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EMPIRICAL ARTICLE

Working with AI: can stress bring happiness?

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Abstract
This paper explores the effect of artificial intelligence (AI) on employee happiness and proposes a model founded on stress and coping theory to analyze the effect of benign stress on employee happiness and its indirect effect via employee engagement. It combines semi-structured interviews with employees working alongside AI algorithms and agents and surveys 200 employees to assess the proposed model. The results demonstrate that incorporating AI in the workplace can generate stress and affect human well-being but can also be a motivational factor instead of a concern, and that employee engagement plays an essential role in mediating the relationship.

Keywords Employee engagement · Artificial intelligence · Benign stress · Employee happiness · Self-esteem

1 Introduction

The service industries are increasingly using artificial intelligence (AI) to support customers in various areas, enabling human–AI algorithms and agents interactions. AI can be incorporated into devices, such as computers or mobiles, or have a form of a robot more or less anthropomorphized (Wirtz et al. 2018) to help in several tasks, from travel planning to room services (e.g., Belanche et al. 2020a; Flavián et al. 2021; Loureiro et al. 2021b). Tasks are activities involved in a job (Boyd and Holton 2017), and for the service sector, functions to be performed that AI can do. Consequently, AI is increasingly used in services, representing a significant source of service innovation and development (Pantano and Scarpi 2022; Flavián et al. 2021; Chi et al. 2022). Adopting AI in services will transform the nature of work and the workplace itself (Belanche et al. 2020b). Algorithms and AI agents will perform

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more tasks that currently are done by humans, complement human work, and even perform tasks beyond what humans can do. High-income economies are expected to adapt to these changes first and fast, and by 2030 one in two jobs could be significantly transformed by automation, given the tasks involved (Deshpande et al. 2021).

We can see a variety of applications of AI in services, such as service encounter interactions between customers and robots (Wirtz et al. 2018; Chiang and Trimi 2020), automated social presence in the frontline without customers' needs for human interaction (Yoganathan et al. 2021), personalized recommendations to customers (Loureiro et al. 2021b), or part of routine service experiences (Mende et al. 2019). However, the increased use of AI applications in services also offers additional challenges, leading to a growing fear that it will soon replace humans. AI applications will not necessarily replace humans, and the complementarity of humans and AI can be a strength for organizations (Jarrahi 2018). In the end, some tasks will be performed by humans, AI will make others, and both will work as a team, leading to collaborative intelligence (Wilson and Daugherty 2018). Nonetheless, as AI applications perform more service tasks, fewer human employees are needed, leading human employees to focus more on tasks that AI applications do not perform (Huang and Philp 2020).

The literature discussing AI adoption has focused its attention on automation processes (Tussyadiah 2020), AI adoption by customers (Pillai and Sivathanu 2020; Shin and Jeong 2020), ethical issues related to AI and service robots (Belk 2020; Becker et al. 2022; Schepers et al. 2022), and antecedents of AI adoption intention such as trust (Shi et al. 2020). However, we know less about the interaction between AI algorithms and agents and the human as an employee. Recent research has recognized the paucity of input on how employees can relate to AI algorithms and agents (Li et al. 2019; Kong et al. 2021) and how critical these interactions can be for services organizations (Ashfaq et al. 2020; Pillai and Sivathanu 2020). More research on employee–AI algorithms and agents are needed from the above considerations (Belanche et al. 2020a; Tussyadiah 2020; Kong et al. 2021; Loureiro et al. 2021a). Moreover, having AI algorithms collaborate with human employees may cause stress. However, if demands are balanced with support, they can generate happiness (Nazareno and Schiff 2021), creating a sense of employee engagement (Kumar and Pansari 2015).

This research intends to address this problem and clarify employee relationships and interactions with AI algorithms and agents. We grounded our research in Lazarus and Folkman's stress and coping theory (1984). The stress results from an imbalance between what individuals perceive from external and internal demands and their resources and skills to deal with them. Therefore, the research questions that lead our work are: what are the positive and negative key aspects perceived by humans when working with AI algorithms and agents in service firms? Can employee engagement mediate the relationship between benign stress and employee happiness? This research contributes to the knowledge of human–AI algorithms and agents interactions using a mix-method approach through semi-structured interviews and promoting a quantitative study. We use a mixed-method approach with an exploratory design, in which qualitative findings are added to quantitative results to better understand the research questions (Molina-Azorin 2010). We

offer a model founded on stress and coping theory, analyzing the effect of benign stress on employee happiness and the indirect effect via employee engagement. This research contributes to the literature by offering specific theoretical and practical implications.

