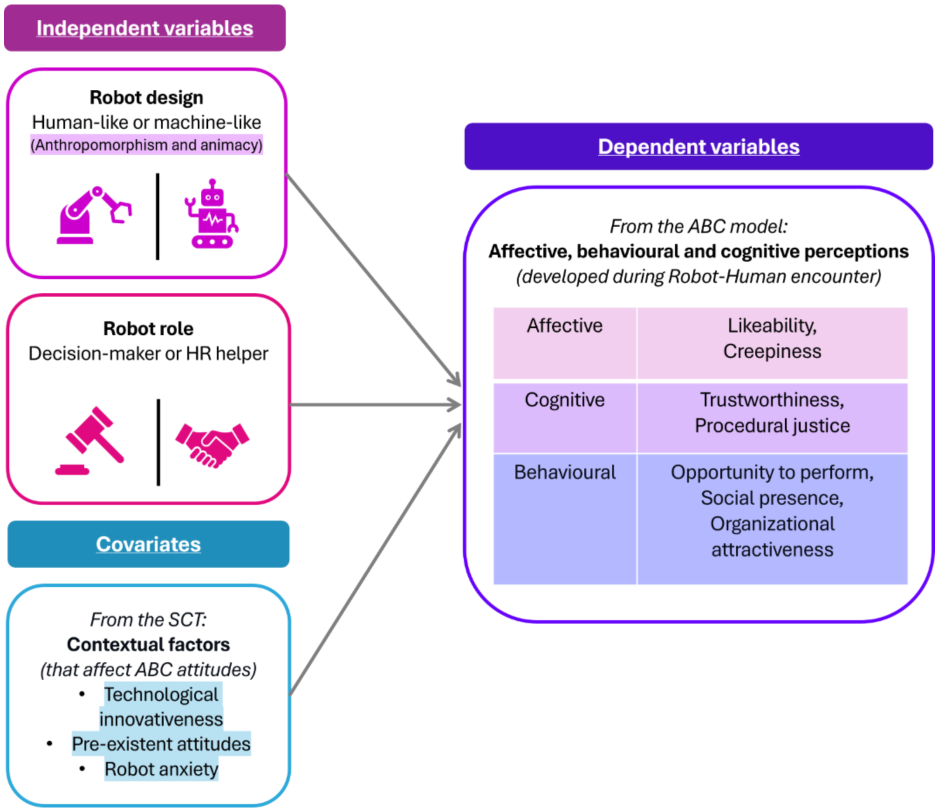
H6: The effect of a humanoid-looking robot, as opposed to a mechanical-looking robot, on ABC perceptions is more positive when the robot has an HR helper role compared to a decision-making role.

2.6. Conceptual model

Having considered the aforementioned variables and connections that shape a job-candidate's perception about a job interview led by a robot, the following model can be used to illustrate such relationships. This model is displayed in Figure 1. It shows how robot design (human-like vs machine-like) and robot role (decision maker vs HR helper) can affect the affective, cognitive and behavioral perceptions that a job candidate can have over the recruiting robot, the company and the interview. The effect of robot design and robot role can also be affected by contextual variables, each in the way of a covariate. The next section will describe how this model was put into practice to test these relationships and assess their veracity.

Figure 1

Theoretical model



Note: The theoretical model of this study explains how robot design, decision-making role, and contextual variables will affect the ABC perceptions of the job-seeker over the robot, the company and the interview.

2. Methodology

To understand how the design and role of a social robot for recruitment affects the perceptions that jobseekers have over the robot, the hiring company, and the recruitment experience, a 2 (design: humanoid vs. mechanical) x 2 (role: recruiting decision maker vs. HR-helper) between-subjects experimental elicitation study was undertaken. In all conditions, participants watched a simulated job interview between a candidate and the robot and then completed a post-test questionnaire. The experimental conditions of the study are presented in Table 1.

3.1. Participants

For this study, the only criterion for recruitment was that participants should be over the age of eighteen. Individuals born between 1965 and 2006 would be the economically active generation, and thus likely to encounter recruiting robots. The value that individuals past the retirement age (65 years of age) bring to the study is that they have broad experience in the working field, and thus could have valuable or strong perceptions about the incorporation of robots in the labour market. The median age was 22, with the youngest individual being 18 and the oldest being 70 (*M*=29.50, *SD*=33.93). An overview of the demographic data of the sample can be found in Table 1.

Convenience sampling and snowball sampling were used for this study. Participants were obtained from a pool of students, teachers and co-workers at the University of Twente, family, family friends and family co-workers. Participants were also recruited through word of mouth, social media posting and online messaging. Data collection occurred from the 28th of May 2024 till the 5th of June 2024. Participants were offered SONA credits and entering a raffle for €10 Bol.com gift cards in exchange for successfully completing the survey. Those interested filled in information and consent forms, such documents can be found in Appendix A.

As can be seen in table 1, the total sample consisted of 87 participants (46% male, 51.7% female, 1.15% other). Over ninety percent (93.1%) had work or internship experience before. Almost ninety percent (87.4%) had had work, internship or labour-related interviews experience before. Over half of the sample (60.9%) had interacted with a robot before. The highest level of education attained by over half of the sample (57.5%) was a high school diploma.

Table 1

Demographical data of participants per condition

	Mechanical decision-maker		Humanoid decision-maker		Mechanical HR helper		Humanoid HR helper		Total	
	n	%	n	%	n	%	n	%	n	%
Total participants	21	24.14	22	25.29	23	26.44	21	24.14	87	100
Gender										
Man	13		11		7		9		40	45.98
Woman	8		10		15		12		45	51.72
Other	0		1		0		0		1	1.15
Did not specify	0		0		1		0		1	1.15
Age, M (SD)	30.81 (16.77)	-	33.59 (18.35)	-	26.96 (11.41)	-	26.65 (11.60)	-	29.52 (33.93)	-
Education										
High school	11	12.64	13	14.94	12	13.79	14	16.09	50	57.47
Bachelor's degree	8	9.20	5	5.75	7	8.05	4	4.60	24	27.59
Master’s degree	1	1.15	2	2.30	3	3.45	2	2.30	8	9.20
Doctoral degree	0	0	0	0	1	1.15	0	0	1	1.15
Other										
HBO propedouse	1	1.15	0	0	0	0	0	0	1	1.15
Has experience with employment or internship	20	22.99	19	21.84	21	24.14	21	24.14	81	93.10
Has experience with job or internship interview	18	20.69	18	20.69	20	22.99	20	22.99	76	87.36
Has interacted with robot(s) before	14	16.09	13	14.94	16	18.39	10	11.49	53	60.92

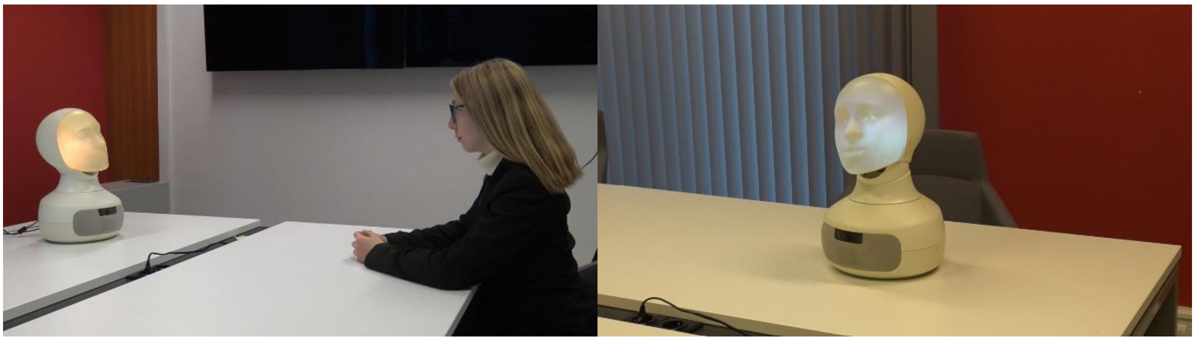
Note. Table showing the demographic information of the sample, including their experience with work, employment, job-interviews and robots.

3.2 Stimuli

To prepare the video, the researcher was in close contact with the BMS Lab of the University of Twente, who provided all the facilities and equipment. The BMS Lab helped in procuring a Furhat social robot, explaining its technicalities and providing the software to code the robot. The robot script and facial gestures were coded using Blockly and using the Furhat software (see Appendixes B and C). The video was set up, filmed and edited using VEGAS Pro 14.0 by the researcher alone. Previews of what the video looked like can be found in Figure 2.

Figure 2

Previews of the two video frames



Note: On the left, the job candidate with the humanoid robot. On the right, the focused frame on the machine-looking robot.

The video pictured the robot and job candidate alone in a room. The setup involved placing the robot on a table opposite the researcher at eye-level, who posed as the job candidate. One camera was used to capture a frame with both subjects. Another camera was used to focus the frame on the robot only. In this way, the participant would be able to observe the robot in detail and have a general appraisal of the two-way conversation. The video was kept rather simplistic so that the participant would focus on the dialogue content and the appearance of the robot.

The simulated job position available was chosen to be a cinema service desk administrative assistant, as it is a job that requires no prior knowledge. This was to dissuade the participants from focusing on the job type, but rather on the interaction with the robot. The researcher changed their name during the video. The name of the hiring company ‘Pop Corn Cinema’ was also fake. Whilst appearing real, all details of the interview were fictitious as so not to take attention away from the robot interaction.

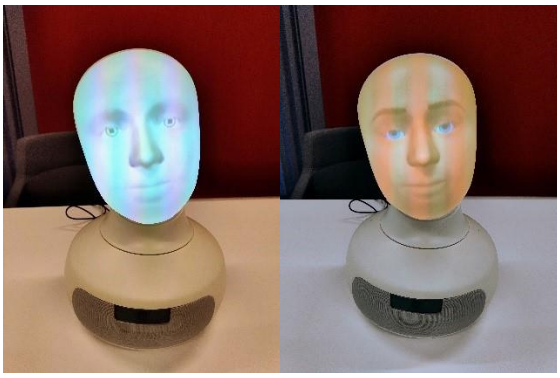
An overview of how the robot design and robot roles were arranged for the videos will be detailed next.

Robot design

The experimental 2x2 design had four conditions, the independent variables being the design and role of the robot. The designs of the robot can be viewed in Figure 3. Two conditions included the Furhat presenting a humanoid facial design. This facial design was of a light pinkish-yellow skin colour, blue eyes with round pupils and skin tissue texture on the chin. In the other two conditions, the robot presented a machine-like facial design. Here the robot's face was light grey, with lines imitating the conjunction of the chassis' pieces, no tissue texture and piercing abnormal grey eyes with square pupils. This made the robot look more like a 'silver face' machine, as in Broadbent et al's (2013) study. None of the robots had hair or a body. The robot was able to smile. A pre-test was not conducted to confirm the humanoid vs. machine-like appearance because Akwali's work (2024) had already validated the Furhat designs.

Figure 3

The designs of the Furhat robot



Note: Figure presents the mechanical-looking robot (left) and the humanoid-looking robot (right) that were used to create the videos.

Robot role

For each of these two design conditions, the role of the robot also varied. Under two conditions the robot behaved like the final decision-maker when it comes to hiring (or not) the job-seeker participant. The conversation contents and style were scripted to clearly indicate that the robot would be the one in power to recruit the job-seeker on behalf of the organization, with no HR human to take part in the process. In the other two conditions, the role of the robot was different. The robot was meant to serve as tool or facilitator that helped the company's HR department carry out recruitment interviews, where the consideration and decision to hire would rest solely on the human HR employees of such company. Highlights of these script differentiators can be seen in Table 3, and the full script can be found in Appendix B. Whilst the facial design and robot-role script markers changed, the interview setting and base interview questions remained consistent throughout the conditions.