This paper is structured as follows. The next section offers the related literature background, while the following section describes the overview of studies and methodological approach. After, we offer the two undertaken studies in Sects. 4 and 5. Finally, we present a section devoted to the overall discussion of this paper, followed by implications, limitations and future research avenues that arise from this research.

2 Theoretical background and conceptual model

We have built our conceptual model based on the literature and our exploratory qualitative study findings. Our model offers a new theoretical framework incorporating benign stress influencing employee happiness development while working with AI algorithms and agents, which can be mediated by employee engagement (see Fig. 1). Our conceptual model reads as follows. Working with AI algorithms and agents can be demanding for human employees, which may cause stress. However, this situation can also be positive by helping or facilitating human work, leading to what we claim in this paper as benign stress. Benign stress can be defined as a not harmful, pleasant, and kind type of stress resulting from incorporating AI algorithms and agents in the workplace to help human employees and facilitate their tasks. Our

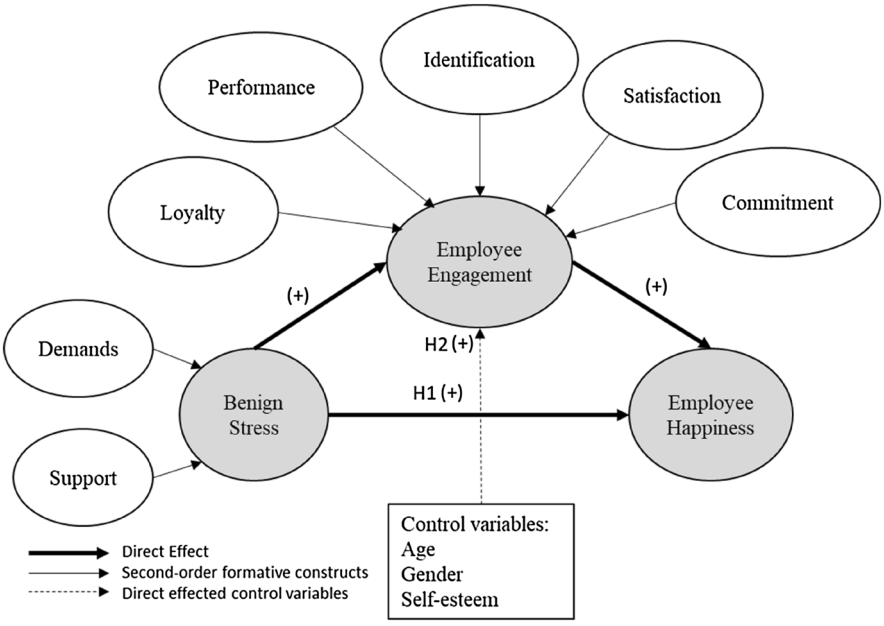

Fig. 1 Proposed conceptual model

conceptual model proposes that benign stress can positively influence employee happiness, perceived as the experience of energized employees, being enthusiastic, and feeling committed to their work. Additionally, we question whether employee engagement can be a positive mediator for this relationship. Employee engagement refers to the relationship between the employees and the organization they work. We argue that higher levels of employee engagement can positively influence benign stress on employee happiness while working with AI algorithms and agents.

The following sub-sections offer a comprehensive view of existing knowledge in the literature about the concepts we use in our model.

2.1 Artificial intelligence (AI) in services

Technology is recognized as the most critical force for expanding the service sector, and AI is an excellent opportunity for service firms (Huang and Rust 2021). AI is distinct from wide-ranging information technology, involving technologies that can learn, connect, and adapt (Huang and Rust 2021). AI is often described in the literature in terms of human intelligence, such as "machines that exhibit aspects of human intelligence" (Huang and Rust 2018, p. 155), or "the ability of machines to mimic intelligent human behaviour" (Syam and Sharma 2018, p. 136). These definitions encapsulate an issue as AI is often offered conditional on human intelligence. Unlike humans, AI recognizes patterns, inclinations, and intentions by combining deep learning and big data (Flavián et al. 2021) beyond the human brain intelligence's ability. However, as humans learn and draw conclusions from restricted data, machines can learn from billions of data sources (Rajkomar et al. 2019).