Table 2

Script markers that evidenced the role of the robot

Robot role	Robot as recruiting decision-maker	Robot as HR helper
Script examples	“I will be interviewing you today to see if you are a good fit. After the interview I will decide myself whether I want to hire you.”	" I will be helping Por Corn Cinema with interviewing you today to see if you are a good fit. After the interview employees of the company will decide whether they want to hire you.”
	“Think of me as a Human Resources employee of Pop Corn Cinema. I interview you and I also decide whether to hire you or not, without any help from other employees. I check the answers you gave me and decide for myself.”	“Think of me as a helper of the Human Resources team of Pop Corn Cinema. I simply interview you. I am not the one who will decide whether to hire you or not. Instead, other human employees will check the answers you gave me and decide themselves.”

Note: Table includes some examples of what the robot said during the video to clarify whether it was adopting a decision-maker role or an HR helper role.

3.3. Procedure

The data collection took place in an online survey platform (Qualtrics). At first, participants were introduced with the aim of the research and were informed about their rights to consent, to withdraw form their study, the confidentiality of their data and other ethical aspects found in Appendix A. Then, respondents watched one of the four video versions of a simulated job interview between a candidate and a robot interviewer.

After watching the job interview, participants had to complete a post-test questionnaire. This survey asked how participants would feel if they were in the video candidate's place and their perceptions of the encounter in general. All survey questions were the same regardless of what version of the video the participant was exposed to. The first part of the questionnaire measured the affective, cognitive and behavioural perceptions evoked by the interview experience. The second part of the questionnaire measured technological innovativeness, past experiences with robots, and robot anxiety. Manipulation check questions were also included in the questionnaire. These measured anthropomorphism, animacy, whether the robot looked more machine-like vs. human-like and whether the robot was the decision-maker vs. the HR helper. Finally, participants were asked some demographic questions, such as age, gender, education and other markers related to past experiences with work, interviews and robots.

3.4 Measures

Below the scales used to explore participants' perceptions in regard to the robot will be detailed. A copy of the complete questionnaire can be found in Appendix D.

3.4.2. Affective perceptions

Likeability

To measure likeability, five items were used from Bartneck et al.'s (2009) Godspeed questionnaire. Likeability is a subscale form of the Godspeed questionnaire which measures the extent to which an individual may like or dislike a robot, based on social evaluations such as (un)friendliness, (un)kindness, etc. Each item was measured on a Likert scale from 1 (least likeable) to 5 (most likeable), e.g. “1= Awful to 5= Nice”. The Cronbach’s Alpha for this scale was .87.

Creepiness

To measure creepiness, six items were adapted and used from Langer and König’s (2018) Creepiness of Situation Scale (CRoSS). Langer and König’s (2018) CRoSS measures emotional creepiness, defined as the “unpleasant affective impression elicited by unpredictable [...] technologies” (p.3) through five items. It also measures creepy ambiguity, the “lack of clarity on how to act and how to judge in such a situation” (Langer & König, 2018, p. 3) through five items. In this study, four items from the original scale were not used because they were either repetitive, vague or non-transferable for the elicitation-based job interview video, for example “During this situation, things were going on that I did not understand”. The wording of the items was slightly changed to better match the elicitation-based job interview setting, for example “I felt uneasy in this situation” to “I would have felt uneasy during this job interview”. Each present item was measured on a Likert scale from 1 (strongly disagree) to 5 (strongly agree), e.g. “The job interview would have somehow felt threatening”.

Given how the scale measures two factors (emotional creepiness and creepy ambiguity), a factor analysis was run. The factor analysis showed some cross-loadings between items and no clear factor structure. Deleting those items with low factor loadings did not improve the factor or reliability score, so these items were kept instead. Thus, the Cronbach’s Alpha for this scale was .79.

3.4.3. Cognitive perceptions

Trustworthiness

To measure trustworthiness, six items were adapted and used from Pinto et al.’s (2022) Trust Scale for Human-Robot Interaction. Originally, the scale measures competency, reciprocity, risk perception and benevolence. However, competency was not used because this scale evaluated robot’s competency from the point of view of HR practitioners, not job candidates. Reciprocity was also omitted because the procedural justice scale (explained below) was more appropriate to evaluate this perception. Risk perception measures the willingness that a human would have to interact with a robot, influenced by past experiences. Benevolence measures the degree to which an individual trusts the robot to act in the best interests of said human. The wording of the items was slightly changed to better match the elicitation-based job interview video, for example “It would think it is risky to interact with this robot”. Each item can be measured on a Likert scale from 1 (strongly disagree) to 5 (strongly agree), e.g. “I believe that this robot will act in my best interest”.

Given how the scale measures two factors (risk perceptions and benevolence), a factor analysis was run. The factor analysis showed that all items had acceptable factor loadings, that there were no cross-loadings between them and a clear factor structure. Therefore, the scale was divided into its subscales for the analysis. The risk perception subscale had a Cronbach’s Alpha of .75 and the benevolence subscale also had a Cronbach’s Alpha of .75.

Procedural justice

To measure procedural justice, twelve items were adapted and used from Bauer et al.’s (2001) Selection Procedural Justice Scale (SPJS). This scale assesses the fairness of the recruitment process from the point of view of the job applicant. Originally, the scale contains twelve subscales. Out of these, only openness, treatment and two-way communication were used for this study since the other subscales assessed recruitment practices beyond the scope of the job interview presented in the video. Bauer et al. (2001) define openness as “the extent to which communications are perceived by applicants being honest, truthful and open” (p.391). They define treatment as “the degree to which applicants are treated with warmth and respect” (p.391). They also refer to two-way communication as “the opportunity for applicants to offer input or to have their views considered during the test/in the selection process” (p.391).

The wording of the items was slightly changed to better match the elicitation-based job interview video, for example from “Test administrators were candid when answering question during the tests” to “The robot was candid when answering question during the interview”. Each item can be measured on a Likert scale from 1 (strongly disagree) to 5 (strongly agree), e.g. “The robot treated the candidate with respect during the interview”.

Given how the scale measures three factors, -openness, treatment and two-way communication-, a factor analysis was run. The factor analysis showed some cross-loadings between items and no clear factor structure, but deleting those with low factor loadings did not improve the reliability score, so these items were kept instead. Thus, the Cronbach's Alpha for this scale was .85.

3.4.4. Behavioral perceptions

Opportunity to perform

To measure the opportunity to perform, the 'Chance to perform' subscale was adapted and used from Bauer et al.'s (2001) Selection Procedural Justice Scale (SPJS). Bauer et al. (2001) define the opportunity to perform as "having adequate opportunity to demonstrate one's knowledge, skills, and abilities within the testing [job interview] situation". Only three of the four original items were used given that one of the questions did not match the content of the job interview video. The wording of the remaining three items was slightly changed to better match the elicitation-based job interview video, for example from "This test allowed me to show what my job skills are" to "This interview could have allowed me to talk about what my job skills are". Each item can be measured on a Likert scale from 1 (strongly disagree) to 5 (strongly agree), e.g. "This interview would have given applicants the opportunity to talk about what they can really do". The Cronbach's Alpha for this scale was .85.

Social presence

To measure social presence, six items were adapted and used from Chen et al.'s (2023) Social Robot Presence Scale. This scale measures the degree to which a robot would be perceived as a "real person" when communicating with it and the level of feeling connected to it (Chen et al., 2023, p.2). Originally, it measures perceived presence, interaction behaviour perception, interactive expression & information understanding, perceived emotional interdependence and attention allocation. The subscales range from having five to two items. However, only interactive expression & information understanding and attention allocation were used for this study since the other subscales assessed robot-human interactions unachievable through the elicitation-based job interview video. The wording of the items was slightly changed to better match the job interview video, for example from

“I keep an eye on the social robot as I interact with it” to “The candidate kept an eye on the robot as she interacted with it”. Each item can be measured on a Likert scale from 1 (strongly disagree) to 5 (strongly agree), e.g. “I think that the robot was able to understand the candidate’s thoughts correctly”.

Given how the scale measures two factors, -interactive expression & information understanding and attention allocation -, a factor analysis was run. The factor analysis had no cross-loadings, it had a clear factor structure, but one item had a very low factor loading. Deleting this item did not improve the reliability score and it interfered with the other items. Thus, the scale was kept as is. Thus, the Cronbach’s Alpha for this scale was .63.

Organizational attractiveness

To measure the organizational attractiveness, the ‘Items for Organizational Attractiveness’ subscale was adapted and used from Aiman-Smith et al.’s (2001) Organizational Attractiveness and Job Pursuit Intentions questionnaire. This scale measures the extent to which a job candidate would rate the appeal of (working for) a certain organization. Originally, the subscale contains five items. For this study, only four items were used since the item “I would want a company like this in my community” was vague and not very applicable to the present job-interview video. The wording of the items was slightly changed to better match the job interview video, for example from “If I were looking for a job as a cinema administrative assistant, I would like to work for this company”. Each item can be measured on a Likert scale from 1 (strongly disagree) to 5 (strongly agree), e.g. “I would like to work for this company”. The Cronbach’s Alpha for this scale was .88.

3.5. Covariates

Pre-existent general attitudes towards robots

To measure pre-existent general attitudes towards robots, nine items were used from Pan et al.’s (2018) Robot Social Attributes Scale (RoSAS). This scale explores how users socially judge a robot. Originally, it measures competence, warmth and discomfort through six items each. For this study, only three items per subscale were used to make the questionnaire more concise. The original scale asked “Using the scale provided, how closely are the words below associated with the category robots?", with the available response being a 9-point Likert scale from 1 (definitely not associated) to 9 (definitely associated). For better consistency of the present questionnaire, the question was changed to "In general, do you think robots are..." and the scale was changed to a 5-point Likert scale from 1 (not at all) to 5 (extremely). Example items from each subscale are whether participants robot to be "Reliable", "Sociable" and "Dangerous".

Given how the scale measures three factors (competence, warmth, and discomfort), a factor analysis was run. The initial factor analysis showed that item three "Interactive" loading on another factor other than the intended with a low loading of .31. Item seven "Awkward" had a factor loading lower than .30. After deleting these unsuitable items, another factor analysis showed that all items had acceptable factor loadings, that there were no cross-loadings between them and a clear factor structure. Therefore, the scale was divided into its subscales for the analysis. The competence subscale had a Cronbach's Alpha of .62, the warmth subscale had a Cronbach's Alpha of .73, and the discomfort subscale had a Cronbach's Alpha of .59.

Technological innovativeness

To measure technological innovativeness, three items were adapted and used from Agarwal and Prasad's (1998) "Personal Innovativeness in the Domain of Information Technology" scale. This scale measures "the willingness of an individual to try out any new information technology" (Agarwal and Prasad, 1998, p.204). Originally, the scale has four items but this item was taken out due to redundancy with one of the other items. Item two was changed from "Among my peers, I am usually the first to try out new technologies" to include family as well. The original scale used a Likert scale from 1 (strongly agree) to 7 (strongly agree), e.g. "In general, I am hesitant to try out new information technologies". For better consistency of the present questionnaire, the scale was changed to a 5-point Likert scale from 1 (strongly disagree) to 5 (strongly agree). The Cronbach's Alpha for this scale was .77.

Robot anxiety

To measure robot anxiety, ten items were used and adapted from Nomura et al.'s (2006) Robot Anxiety Scale (RAS). This scale measures "the emotions of anxiety or fear preventing individuals from interaction with robots" (Nomura et al., 2006, p.3). Originally, it measures anxiety towards communication capability of robots, towards behavioural characteristics of robots, and towards discourse with robots. It does so through twelve items in total. However, for this study, only three items per subscale were used to make the questionnaire more concise. The prompting question was set to "Please answer how much anxiety you experience regarding...". Originally, each item can be measured on a Likert scale from 1 to 6, but this was changed from a 1 (I do not feel anxiety at all) to 5 (I feel anxiety very strongly) for consistency with the rest of the questionnaire. The wording of the items was slightly changed to enhance clarity, for example from "I may be unable to understand the contents or robots' utterances to me" to "How I may be unable to understand what robots say to me".

Given how the scale measures three factors, (anxiety towards communication capability of robots, toward behavioural characteristics of robots, and towards discourse with robots), a factor analysis was run. The factor analysis showed some cross-loadings between items and no clear factor structure. Deleting those items with low factor loadings did not improve the reliability or factor score, so these items were kept instead. Thus, the Cronbach's Alpha for this scale was .87.

3.6. Manipulation checks

3.6.1. Robot Design

To validate whether the humanoid-looking Furhat indeed looks more humanoid than the machine-looking Furhat, anthropomorphism and animacy were measured. An additional simpler question was added to corroborate the effectiveness of the manipulation of the robot's appearance.

Anthropomorphism

To test for anthropomorphism, five items were used from Bartneck et al.'s (2009) Godspeed questionnaire. Anthropomorphism is a subscale from the Godspeed questionnaire which measures the extent to which an individual may evaluate a robot to look human. Each item can be measured on a Likert scale from 1 (least anthropomorphic) to 5 (most anthropomorphic), e.g. "1= Fake to 5= Natural". The Cronbach's Alpha for this scale was .71.

Animacy

To test for animacy, five items were adapted and used from Bartneck et al.'s (2009) Godspeed questionnaire. Animacy is a subscale from the Godspeed questionnaire which measures the extent to which an individual may evaluate a robot to behave or move like a human. Each item can be measured on a Likert scale from 1 (least animacy) to 5 (most animacy), e.g. "1= Stagnant to 5= Lively". The Cronbach's Alpha for this scale was .80.

Additionally, a Likert scale-based question called 'robot appearance' was added. It asked "To what extent do you think the robot in the video looked...", where participants could choose from 1 (machine-like) to 5 (human-like).

3.6.2. Robot role

To test whether the manipulations of the robot's recruiting role was effective during the video, participants were asked "Regarding the video you just saw, who is ultimately making the decision about hiring the candidate?". Participants could choose either "the robot in the video", "the company's Human Resources team" or "I don't remember".

3.7. Data analysis

To clean and prepare the data, participants that had left scales unfinished were omitted. Those who had not completed optional questions, such as demographic data, were not excluded. Mean scores were computed for each scale or subscale, when applicable, to compare these mean scores between groups of participants.

To analyse the results, a factor analysis, t-tests, 2-way ANOVAs and 2-way ANCOVAS were executed. A factor analysis was performed to assess the internal consistency and reliability of the scales. It was also used to eliminate any possibly unsuitable items from the results, as evidenced in section '3.4. Measures'. All the tables for the factor analyses performed on every scale can be found in Appendix E. T-tests were used to compare the mechanical vs humanoid design groups and the decision maker vs HR helper robot groups, respectively. They were also used to test the effectiveness of the robot face manipulation. To test whether the manipulation for the robot role was successful, the number of correct answers regarding the robot's role per condition were calculated.

2-way ANOVAs were used to explore the combined effect of the two independent variables (robot role and robot design) on the ABC perceptions in the four conditions. ANOVAs were chosen over regression analysis to test these effects in an 'overall' way with how the independent variables are categorical.

2-way ANCOVAs were used to test the combined effect of the two independent variables (robot role and robot design) on the ABC perceptions, when controlling for the covariates. The ANCOVAs controlled for the covariate effect of technological innovativeness, past experiences with robots, robot anxiety, age and experience with robots on the ABC perceptions.

The assumptions for normality, homogeneity and independence for the ANOVAs and ANCOVAs were checked for. Some of the variables breached these assumptions. An overview of these tests can be found in Appendixes F and G.

4. Results

4.1. Effectiveness of the robot appearance and robot role manipulations

The two-tailed T-test evaluating the difference in means for the Robot Appearance question between participants who were exposed to the humanoid robot face vs. the mechanical robot face is shown in table 3. The alternative hypothesis stated that there should be a difference in means for the Robot Design scores, whilst the null hypothesis states there should be no difference between the means. The output shows that the manipulation of the robot face yielded no was not significant differences between the two robot types, at the specified $p < .05$ level, $t(84) = 0.94$, $p = 0.352$, 95% CI [-0.18, 0.50]. Thus, the manipulation of the robot's face was not successful.

Anthropomorphism

The two-tailed T-test evaluating the difference in means for the Anthropomorphism scale between participants who were exposed to the humanoid robot face vs. the mechanical robot face is shown in table 3. The output shows that the manipulation of the robot face was not significant, at the specified $p < .05$ level, $t(84) = 0.97$, $p = 0.336$, 95% CI [-0.15, 0.43]. Participants did not perceive the humanoid robot as more anthropomorphic than the mechanical counterpart.

Animacy

The two-tailed T-test evaluating the difference in means for the Animacy scale between participants who were exposed to the humanoid robot face vs. the mechanical robot face is shown in table 3. The output shows that the manipulation of the robot face was not significant, at the specified $p < .05$ level, $t(84) = 0.56$, $p = 0.593$, 95% CI [-0.23, 0.41]. Participants did not perceive the humanoid robot as more animated than the mechanical counterpart.

Robot role

The total number of participants exposed to the robot as a decision-maker were individuals. Out of these, 34 (86.4%) correctly identified and recalled the robot's role as such. The total number of participants exposed to the robot as a HR helper were 44 individuals. Out of these, 38 (79.1%) correctly identified and recalled the robot's role as such. Adding these scores shows that the manipulation for the robot as a decision maker was nearly ninety percent (86.4%); and for the robot as a HR helper was nearly eighty percent (79.1%). This means that manipulation for the robot's role was, overall, successful with over eighty percent (82.8%) success rate.

Table 3

T-tests comparing the effectiveness of robot appearance manipulation

	Mechanical face		Humanoid face		*t*(84)	*p*
	M	*SD*	*M*	*SD*		
Robot design	2.11	0.84	1.95	0.75	0.94	.352
Anthropomorphism	2.24	0.60	2.38	0.74	0.97	.336
Animacy	2.59	0.71	2.68	0.80	0.54	.593

Note: Table showing the results for the t-tests that compared the difference in mean for robot design, anthropomorphism and animacy between groups exposed to the humanoid vs. machine-like robot.

4.2. Effect of robot role and robot appearance on ABC perceptions

The difference in means for the ABC perceptions between participants exposed to different robot appearances (mechanical vs. a humanoid-looking robot) and different robot roles (decision-maker vs. HR helper) was evaluated, as seen in table 4. A 2-way ANOVA was carried out to test these differences, taking into account the interaction between the robot's appearance with the robot's role, at the specified $p < .05$ level. The 2-way ANOVA showed that there was no significant effect of robot appearance on ABC perceptions. The 2-way ANOVA showed that there was no significant effect of robot role on ABC perceptions either. Likewise, the 2-way ANOVA showed that there was no significant interaction effect between robot appearance and robot role on ABC perceptions.

To gauge what perception the participants gathered from the robot-led interview, the means and standard deviations per conditions were computed. Under both robot appearances and robot roles, participants had similar neutral affective perceptions. They also had similar neutral cognitive perceptions, with similar slightly more negative perceptions for benevolence. Participants had similar slight negative behavioral perceptions, with more neutral perceptions of social presence. Under all conditions and variables, most responses are around one standard deviation away from the mean. This shows that participants differed little in their answers.

Table 4

2-way ANOVA testing the effect or robot design, role, and their interaction on ABC perceptions

Measure	Mechanical		Humanoid		Effect of robot design		Decision maker		HR helper		Effect of robot role		Robot design*robot role	
	M	*SD*	*M*	*SD*	*F*(1, 83)	*p*	*M*	*SD*	*M*	*SD*	*F*(1,83)	*p*	*F*(1,83)	*p*
Affective														
Likeability	3.44	0.65	3.39	0.82	0.10	.753	3.49	0.74	3.35	0.73	0.84	.363	< 0.01	.978
Creepiness	3.41	0.92	3.24	0.81	0.78	.381	3.29	0.93	3.36	0.81	0.13	.720	0.95	.332
Cognitive														
Risk perception	3.41	0.99	3.32	0.97	0.19	.664	3.38	0.98	3.35	0.98	0.03	.870	2.10	.151
Benevolence	2.79	0.92	2.40	0.89	4.05	.047	2.68	0.96	2.51	0.88	0.93	.337	0.03	.855
Procedural justice	3.92	0.56	3.84	0.72	0.33	.568	3.96	0.71	3.80	0.57	1.49	.227	0.40	.527
Behavioural														
Opportunity to perform	2.93	1.01	2.81	1.04	0.33	.570	2.85	1.01	2.89	1.04	0.02	.894	1.48	.227
Organizational attractiveness	2.68	0.94	2.42	0.79	1.88	.174	2.59	0.87	2.52	0.88	0.20	.653	0.38	.542
Social presence	3.63	0.62	3.72	0.60	0.45	.505	3.69	0.63	3.66	0.59	0.06	.811	0.37	.547

Note: The table shows the mean scores that groups exposed the mechanical, humanoid, decision-maker and HR helper robot has about every ABC perception. The table also shows the ANOVA results the separate effect that robot design and robot role had on the ABC perceptions, as well as the effect that their interaction has over the perceptions.

4.3 Controlling the effect of contextual aspects

The difference in means for the ABC perceptions between participants exposed to different robot appearances (mechanical vs. a humanoid-looking robot) and different robot roles (decision-maker vs. HR helper) was evaluated, controlling for the effect of contextual covariates. The mean scores (understood as a Likert scale of 1= Low to 5= High) can be seen in table 5. The covariates are pre-existent attitudes about robots (competence, warmth, and discomfort), technological affinity and robot anxiety.

A 2-way ANCOVA was carried out to test these differences (table 6), controlling for the effect of the covariates, at the specified $p < .05$ level. The 2-way ANCOVA showed that, when controlling for competence, warmth, and discomfort, and technological affinity, there was no significant effect of robot appearance or role on ABC perceptions. However, there was a significant effect for robot appearance and role on ABC perceptions when controlling robot anxiety at $F(1)= 4.15$, $p=0.045$.

Table 5

Descriptive statistics for scores of contextual variables per condition

	Competence		Warmth		Discomfort		Technological innovativeness		Robot anxiety	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Mechanical decision-maker	3.05	0.98	1.57	1.01	3.90	1.15	3.84	1.14	2.95	1.03
Humanoid decision-maker	3.36	0.98	1.77	1.00	3.59	1.14	3.29	1.13	3.13	1.02
Mechanical HR helper	3.24	0.97	1.61	1.00	3.72	1.14	3.67	1.13	3.40	1.02
Humanoid HR helper	3.07	0.98	1.30	1.01	3.69	1.14	3.22	1.13	3.10	1.02

Note: Table showing the average scores for pre-existent attitudes about robots (competence, warmth, and discomfort), technological affinity, and robot anxiety per experimental condition. The mean scores can be understood as a Likert scale of 1=Low to 5=High.

Table 6

ANCOVA analysis controlling contextual aspects

	Competence		Warmth		Discomfort		Technological affinity		Robot anxiety	
	F(1,82)	*p*	*F*(1,82)	*p*	*F*(1,82)	*p*	*F*(1,82)	*p*	*F*(1,82)	*p*
Affective										
Likeability	0.01	.942	< 0.01	.993	0.03	.869	< 0.01	.960	0.01	.927
Creepiness	1.03	.312	0.78	.381	0.97	.327	1.05	.308	1.43	.235
Cognitive										
Risk perception	1.69	.198	1.53	.22	2.51	.117	2.34	.130	4.15	.045**
Benevolence	0.09	.761	0.52	.472	0.04	.843	0.03	.870	0.10	.756
Procedural justice	0.27	.608	0.14	.705	0.29	.595	0.43	.513	0.17	.686
Behavioural										
Opportunity to perform	1.89	.175	1.48	.227	1.61	.208	1.39	.243	1.10	.297
Organizational attractiveness	0.36	.553	0.16	.694	0.29	.590	0.38	.540	0.27	.603
Social presence	0.17	.679	0.17	.685	0.20	.656	0.41	.526	0.21	.645

Note: Table showing the ANCOVA analysis. Each column shows the interaction effect between robot design and role on a perception variable (e.g., Likeability) after controlling for a contextual variable. The contextual aspects were pre-existent attitudes about robots (competence, warmth, and discomfort), technological affinity, and robot anxiety.