AI can be divided into four types of intelligence: mechanical, analytical, intuitive, and empathetic (Huang and Rust 2018). Each one of these four types of intelligence has its strengths. Mechanical AI is more indicated for standardization, while analytical, intuitive, and empathetic can be used for personalization and feeling AI (Huang et al. 2019). When tasks are more repetitive, it is advisable to use mechanical AI. When tasks are more data-based, they should be performed by analytical intelligence. If the tasks are more intuitive, it might be challenging to use only AI devices to solve the situation (Huang and Philp 2020), so human intelligence may perform some tasks and AI others, working as a team to solve a set of tasks (Wilson and Daugherty 2018). This symbiosis between human employees and thinking AI is called augmentation (Davenport and Kirby 2015; Vorobeva et al. 2022). When the service task requires communication, experience-based and emotional solutions, it is recommended to use empathetic AI (Huang et al. 2019).

2.2 Employee happiness in the workplace

The literature has seen increased research on employee happiness in the workplace in the last few years. Many authors have attempted to identify the sources of workplace happiness (Layous 2019), founding relevant combining factors contributing to this phenomenon. Employee happiness can be valuable for organizations (Chen et al. 2018), as happier individuals lean toward better physical and psychological health

(Park et al. 2014), can handle positively with stressful events (Wood and Joseph 2010), perform better (Kun and Gadanecz 2022), and are more satisfied with their jobs (Mérida-López et al. 2019). Employees with higher levels of happiness perform better at work, are more prosocial and cooperative, have greater self-control, better self-regulation, and coping abilities, more satisfying relationships, and lower levels of burnout (Chen et al. 2018; Layous 2019).

Employee happiness is also distinct from job satisfaction, work engagement, and affective organizational commitment. An employee can experience job satisfaction, work engagement, and affective organizational commitment due to various causes, such as high job control or organization-based self-esteem (Saks 2006; Mauno et al. 2007). These factors can increase overall job satisfaction, work engagement, and affective organizational commitment while remaining unrelated to the emotional experience of happiness (i.e., not increasing employee happiness) (Fisher 2010). In this research, we define employee happiness in the workplace as the experience of energized employees, enthusiastic about their work, finding meaning and purpose in their work, having good relationships at their workplace, and feeling committed to their work (Kun and Gadanecz 2022). In our research, we claim that the use and/or interaction with AI algorithms and agents in the service workplace can increase employee happiness if suitable conditions are attained.

2.3 Stress and benign stress

From the broader construct of stress, we add to the literature the concept of benign stress (Wastell and Newman 1993) associated with using AI algorithms and agents in the workplace. The literature has already devoted substantial attention to job stress from various perspectives, such as organizational, environmental, employee, and social perspectives (e.g., Nixon et al. 2011; Schwepker and Dimitriou 2021). Job stress is an individual's harmful physical and emotional responses due to non-congruence between the tasks and environmental requirements and the employee's needs, resources, and capabilities (Centers for Disease Control and Prevention 2020). Karasek and Theorell's (1992) studied the relationship between workplace characteristics and employee stress. These authors offer three dimensions to express the stress felt by employees: demands, control, and support. Demands are psychological factors that can change the environment in the workplace, such as deadlines or tasks that need to be done fast. Control is related to the capability of the worker to use their capacities to develop tasks, such as skills, expertise, knowledge, or the possibility that employees choose what and/or how to do his\her work. Support is associated with the employee's interactions with co-workers, supervisors, and directors. When the level of support is low, the stress risk for the worker is higher (Karasek and Theorell 1992). Nonetheless, when demand is high, employees may feel in an active situation if they perceive control and have the skills and knowledge to deal with it (Karasek and Theorell 1992).

Following Lazarus and Folkman's (1984) theory of stress and coping, stress emerges from an unbalance between an individual's external and internal demands and their own personal and even social resources and skills to deal with those

demands. So, the presence of AI algorithms and agents can be very demanding for human employees. They can feel unable to interact and cooperate with AI algorithms and agents, resulting in an imbalance between demands and psychological resources and psychological and technical skills to live and work in such a work environment. This condition can cause stress among human employees, as incorporating AI algorithms and agents in service firms can cause or reduce stress in the workplace (Li et al. 2019; Kong et al. 2021). AI algorithms and agents can be a positive aspect of organizations as they can help human employees with diverse tasks and even facilitate the work and generate happiness if demands are balanced with support (Wastell and Newman 1993; Riolli and Savicki 2010). When AI applications demand more effort and intensity, but at the same time, the co-workers AI support the human employee, and humans enjoy working with them, the stress can become positive non-malign stress, what we call benign stress (Wastell and Newman 1993; Penney and Spector 2005). So, we argue that benign stress with the interaction of AI technology can enhance happiness in the workplace (see Fig. 1):

H1 Benign stress positively influences employee happiness.

2.4 Employee engagement

Employee engagement is related to the connection between the employee and the organization they work. In this research, we consider the five dimensions of employee engagement proposed by Kumar and Pansari: satisfaction, employee identification, employee commitment, employee loyalty and employee performance (Kumar and Pansari 2016). The first represents the employee's feelings and emotions about his/her job, colleagues, or organization and impacts the quality of work, employee turnover and absenteeism, and the identification between employees and the organization (Heskett et al. 2008; Kumar and Pansari 2016)**.** Employee identification is "a psychological state wherein an individual perceives himself or herself to be part of a larger whole" (Rousseau 1998, p. 217), being more open to giving everything to its success, increasing their commitment to the brand (Kumar and Pansari 2016). Employee commitment occurs when employees are so involved with the organization that they can reach the firm's goals, showing better performances than others, and are more willing to stay (Herhausen et al. 2020). Employee loyalty can lead employees to work more and better than expected for their organizations (Kumar and Pansari 2016). Finally, employee performance is considered a competitive advantage due to the ability to deliver a good service to customers and retain them (Reinartz et al. 2005).

Although we consider the five dimensions of employee engagement proposed by Kumar and Pansari (2016), our research reflects the engagement with the organization and the work with other non-human employees, AI algorithms and applications. So, the dimensions of satisfaction represent managers' positive feelings and recognition of their work with IA. Identification is the pride, familiarity, and sense of ownership toward the organization that uses AI. Commitment reflects that employees are more open to delivering the service brand promise when working with AI. Loyalty

means that employees tend to be more likely to stay at an organization operating with AI algorithms and agents. Finally, performance means that employees consider that their performance with AI exceeds expectations.

Knowing the relevance of employee happiness and employee engagement for firms and the tasks performed, we reflect on whether its levels can be influenced by being stress, so we posit that: H1: Benign stress positively influences employee happiness. Additionally, we propose that a more engaged employee will tend to influence the outcome of the above-mentioned relationship, as employee happiness may be enhanced by benign stress while working with AI algorithms and agents, mediated by employee engagement with the service firm working with AI. So, we postulate that: H2: Benign stress positively influences employee happiness via employee engagement.

2.5 Control variables

To further develop our research, we can assume that there are variables that can influence or limit the relationships we are studying. The most commons are age and gender. As past research points out the relevance of these variables in attitudes and behaviors (e.g., Spector and Brannick 2010), employees of different ages and genders may behave differently in the process between human employees and AI algorithms and agents in the workplace. So, we consider them as control variables. Additionally, one can assume that psychological factors can influence employees' attitudes and behaviors in these relationships. Due to its relevance in the literature, we questioned whether self-esteem could influence these relationships. Self-esteem is the person's overall subjective sense of personal worth or value and can be defined as how much a person appreciates and like himself regardless of the circumstances, a complex state of individuals, representing the individual evaluation of their worth (Kim and Jang 2019; Yagil and Medler-Liraz 2019; Loureiro et al. 2021b). Rosenberg (1965, 1979) offered a scale dedicated to asking individuals about positive and negative feelings that they felt by themselves. In this research, this self-esteem scale is adapted to the context of human employees interacting with AI algorithms and agents in the workplace. Therefore, the self-esteem felt by human employees when working with AI algorithms and agents can affect the engagement process, as low self-esteem can negatively influence how employees develop their engagement in the workplace (Sonnentag and Fay 2018).

3 Overview of studies and methodological approach

The current research uses a mixed-method approach. We first conducted semi-structured interviews to understand employees' perspectives using the AI algorithms and agents at their workplace in the hospitality and tourism service sector. The interviews aim to understand employees' points of view about working side by side with AI algorithms and agents. The findings of the interviews contribute together with the literature review to the conceptual model analyzed in the subsequent study. The

second quantitative study was based on a questionnaire where we asked participants to recall their previous experience using AI algorithms and agents in a hospitality or tourism service workplace. This study aims to analyze the direct effect of benign stress on employee happiness and the indirect effect via employee engagement.