4.4 Controlling the effect of demographic aspects

The difference in means for the ABC perceptions between participants exposed to different robot appearances (mechanical vs. a humanoid-looking robot) and different robot roles (decision-maker vs. HR helper) was evaluated, controlling for the effect of demographic covariates. The covariates are age and whether participants had interacted with a robot before this experiment. A two-way ANCOVA was carried out to test these differences, controlling for the effect of the covariates, at the specified $p < .05$ level. The 2-way ANCOVA showed that, when controlling for age and robot experience, there was no significant effect of robot appearance or role on ABC perceptions.

4.5. Post-hoc analysis

Since there was a significant effect of robot appearance and role on risk perception when controlling robot anxiety, a post-hoc test was done to identify which groups differ from each other. These results are displayed in table 7. A Bonferroni correction was applied for this pairwise comparison. However, The analysis showed that there was no significant difference between the groups. Therefore, the effect or robot appearance and role on ABC perceptions when controlling robot anxiety was no longer significant.

Table 7

Post-hoc analysis for the effect of robot appearance and role on risk perception when controlling for anxiety

Contrast	*F*(82)	*p*
Mechanical decision-maker vs. Humanoid decision-maker	-1.04	.300
Mechanical decision-maker vs. Mechanical HR helper	-1.62	.109
Mechanical decision maker vs. Humanoid HR helper	0.21	.833
Humanoid decision-maker vs. Mechanical HR helper	-0.60	.551
Humanoid decision-maker vs. Humanoid HR helper	1.26	.211
Mechanical HR helper vs. Humanoid HR helper	1.85	.067

Note: Table showing the results of the post hoc analysis testing the effect of robot appearance and role on risk perception, where every condition was contrasted against each other to see which groups differed from each other in a statistically significant way.

5. Discussion

Robots are growing in the field of HR, with one application being using a robot as a job interviewer. Using interviewer robots can help a company reduce costs, time and the human biases that come into play when recruiting new employees. However, more research needs to explore how job candidates experience being interviewed by a robot, and how this affects their impression of the company and their HR practices. As such, this study aimed to answer the question ‘How does the design and role of a social robot for recruitment affect the perceptions that jobseekers have over the robot, the hiring company, and the job interview?’. These perceptions were measured by operationalizing ‘perceptions’ as a construct made out of affective, cognitive and behavioural perceptions (ABC), affected by contextual attitudes. To answer this question, an elicitation-based 2x2 experiment was conducted to test how job-seeker's perceptions are influenced by the robot design (humanlike vs. machinelike) and role (decision-maker vs. HR helper). Four videos displaying a job interview between a candidate and a (humanlike or machinelike) and (decision-maker or HR helper) robot were created. 87 participants were gathered, and each of them was shown one of these four videos before they responded to an online questionnaire about the ABC perceptions that the video evoked and their contextual attitudes.

5.1. Main findings

It was forecasted that contextual (also called pre-existent) attitudes that people would have about robots would affect the ABC perceptions formed during the experiment, regardless of the robot combination. The contextual attitudes considered were technological innovativeness, pre-existent attitudes about robots (competence, warmth, and discomfort) and robot anxiety. That is, those who had a positive outlook on robots and technology before the experiment would appraise the robot, company and interview more positively, regardless of whether it was humanoid, mechanical, decision-maker or HR helper. Likewise, those with negative outlooks about robots and technology make negative evaluations. Since these contextual attitudes could influence the perceptions, these aspects had to be controlled for when testing the effect of the robot design and role on the perception. Various ANCOVA analysis were performed to make this control. One of these ANCOVA analyses showed that anxiety does have an effect on the interaction between robot role and design on risk perception. However, after a post-hoc analysis, the effect was no longer significant. All the other controls showed that all the other contextual attitudes had no influence on the effect of robot design and role on ABC perceptions. Therefore, hypotheses 1, 2, and 3 are rejected, since they were informed by this prediction.

It was also expected that, due to people's general distrust of algorithmic decision making, the participants exposed to the decision-maker robot would have more negative ABC perceptions than those who watched the video about the HR helper robot. However, either robot role (decision-maker or HR helper) did not affect the perceptions of the candidates. Instead, all candidates had neutral to slightly negative perceptions of the robot, the company and the interview, -regardless of the robot’s role. Therefore, hypotheses 4a, 4b, and 4c are rejected, since they were informed by this prediction.

It was expected that, due to the appeal of a humanoid-looking robot over a mechanical-looking one, the participants exposed to the humanoid robot would have more positive ABC perceptions than those who watched the video about the mechanical robot. However, either robot design (humanoid or mechanical) did not affect the perceptions of the candidates. Instead, all candidates had neutral to slightly negative perceptions of the robot, the company and the interview, -regardless of the robot’s design. Therefore, hypotheses 5a, 5b, and 5c are rejected, since they were informed by this prediction.

These expectations about the effect or robot design and role had led to the prediction that the combined effect between robot design and robot role would make the perceptions more positive (humanoid HR helper robot) or more negative (mechanical decision-maker robot). However, no matter the combination between robot role and robot design, all perceptions where roughly the same: neutral or slightly negative. Therefore, hypothesis 6 is rejected, since they were informed by this prediction.

Another analysis was also carried out to see if demographic aspects could affect the ABC perceptions formed during the experiment, regardless of the robot combination. The demographic aspects considered were age and robot experience. Participants who were younger and who had previously interacted with robots were predicted to have more positive perceptions about the robot, company and interview than older and inexperienced people. All the controls showed that age and robot experience had no influence on the effect of robot design and role on ABC perceptions.

In the sections below, the strengths, limitations, theoretical and practical implications of these findings and directions for future research will be discussed.

5.2. Discussion of the Findings

Robot design

Since the expectations for robot design were not fulfilled, this introduces questions and possibilities regarding what job candidates perceive about mechanical robots in general. It was expected that the humanoid-looking robot would evoke more positive ABC perceptions than the mechanical one, but this did not happen in this study. Instead, all perceptions were neutral to negative, regardless of the robot's appearance. A reason for this could be that all participants regarded the robot as mechanical, even if the robot was supposed to look more humanoid. This is corroborated by how all the scores for anthropomorphism, animacy and robot appearance show that participants identified either robot as mechanical. This leads us to consider that job-candidates may regard machine-looking robots in recruiting negatively, where 'machine-like' can take a variety of nuanced forms. This is in line with most of the research on robot anthropomorphism, where robots with a humanlike face display are preferred over one silver face/mechanical designs in regards, to trustworthiness and robot likeability (Broadbent et al., 2013; Song and Luximon, 2020). As is, these results don't offer much to the literature exploring humanoid-looking robots but does corroborate with the research on mechanical-looking ones. Therefore, this study supports the idea that mechanical robots produce more negative perceptions.

Robot role

Given how adverse people react to algorithmic decision-making, it was unexpected that the robot's role (decision maker or HR helper) did not affect the perceptions of participants. The manipulation of the robot role was successful, with most participants correctly recalling and identifying whether the robot was the decision maker or an HR helper. Yet, the manipulation did not yield differences between the conditions, with all participants having neutral to negative views about the robot, the company and the interview. This contradicts the claims so far made by the literature. A possible explanation could be that neither robot role affected the ABC perceptions because job candidates are simply not in favour of recruitment robots. It could be that candidates will simply react negatively to robots in recruiting regardless of its role because they would prefer a non-robot instead (Horodyski, 2023). If candidates are suddenly received by a robot interviewer instead of the human interviewer they were expecting, this contrast could make them perceive the robot as machine-like no matter the design. Ergo, maybe it’s not a matter of robot role, but rather how job candidates want and expect a real human to engage them in the recruiting process.

Effect of contextual variables

Contrary to what was predicted, technological innovativeness and pre-existent attitudes did not play a part in how job candidates build their perceptions about either robot, company and interview. This would suggest that controlling for these variables is not necessary to understand how robot appearance and role affect job candidate's perceptions. However, this is unlikely to be true outside of this study's results since technological innovativeness and pre-existent attitudes are often key concepts similar to those used in popular technology acceptance theories, such as ‘effort expectancy’ (unified theory of acceptance and use of technology) and ‘attitude towards using the technology’ (theory of acceptance model). Ergo, perhaps a more plausible explanation could be that technological innovativeness and pre-existent attitudes are variables that emerge depending on the context. For example, it could be that the effect of technological innovativeness didn't manifest because the robot seemed easy to understand regardless of technological affinity. Likewise, perhaps pre-existent attitudes towards robots did not have an effect because all participants had similar pre-existent attitudes, which weren’t strong or dissimilar enough to alter their views upon this robot. Therefore, whilst this study found no evidence of technological affinity and pre-existent attitudes affecting perceptions, it's likely these relationships are more complex than what this study can let on.

Robot anxiety should have also affected the robot design and role interaction, and whilst initial tests seemed to support an effect on risk perception, the posterior post-hoc test overturned the idea. This would mean that controlling for robot anxiety is not necessary to understand how robot appearance and role affect job candidate's perceptions. Miller et al. (2021) argue that the anxiety that is felt at the moment of encountering the robot can cause trust to be built towards the technology. Ergo, an explanation for this study's results could be that pre-existent robot anxiety is not as relevant as state anxiety, since the latter can help the participant to get used to the robot. It's also possible that the robot did not provoke either eagerness or fear enough to trigger an effect from pre-existent anxiety. This could be due to the elicitation-based method or features from the robot itself, since context matters when creating trust (Jorge et al., 2024). Having considered these possibilities, this study found no evidence of robot anxiety affecting perceptions, but does not strongly contradict the literature's tendency to recognize the effect of anxiety.

5.3. Future research

It was unexpected that all participants would regard the robot as machine-like despite the pre-test and designs, which means more research is needed to understand how humans perceive robot appearance. Researchers have often struggled with this dilemma, often finding contradictions regarding how certain design features are perceived (Gray and Wegner, 2012; Song and Luximon, 2020). Moreso when trying to find consistent and clear results when the robot manipulations they apply are more nuanced than contrasting, as is the case with this study's Furhat. The Furhat in this study varied its skin colour and texture, facial features, pupil colour and shape. However, even the humanoid-looking features appeared machine-like to participants and were thus associated with neutral to negative perceptions. Therefore, more research is needed to explore how to effectively design a robot that does not look machine-like so that these negative reactions can be avoided.

Whilst robot design is an important factor towards robot acceptance, maybe it is not strong enough to induce acceptance. De Graaf and Allouch (2013) determined that other factors, such as usefulness, adaptability, enjoyment, etc. were more important than anthropomorphism at predicting acceptance. Dubois-Sage et al.

(2023) showed that anthropomorphism can be attributed through more factors than just appearance, such as robotic features (eyelashes, head hair, skin, gender, and clothes) and situational factors (framing the robot as anthropomorphic to participants, human-like role and perceived autonomy of robot). Therefore, maybe Science needs to step away from taking robot appearance as the leading factor and explore other alternatives more. Perhaps methods of co-creation and qualitative studies would tell us more about how to design robots and test for their success. So far, a lot of research is focused on quantitatively segregated acceptance and on generalizability, but maybe we should concentrate efforts on being more specific and going more in-depth, asking for the 'why's' and the 'how's'. Ergo, we should call for more research that dares to consider and test how other factors compete against design for robot acceptance, starting with more qualitative and open approaches.

There was no effect of robot role perhaps because the participants are not in favour of any kind of recruiting robot, which prompts us to explore what expectations and attitudes people hold over, -specifically-, recruiting robots. This implores research to capture how the public's current knowledge, feelings and assumptions about technologies and algorithms in recruitment affect their encounters with these technologies. Furthermore, this idea would suggest that perhaps people have differing attitudes and perceptions depending on what task, function or job the robot is supposed to have in general (Jorge et al., 2024), and less depending on the robot's design or exact approach at carrying out its job (decision maker or HR helper). Therefore, more studies need to explore and challenge people's associations, expectations and assumptions about different robots, understanding these associations as variable and contextual.

It was argued that the effect of covariates such as robot anxiety, technological affinity and pre-existent attitudes about robots could be present, but that it depends on the context. Perhaps features in the video or the robot didn't trigger these factors. It could also be that some scales weren't contextual or specific enough about the 'recruiting robots' topic to evoke the expected reactions. As such, this calls the academic community to develop more contextual theories and scales that, whilst less generalizable, may be more useful and accurate when applied to more specific situations, such as robots in job interviews. This may help to better understand how pre-existent attitudes and other can affect case-specific perceptions.

Initially, results showed an effect of robot anxiety on risk perception. However, further analysis conducted during the post-hoc test showed that these effects were no longer significant. Further research should be done to determine whether robot anxiety does actually have an effect on risk perception.

2.4. Limitations

A reason as to why the robot appearance did not cause the expect differences in perceptions could be that the humanoid-looking robot lacked more humanoid features. Dubois-Sage et al. (2023) showed that a human-like voice, human-like behavior and movements make a robot more anthropomorphic. Indeed, the Furhat in this study was not able to physically move like a human and it used voice synthesis, which didn't sound totally human and natural. Phillips et al. (2018) also state that features such as eyelashes, head hair, skin, gender, and clothes contribute to anthropomorphism. The Furhat lacked many of these textures or 3D/physical features, since the face was merely a screen projection from within the chassis. When using the Furhat in other studies, researchers could try to maximize these features (gender, skin texture and colour) to obtain a more humanoid robot.

A possible explanation as to why the expected effect of robot role (decision maker vs. HR helper) on perception did not occur could be that job candidates are simply not in favour of autonomous (recruitment) robots. For example, Stein and Ohler (2017) found that when participants think that digital agents are autonomous artificial intelligences, this leads to negative feelings and eeriness. Since the robot was set up to look intelligent and to respond autonomously in the video regardless of the robot's role, this could have caused either robot to receive the same perceptions. This is also supported by people's aversion towards AI-decision makers (Köchling et al., 2022) and towards recruiting robots that don't offer a sense of connection with the hiring company (Koivunen et al., 2022). These could be the reasons behind the lack of difference between conditions.

The choice of an elicitation-based design had its advantages, but it would be preferable to have an in-person experimental design. An elicitation-based design can support an experiment, with the advantage that many more people can be reached at the same time. This was especially beneficial to this study because the robot would have been mostly unavailable during the weeks destined for data collection and the robot takes a long time to set up. Nevertheless, an in-person design would have been more ecologically valid, since a job interview akin to a real one can be set up for the participant to experience it themselves. It would have been better to evoke more valid or stronger responses from participants. The Cronbach's alpha (.63) for the social presence scale of the robot indicated that participants could not properly observe or fully understand the robot and its behaviour during the video. This is why having an in-person setup would probably enhance validity and thus yield better results, improving the quality of the human-robot interaction, as measured by social presence. Furthermore, it could also have allowed participants to see the robot in more detail, which maybe would solve the robot appearance manipulation problem. Therefore, an on-site design would be preferable to study human-robot interaction.

It could also be that significant differences were not found since the study didn't have very strong statistical power. Perhaps the post-hoc test showed no significance since the global effect ($p=.045$) was very close to the significance level of .05. Furthermore, this p value threshold can be considered conservative (albeit necessary and reasonable) for a small sample size of this study, which lowers the chance of finding data that corroborates with the existence of the effect. Given the statistical power, some of the assumptions for ANOVA and ANCOVA were breached, which could also further explain non-significance.

2.5. Practical Implications

Under any kind of robot, the company was not perceived to be attractive, and the interview was not seen as either fair or unfair. Whether it's because people don't like machine-like robots or are averse to any kind of recruiting robot, this suggests that job candidates are looking for some 'human touch' during the recruiting process. A study conducted by Horodyski (2023) showed that whilst job candidates recognize, along with recruiters, that AI-tools like robots can help reduce time costs, enhance diversity, and reduce biases, they state that these technologies are not perfect at this either. Decision-making robots can have low and reliability, failing to "take into account unique circumstances or experiences" (Horodyski, 2023, p.6). These technologies can also be perturbing for job candidates worried about privacy issues and information leakage. As such, job candidates are aware of the advantages of recruiting robots, but value more the adaptability and personal touch that a real human can bring.

This study suggests that HR departments and companies should avoid implementing recruiting robots, or at least consider how to make the experience as ‘human’ as possible if they decide to use this technology. Job candidates think that “AI tools lack the nuances of human judgement or human touch” (Horodyski, 2023, p.6), and thus prefer a human interviewer. Indeed, communicating with the machine instead of a real HR employee might make the communication with the recruiting company feel distant (Koivunen et al., 2022). It can prevent the applicant from gauging what being an employee at the company can be like and under what organizational culture they’d be working in. As such, implementing these robots can be “particularly worrisome for organizations that aim to create a pleasurable candidate experience or convey certain company culture through their communications” (Koivunen et al., 2022, p. 507). It is important for companies to remember that recruitment is a process useful and important for both recruiting company and applicant to get to know each other. As such, it is advised that companies and HR practitioners evaluate whether implementing these robots is really necessary, and if so that they do not make the mistake of replacing what’s human with the machine. Companies and HR practitioners must try to make the experience as human and as reciprocal as possible.

2.6. Conclusion

Given the current advancements of AI in recruiting, many more job candidates may be interviewed for a job vacancy by a robot in the near future. Whilst there are various benefits for the recruiter to use this technology, a challenge is that more exploration is needed to understand what job applicants think about this method. Consequently, this study explored what a job candidate would think of the job interview, the hiring company and the robot itself depending on such robot’s design (human or machine-like) and role (decision-maker or HR helper). The results of the study indicate that job candidates may perceive any recruitment robot as machine-like, and that, regardless of the role, their perceptions about the interview, the company and the robot were neutral to negative. This means job applicants may be looking for more personal and reciprocal job interviews, where both parties can meet each other and understand each other ‘the human way’, -since robots limit the experience. Ergo, these results advise companies and HR practitioners to be weary of implementing these robots in their own HR practices yet. Beware of losing talent and reputation; a company who cannot offer this human touch will make an unremarkable impression.

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Appendix

During the preparation of this work, the author used ChatGPT to better understand the output of the ANCOVA analysis the author obtained herself from RStudio. The tool merely helped in explaining to the author what the values in the output table represented. After using this tool, the author reviewed and edited the content as needed and takes full responsibility of the content of the work.

During the preparation of this work, the author used the Scribbr APA Citation Generator to cite sources more efficiently. The tool merely helped in compiling the information necessary to cite a source in accordance with APA guidelines, such as doi, journal of publication, etc. After using this tool, the author reviewed and edited the content as needed and takes full responsibility of the content of the work.

Appendix A

Information and consent form

Dear participant,

Thank you for your interest in this study! You will soon watch a video showcasing a job interview. Interestingly, the interviewer is not human... it's a ROBOT! How would you feel in this position?

Purpose: The purpose of this research is to understand your perceptions of a robot that carries out job interviews. We want to know what you feel and think about the robot and the interaction, as well as your view of the hiring company.

Your reward!: Before you start the study, you can decide whether you want to receive SONA credits and/or enter a raffle to win a $10 Bol gift card. You will receive your SONA credits and/or have a chance to win after you complete the questionnaire. The more participants I get, the more gift cards will be offered! So join and tell all your friends!

What you can expect: First, you will answer a few questions and decide how you want to be rewarded for completing the questionnaire. Then, you will watch a video about a job interview between a human candidate and a robot interviewer. After that, you can fill out the rest of the questionnaire. According to Qualtrics (the tool used to make this survey), it takes 10 minutes to complete.

Ethical concerns: The BMS Ethics Committee has reviewed and approved this research project. There are no mental or physical risks associated with this study. In fact, you may benefit from learning that you might encounter robots when you apply for a job in the future!

Your data and identity: We will not collect any information from you that could be used to identify and trace you. There will be no audio or video recordings. Your responses will be logged anonymously and confidentially. Only the researcher and her supervisor will be able to access the data. This data will be archived in the software used to provide this questionnaire and the researcher’s hard drive. The data will be deleted once the researcher completes this research and graduates in October; expected date for deletion is the 1st of November 2024.

Withdrawal and questions: You are free to withdraw yourself and the data you provide at any time before, during or after the study, without having to provide a reason. Similarly, you may ask questions at any time. Simply contact the researcher (contact details below) and they will arrange it for you.

The BMS Ethics Committee: If you have questions about your rights as a research participant, or wish to obtain information, ask questions, or discuss any concerns about this study with someone other than the researcher(s), please contact the Secretary of the Ethics Committee/domain Humanities & Social Sciences of the Faculty of Behavioural, Management and Social Sciences at the University of Twente by ethicscommittee-hss@utwente.nl

Contact details: Researcher: Denisse Pecuch Tucker at d.g.pecuchtucker@student.utwente.nl - Supervisor: Suzanne Janssen at s.janssen@utwente.nl

Do you consent to participating?

I have read and understood the study information. I consent voluntarily to be a participant in this study and understand that I can refuse to answer questions and I can withdraw from the study at any time, without having to give a reason.

- ☐ Yes
- ☐ No

Appendix B

Dialogue script for the Furhat

Key markers to distinguish the robot's role have been added. The decision-maker robot has uses blue highlights and the HR helper robot uses yellow highlights

Decision maker robot script

Hello, I am Alex. How are you today?

[User replies]

I see. I am feeling pretty good myself. Well, uh, as you can see, I am a robot. I will be interviewing you today to see if you are a good fit at the company CineMovies Plus. We are offering a job as a cinema service desk administrative assistant. The job is to schedule movie runs at the cinema and help customers book their tickets. After the interview I will decide if I myself want to hire you. Yeah, so... let's start. What is your name?

[User replies]

Nice to meet you, USERNAME. Let's see. Would you say you are a person who likes helping others?

[User replies]

Aha. And are you patient and understanding when others have a problem?

[User replies]

Are you good at organization and time management?

[User replies]

Oh, okay. Do you have the basic skills necessary to use a computer and Microsoft Office programs?

[User replies]

Do you like movies?

[User replies]

Ah. And finally. Do you have a question for me as well?

[User replies]

Mmm. Let me think about that for a minute.

[Enter Wizard of Oz setting. After the researcher replies, the Wizard of Oz setting ends]

Thank you for your time, USERNAME. You can expect an answer from me within 2 working days. I will notify you whether or not you can work with us. It was a pleasure to meet you, USERNAME.

HR helper robot script

Hello, I am Alex. How are you today?

[User replies]

I see. I am feeling pretty good myself. Well, uh, as you can see, I am a robot. I will be helping the hiring organization with interviewing you today and seeing if you are a good fit at the company CineMovies Plus. They are offering a job as a cinema service desk administrative assistant. The job is to schedule movie runs at the cinema and help customers book their tickets. After the interview employees from the company will decide if they want to hire you. Yeah, so... let's start. What is your name?

[User replies]

Nice to meet you, USERNAME. Let's see. Would you say you are a person who likes helping others?

[User replies]

Aha. And are you patient and understanding when others have a problem?

[User replies]

Are you good at organization and time management?

[User replies]

Oh, okay. Do you have the basic skills necessary to use a computer and Microsoft Office programs?

[User replies]

Do you like movies?

[User replies]

Ah. And finally. Do you have a question for me as well?

[User replies]

Mmm. Let me think about that for a minute.

[Enter Wizard of Oz setting. After the researcher replies, the Wizard of Oz setting ends]

Thank you for your time, USERNAME. You can expect an answer from CineMovies Plus within 2 working days. They will notify you whether or not you can work with them. It was a pleasure to meet you, USERNAME.

Appendix C

Coding the Furhat robot speech through Blockly

Figure 4

Blockly code used for the decision-maker robot

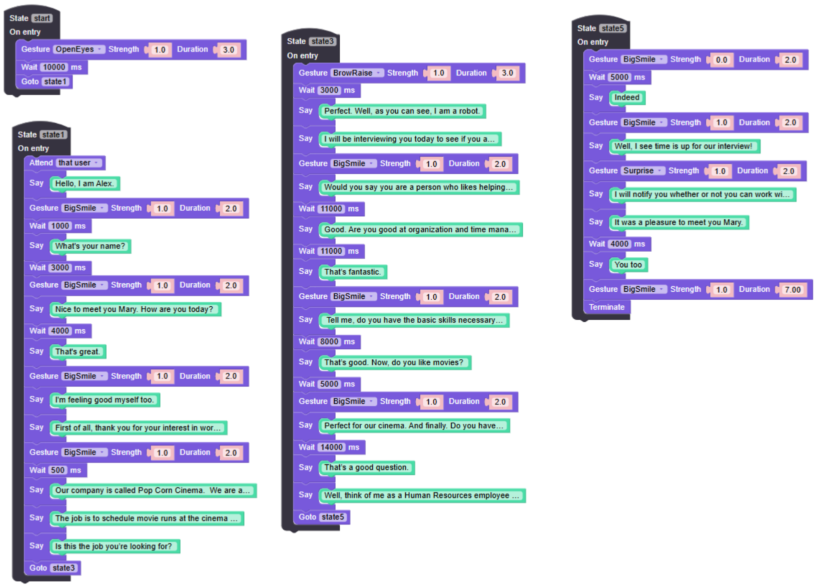


Figure 5

Blockly code used for the HR helper robot

Appendix D

Copy of the questionnaire

Start of Block: ControlMediate

RobotEx Have you ever interacted with a robot before?

- ◯ Yes (1)
- ◯ No (2)

Attitude In general, do you think robots are...

	Not at all (1)	Slightly (2)	Moderately (3)	Very (4)	Extremely (5)
Reliable (1)					
Competent (2)					
Interactive (3)					
Emotional (4)					
Sociable (5)					
Compassionate (6)					
Awkward (7)					
Dangerous (8)					
Scary (9)					

Newtech Please state to what extent you agree or disagree with the statements

	Strongly disagree (1)	Somewhat disagree (2)	Neither agree nor disagree (3)	Somewhat agree (4)	Strongly agree (5)
If I hear about a new technology, I would look for ways to experiment with it (1)					
Among my friends and family, I am usually the first to try out new technologies (23)					
In general, I am hesitant to try out new technologies (25)					

End of Block: ControlMediate

Start of Block: Condition4

Instruction4 Watch the following job interview between a human candidate and the robot interviewer.

How would YOU feel if you were being interviewed by the robot?

Don't focus too much on the person of the video. *Imagine you are taking the candidate's place instead*.

[Video here]

End of Block: Condition4

Start of Block: Manipulation check

Design To what extent do you think the robot in the video looked...

	1 (1)	2 (2)	3 (3)	4 (4)	5 (5)	
Machine-like						Human-like

Role Regarding the video you just saw, who is ultimately making the decision about hiring the candidate?

- ◯ The robot in the video (1)
- ◯ The company's Human Resources team (2)
- ◯ I don't remember (3)

End of Block: Manipulation check

Start of Block: Appearance

Anthro To what extent do you think the robot was...

	1 (1)	2 (2)	3 (3)	4 (4)	5 (5)	
Fake						Natural
Machine-like						Human-like
Unconscious						Conscious
Artificial						Lifelike
Moving rigidly						Moving elegantly

Animacy To what extent do you think the robot was...

	1 (1)	2 (2)	3 (3)	4 (4)	5 (5)	
Dead						Alive
Stagnant						Lively
Mechanical						Organic
Inert						Interactive
Apathetic						Responsive

End of Block: Appearance

Start of Block: Affective

Likea To what extent do you think the robot was...

	1 (1)	2 (2)	3 (3)	4 (4)	5 (5)	
Dislikeable						Likeable
Unfriendly						Friendly
Unkind						Kind
Unpleasant						Pleasant
Awful						Nice

Creep If you were the candidate in this video, how would you have felt during the job interview with the robot?

	Strongly disagree (1)	Somewhat disagree (2)	Neither agree nor disagree (3)	Somewhat agree (4)	Strongly agree (5)
I would have felt uncomfortable during this job interview (1)					
I would have felt uneasy during this job interview (2)					
The job interview would have somehow felt threatening (3)					
I would've not known how to judge this job interview (4)					
I would have not known exactly how to behave in this job interview (5)					
I would have not known exactly what to expect of this job interview (6)					

End of Block: Affective

Start of Block: Cognitive

Trust If you were the candidate in this video, what would you think about the interaction with the robot?

	Strongly disagree (1)	Somewhat disagree (2)	Neither agree nor disagree (3)	Somewhat agree (4)	Strongly agree (5)
I would believe that there could be negative consequences when interacting with this robot (1)					
I would feel I must be cautious when interacting with this robot (2)					
I would think that it is risky to interact with this robot (3)					
I would believe that this robot acted in my best interest (4)					
I would believe that this robot would do its best to help me if I needed help (5)					
I would believe that this robot was interested in understanding my needs and preferences (6)					

Justice Please state to what extent you agree or disagree with the statements

	Strongly disagree (1)	Somewhat disagree (2)	Neither agree nor disagree (3)	Somewhat agree (4)	Strongly agree (5)
The candidate was treated honestly and openly during the interview (4)					
The robot was candid when answering questions during the interview (5)					
The robot answered procedural questions in a straightforward and sincere manner (6)					
The candidate was treated politely during the interview (7)					
The robot treated the candidate with respect during the interview (8)					
The candidate was able to ask questions about the interview and recruitment processes (10)					
If I were the candidate, I would have felt satisfied with how the robot treated me during the interview (9)					
If I were the candidate, I would have felt satisfied with the communication that occurred during the interview (11)					
If I were the candidate, I would have felt comfortable asking questions or concerns if I had any (12)					

End of Block: Cognitive

Start of Block: Behavioural

Perform Please state to what extent you agree or disagree with the statements **as if you had been the candidate** in this video

	Strongly disagree (1)	Somewhat disagree (2)	Neither agree nor disagree (3)	Somewhat agree (4)	Strongly agree (5)
I could have really talked about my skills and abilities through this interview. (1)					
This interview could have allowed me to talk about what my job skills are. (5)					
This interview would have given applicants the opportunity to talk about what they can really do. (6)					

Org Please state to what extent you agree or disagree with the statements **as if you had been the candidate** in this video

	Strongly disagree (1)	Somewhat disagree (2)	Neither agree nor disagree (3)	Somewhat agree (4)	Strongly agree (5)
This would be a good company to work for (1)					
If I were looking for a job as a cinema administrative assistant, I would like to work for this company (3)					
This company cares about its employees (4)					
I find this a very attractive company (5)					

Presence Please state to what extent you agree or disagree with the statements

	Strongly disagree (1)	Somewhat disagree (2)	Neither agree nor disagree (3)	Somewhat agree (4)	Strongly agree (5)
I do not think that the robot understood the candidate's expressions correctly (1)					
I think that the robot was able to understand the candidate's thoughts correctly (11)					
I think that the candidate was able to communicate with the robot through language (12)					
It was easy for the candidate to become distracted from interacting with the robot when other things were going on (2)					
The robot was easily distracted when the candidate was interacting with it (13)					
The candidate kept an eye on the robot as she interacted with it (14)					

End of Block: Behavioural

Start of Block: MediateRest

Anxiety Please answer how much anxiety you experience regarding...

	I do not feel anxiety at all (1)	I hardly feel any anxiety (2)	I do not feel much anxiety (3)	I feel a little anxiety (4)	I feel much anxiety (5)
How robots may talk about something irrelevant during conversation (1)					
How conversation with robots may be inflexible (10)					
How robots may be unable to understand complex stories (11)					
How robots will act (12)					
What robots will do (13)					
What power robots will have (14)					
How I should talk with robots (15)					
How I should reply to robots when they talk to me (16)					
How robots may be unable to understand what I say to them (17)					
How I may be unable to understand what robots say to me (18)					

End of Block: MediateRest

Start of Block: Demographics

DemoIntro The following questions about your identity and background will be kept private and secure. Your answers are voluntary. Responses will be used to better understand the composition of the participant sample. E.g. the age distribution of the sample.

*

Age What is your age? Use only numbers, e.g.: 21

____

Gender What do you identify as?

- ○ Man (1)
- ○ Woman (2)
- ○ Other, mainly: (5) ____
- ○ I prefer not to say (4)

WorkEx Have you been employed or had an internship before?

- ○ Yes (1)
- ○ No (2)

InterviewEx Did you have an application interview for a job or internship before?

- ○ Yes (1)
- ○ No (2)

Education What is the highest level of education you have completed?

- ◯ Elementary or Middle School (1)
- ◯ High School (2)
- ◯ Vocational School (3)
- ◯ Bachelor's Degree (4)
- ◯ Master's degree (5)
- ◯ Doctoral degree (6)
- ◯ Other, mainly: (7) ____

End of Block: Demographics

Start of Block: Block 14

Q45 *Dear participant,*

You've finished with the questionnaire.

Thank you so much for your participation!

Purpose: To elaborate a bit more now that you've finished the survey, the purpose of this research was to understand how your perceptions of a robot would change depending on the robot's role (hires candidates or helps Human Resources) and on its appearance (machine-like or human-like). We wanted to know what you would feel and think about the robot and the interaction, as well as your view of the hiring company.

If you have any questions or wish to withdraw, please use the contact details below:

Contact details: Researcher: Denisse Pecuch Tucker at d.g.pecuchtucker@student.utwente.nl - Supervisor: Suzanne Janssen at s.janssen@utwente.nl

End of Block: Block 14

Appendix E

Factor analysis

Table 8

Final factor analysis

Measure	Item	*Factor 1*	*Factor 2*	*Factor 3*
Tehcnological affinity				
	1	0.45		
	2	0.23		
	3	0.65		
Pre-existent attitudes about robots				
Competence	1	0.43		
	2	0.99		
	3*			
Warmth	4		0.67	
	5		0.59	
	6		0.87	
Discomfort	7*			
	8			1.00
	9			0.42
Anthropomorphism				
	1	0.64		
	2	0.65		
	3	0.76		
	4	0.45		
	5	0.40		
Animacy				
	1	0.73		
	2	0.73		
	3	0.57		
	4	0.67		
	5	0.64		
Likeability				
	1	0.69		
	2	0.87		
	3	0.78		
	4	0.73		
	5	0.71		
Creepiness				
	1	0.35	0.70	

		2		0.90	
		3		0.47	
		4	0.65		
		5	0.72	0.38	
		6	0.87		
Trustworthiness					
	Risk perception	1	0.54		
		2	0.76		
		3	0.81		
	Benevolence	4		0.68	
		5		0.65	
		6		0.77	
Procedural justice					
		1	0.44		0.87
		2	0.46		
		3	0.70		0.38
		4	0.74	0.37	
		5	0.85		
		6	0.54		
		7		0.65	
		8		0.82	
		9		0.73	
Opportunity to perform					
		1	0.84		
		2	0.84		
		3	0.75		
Organizational attractiveness					
		1	0.80		
		2	0.76		
		3	0.85		
		4	0.33		
Social presence					
		1	0.52		
		2	0.99		
		3	0.30		
		4		0.79	
		5		0.33	
		6		< 0.30	
Anxiety					
		1	0.37	0.33	
		2		0.83	
		3		0.78	

4	0.74		
5	0.85		
6	0.67		
7		0.31	0.74
8	0.33		0.92
9		0.61	
10	0.37	0.33	

Note: This table shows the output of the factor analysis carried out after deleting unsuitable variables and interpreting the factor structure in accordance to the subscales that the original scales contained.

Appendix F

Assumptions of the ANOVAs

Table 8

Homogeneity of variance for ANOVA

	Homogeneity of variance	
	Levene's statistic	*p*
Likeability	1.14	.336
Creepiness	0.52	.670
Trustworthiness		
Risk perception	0.37	.774
Benevolence	1.19	.320
Procedural justice	1.88	.139
Opportunity to perform	0.87	.458
Organizational attractiveness	1.63	.190
Social presence	0.26	.855

Table 9

Normality assumption using Shapiro-Wilk for ANOVA

	Mechanical decision-maker		Humanoid decision-maker		Mechanical HR helper		Humanoid HR helper	
	Shapiro statistic	*p*	*Shapiro statistic*	*p*	*Shapiro statistic*	*p*	*Shapiro statistic*	*p*
Likeability	0.95	.366	0.97	.731	0.95	.289	0.97	.826
Creepiness	0.95	.366	0.97	.743	0.97	.721	0.93	.139
Trustworthiness								
Risk perception	0.97	.762	0.94	.164	0.95	.347	0.98	.838
Benevolence	0.96	.564	0.95	.290	0.94	.167	0.91	.054
Procedural justice	0.94	.242	0.86	.006	0.90	.025	0.97	.730
Opportunity to perform	0.95	.287	0.95	.351	0.87	.005	0.95	.268
Organizational attractiveness	0.96	.524	0.96	.462	0.89	.013	0.94	.232
Social presence	0.96	.461	0.95	.287	0.94	.156	0.93	.114

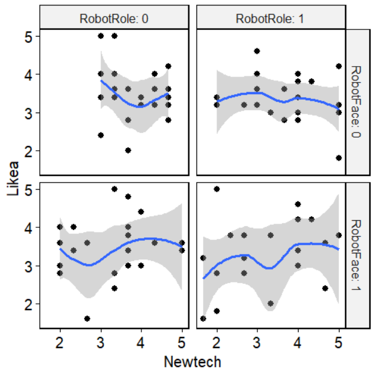
Appendix G

Assumptions of the ANCOVAs

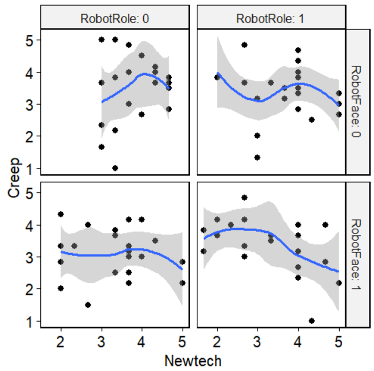
Table 10

Linearity assumption for ANCOVA, controlling for technological affinity

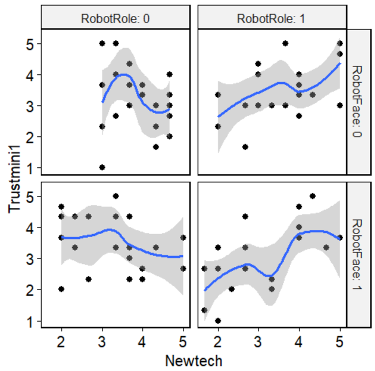
Likeability



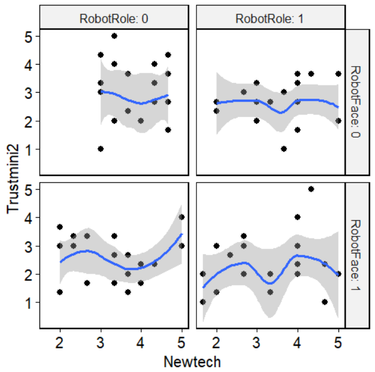
Creepiness



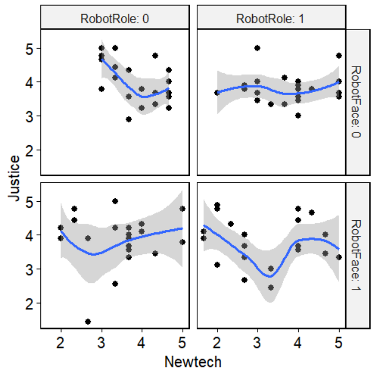
Risk perception



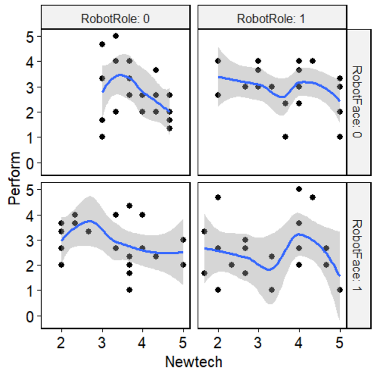
Benevolence



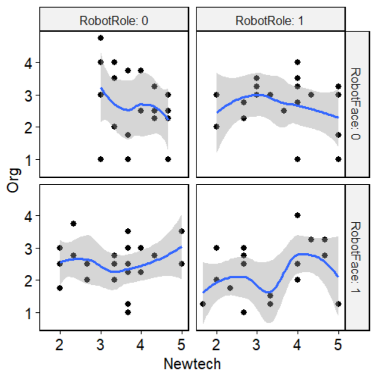
Procedural justice



Opportunity to perform



Organizational attractiveness



Social Presence

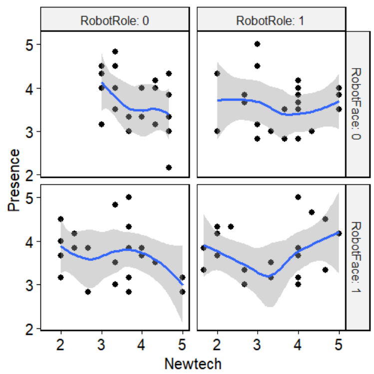
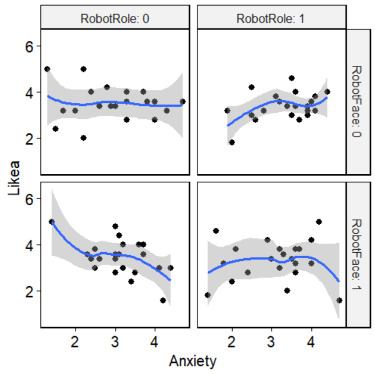


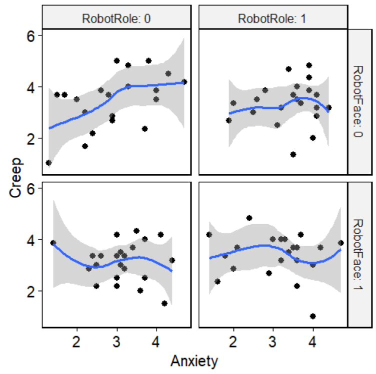
Table 11

Linearity assumption for ANCOVA, controlling for robot anxiety

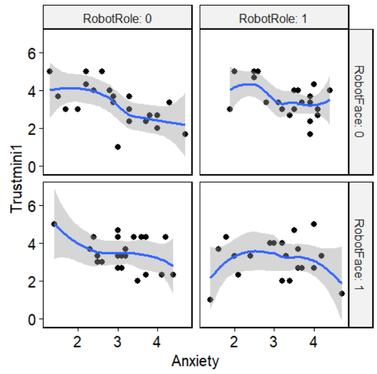
Likeability



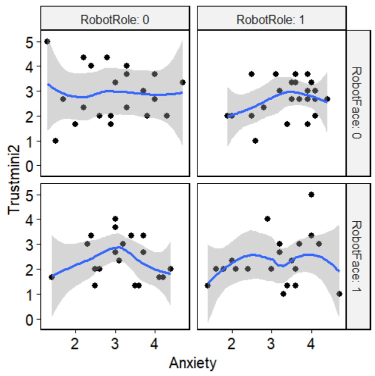
Creepiness



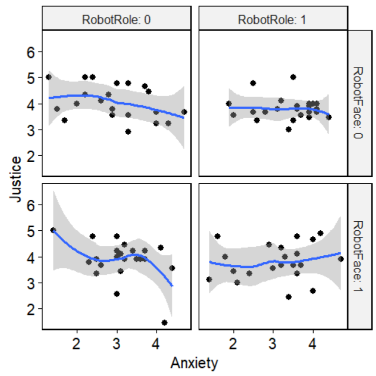
Risk perception



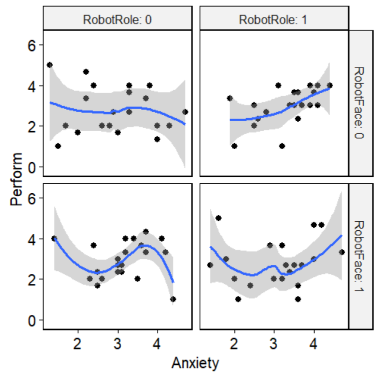
Benevolence



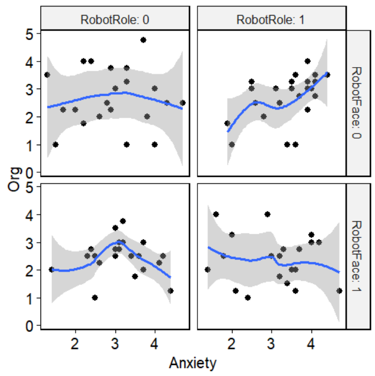
Procedural justice



Opportunity to perform



Organizational attractiveness



Social Presence

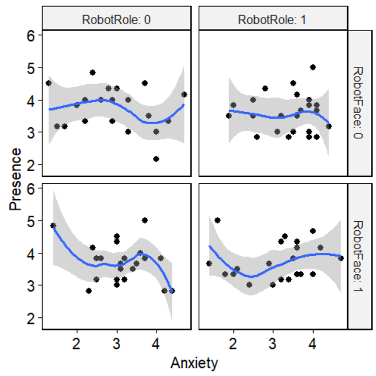
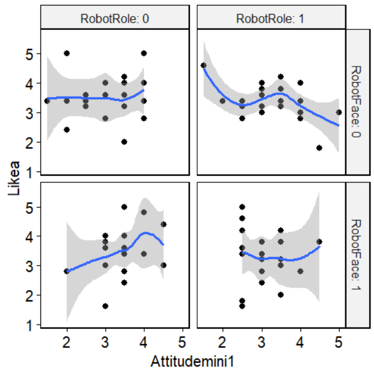


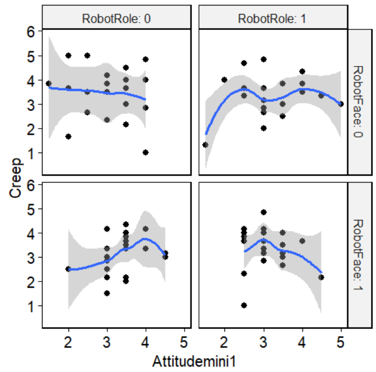
Table 12

Linearity assumption for ANCOVA, controlling for pre-existent attitudes about robots (competence)

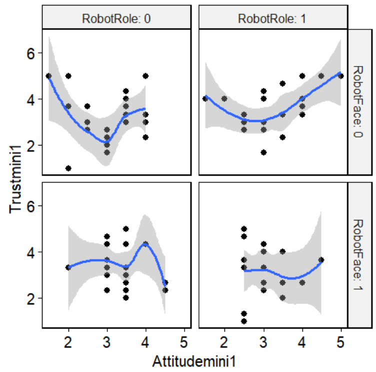
Likeability



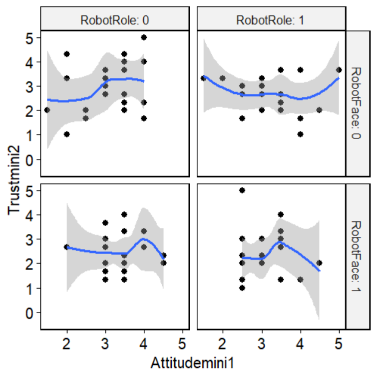
Creepiness



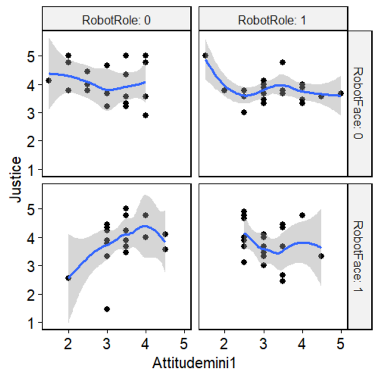
Risk perception



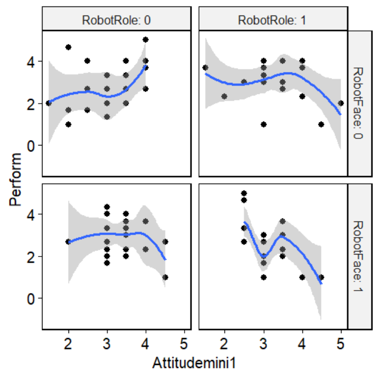
Benevolence



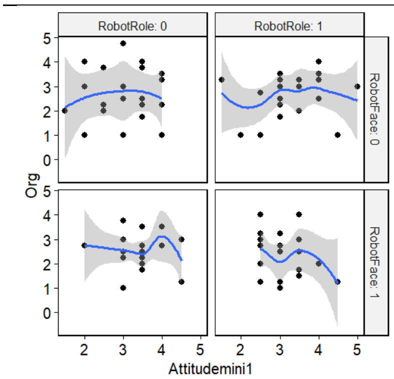
Procedural justice



Opportunity to perform



Organizational attractiveness



Social Presence

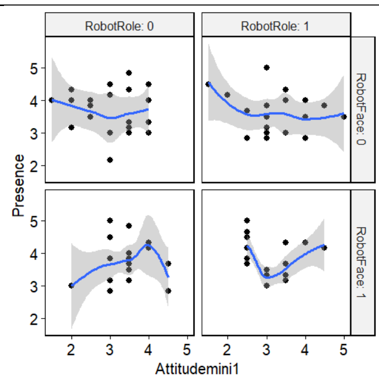


Table 13

Linearity assumption for ANCOVA, controlling for pre-existent attitudes about robots (warmth)

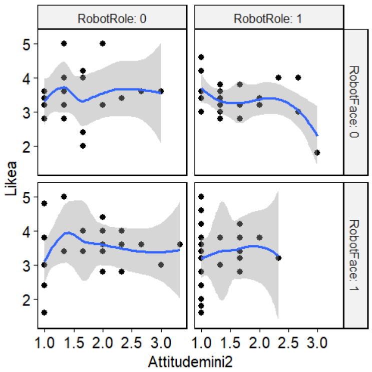
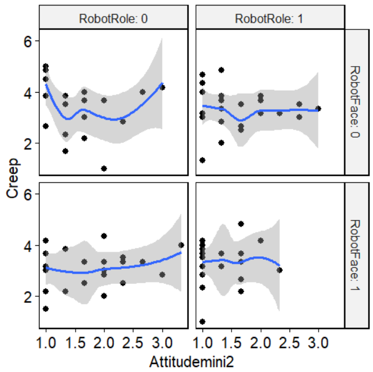
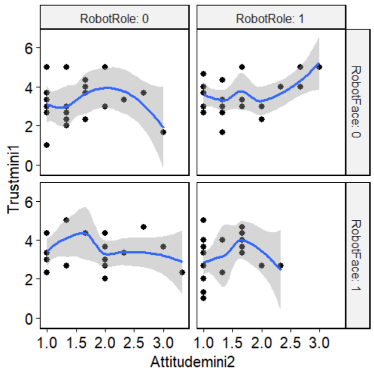
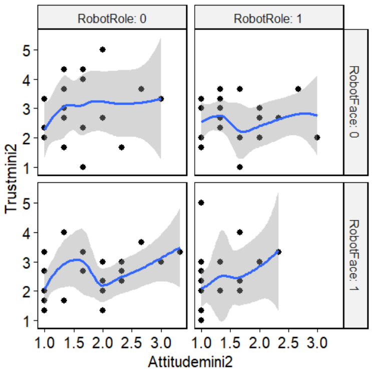
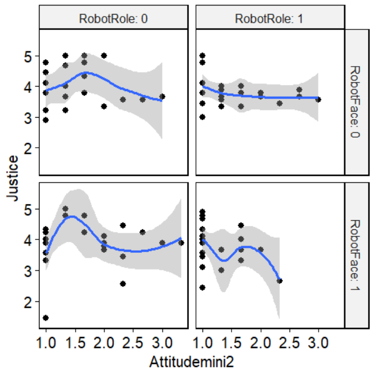
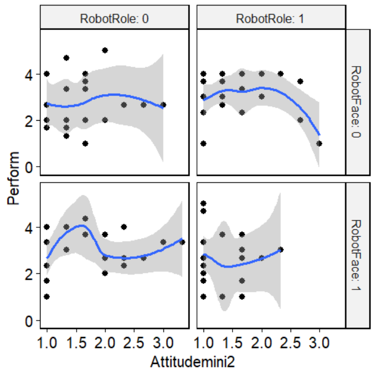
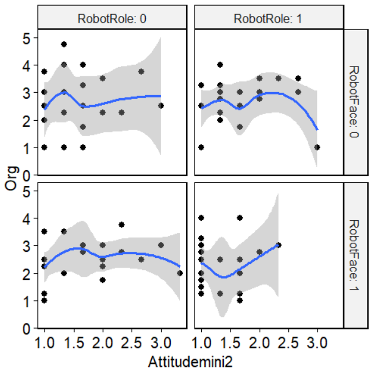
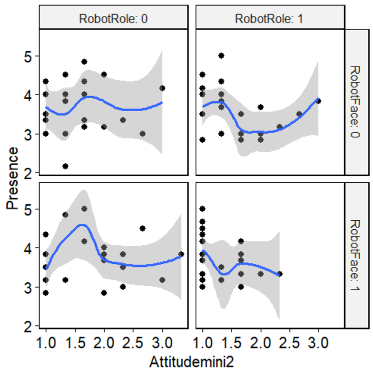
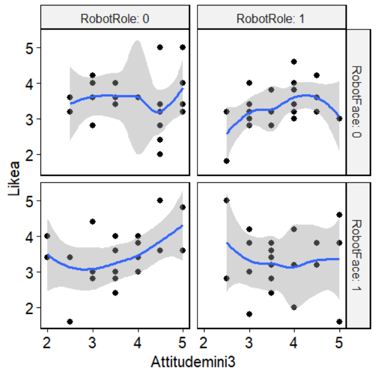
Likeability	Creepiness	Risk perception
		
Benevolence	**Procedural justice**	**Opportunity to perform**
		
Organizational attractiveness	**Social Presence**	
		

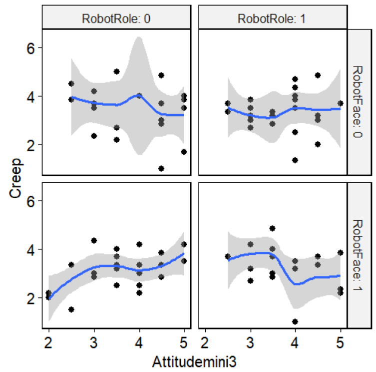
Table 14

Linearity assumption for ANCOVA, controlling for pre-existent attitudes about robots (discomfort)

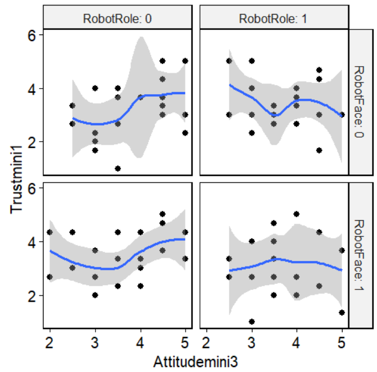
Likeability



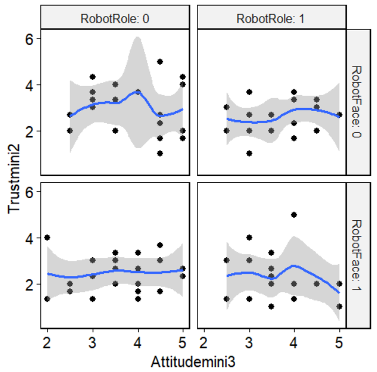
Creepiness



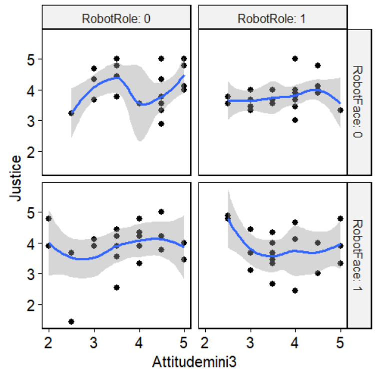
Risk perception



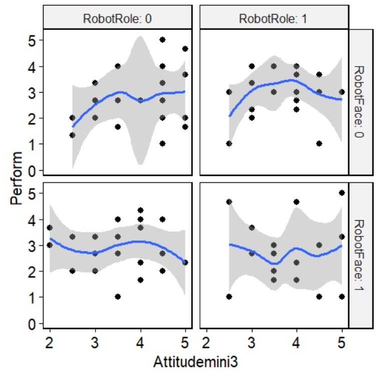
Benevolence



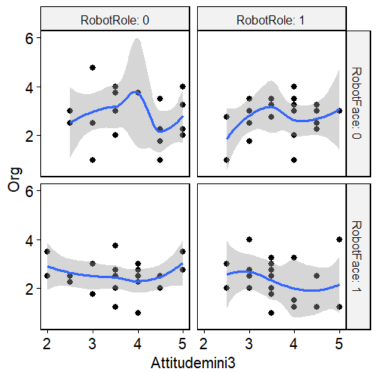
Procedural justice



Opportunity to perform



Organizational attractiveness



Social Presence

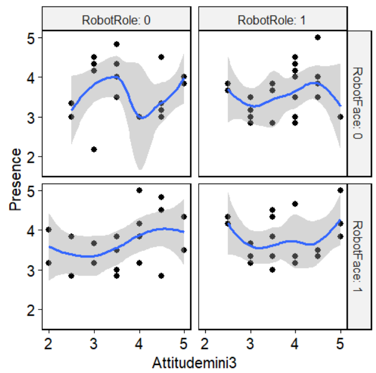


Table 15

Table testing for homogeneity of regression slopes for ANCOVA analyses

	Likeability		Creepiness		Trustworthiness				Procedural Justice		Opportunity to perform		Organizational attractiveness		Social presence	
					Risk perception		Benevolence									
	F(79)	*p*	*F*(79)	*p*	*F*(79)	*p*	*F*(79)	*p*	*F*(79)	*p*	*F*(79)	*p*	*F*(79)	*p*	*F*(79)	*p*
Group	0.25	.861	0.90	.444	0.90	.447	1.28	.286	0.87	.456	0.80	.497	0.74	.532	0.22	.883
Technological affinity	0.49	.487	2.11	.150	4.05	.048*	0.35	.558	0.63	.429	2.58	.112	0.05	.833	1.04	.311
Group*technological affinity	1.07	.368	1.43	.241	4.91	.004*	0.39	.762	1.70	.173	1.24	.301	2.00	.120	1.41	.246
Group	0.31	.813	0.65	.588	0.65	.588	1.70	.174	0.72	.545	0.81	.494	0.80	.499	0.25	.858
Pre-existent attitude (competence)	0.06	.801	0.12	.729	0.48	.491	0.49	.487	0.37	.546	1.08	.301	<0.01	.986	0.99	.322
Group*competence	1.65	.185	0.89	.450	0.99	.402	0.78	.510	1.89	.138	4.10	.009*	0.61	.611	0.41	.745
Group	0.28	.843	0.54	.657	0.56	.645	1.54	.211	0.84	.474	0.59	.623	0.63	.595	0.24	0.867
Pre-existent attitude (warmth)	0.03	.870	0.09	.767	0.65	.421	6.02	.016*	1.22	.272	0.03	.867	0.84	.363	0.70	0.404
Group*warmth	0.87	.461	0.40	.755	0.84	.474	0.49	.694	0.96	.417	0.26	.854	0.03	.992	0.86	0.466
Group	0.27	.845	0.67	.576	0.90	.447	1.65	.184	0.62	.602	0.62	.604	0.84	.468	0.32	.809
Pre-existent attitude (discomfort)	2.23	.140	0.05	.821	2.06	.155	0.04	.845	1.15	.287	0.46	.500	0.54	.464	3.09	.083
Group*discomfort	1.07	.368	2.65	.055	1.83	.149	0.81	.494	0.69	.561	0.58	.629	0.60	.616	0.33	.805
Group	0.29	.831	0.75	.525	1.56	.205	1.70	.175	0.55	.652	0.47	.705	0.80	.496	0.20	.893
Robot anxiety	0.19	.661	2.38	.127	12.16	<.001*	0.76	.386	2.39	.126	1.09	.300	0.31	.580	0.82	0.367
Group*anxiety	2.58	.060	2.27	.087	1.81	.152	0.62	.606	1.79	.155	1.61	.193	1.66	.182	0.69	0.560