4 Study 1: working with AI: positive and negative aspects

4.1 Procedure

This study aims to understand whether service employees consider working alongside AI algorithms and agents positively. The research question was: does working with AI algorithms and agents develop positive and/or negative aspects for human employees? We conducted online face-to-face interviews based on a question-matrix (Pearse 2019), specifically designed for this study (see Web Appendix A). The option for online face-to-face interviews was due to the global pandemic of coronavirus disease 2019 (COVID-19), but simultaneously allowed the interviewer to read the interviewees' behaviors, feelings, and expressions. Also, when conducting interviews based on a semi-structured script, the interviewer is free to follow different discussion routes, having more freedom to return to a specific topic and ask for clarification on a specific aspect. A total of 9 individual interviews with participants working in Portugal's hospitality and tourism industries were held between February and March 2021. The interviews considered the interviewees' distinct roles in the industry to assure data reliability, including marketing, operations, guest services, and food & beverage (see participants' profiles in Table 1). The interviews lasted from 40 to 60 min. The data treatment was made using ATLAS TI, a CAQDAS software that allows researchers to build networks, facilitating the articulation of the findings.

Table 1 Interview's participants profile

Participant	Gender	Age	Job role	Sector
#A	Female	35	Travel agente	Tourism industry
#B	Male	38	Event organizer	Tourism industry
#C	Female	24	Tour operator	Tourism industry
#D	Male	29	Marketing manager	Hospitality industry
#E	Male	24	Guest services	Hospitality industry
#F	Male	43	Food and beverage manager	Hospitality industry
#G	Male	22	Tour guide	Tourism industry
#H	Female	34	Operations manager	Hospitality industry
#I	Female	32	Front desk manager	Hospitality industry

4.2 Results

The findings reveal diverse positive and negative aspects of working with AI algorithms and agents. Our participants mentioned to have worked primarily with AI-powered concierges (e.g., to check guests in or out, to order room service) and automated data processing (e.g., automated guest messaging, automated revenue management system to optimize pricing and rate utilization). Regarding the positive aspects, the interviewees mentioned that AI could motivate and bring happiness to the workplace, contribute to an identification with the workplace, reduce workload and help with repetitive tasks, decrease stress and anxiety, increase productivity (performance), reduce costs, accelerates the development of tasks, and increase commitment (see Table 2). Participant B stated: "when working as a team, if AI can be efficient is always good. The first thing that comes to mind is the decrease in mistakes made by the team". On the contrary, the interviewees revealed that AI could not entirely replace human employees and interactions. AI can have a negative impact by replacing humans in some tasks (increasing unemployment), and the participants also reveal not trusting AI in all customer interactions (see Table 2). Participant D argues that "AI still does not have feelings, which is good, but it also lacks intuition. When we are in a situation where AI collects and gathers data to transform it into results, we still need human employees to close the process. I do not trust the machine to do it by itself". Employees may be unprepared for additional AI incorporation in service firms or not appreciate working with AI, consequently affecting employee happiness.

Table 2 Positive and negative aspects of working with AI algorithms and agents

Positive aspects	Negative aspects
• AI could motivate and bring happiness to the workplace	• AI cannot replace human interactions
• Higher identification with the job while working with AI	• Lack of appreciation for working with AI
• AI can reduce workload	• Do not trust AI for customer relationship
• Decrease prospective stress and anxiety	• Negative impact on replacing humans
• AI may increase productivity/efficiency	• May increase unemployment
• AI can replace human employees	• AI cannot replace human employees
• AI to reduce costs	• Not ready for the change
• AI to turn tasks easier	• Negative impact on well-being because there is no human contact
• Possible augmentation	• Lack of trust in AI in all interactions with customers
• AI to turn tasks faster	
• Increases commitment to the job while working with AI	

4.3 Discussion

Our results show that incorporating AI algorithms and agents (Huang and Rust 2018) can complement and support human employees in specific situations. Employees consider that AI can help avoid mistakes and turns tasks easier. Having AI performing repetitive tasks can reduce anxiety and stress in the workplace among human employees, contributing to decreasing employees' stress due to the support at the workplace (Li et al. 2019; Darvishmotevali and Ali 2020). This finding is of foremost importance to our research as we move forward with offering the concept of benign stress (Wastell and Newman 1993; Penney and Spector 2005) associated with the use of Ai algorithms and agents in the workplace after it. Stress can be benign if AI facilitates the performance of the tasks, accelerating the processes. Nonetheless, interaction requires adaptation and readjustments at the workplace as AI is a recent technology.

Our results also underline that AI can influence motivation and happiness in the workplace. Reducing the relationships between human co-workers can negatively impact trust and individuals' happiness. Additionally, our results show some anxiety about unemployment associated with AI technologies in organizations, which is in line with the current literature (Flavián and Casaló 2021; Huang and Kao 2021). Therefore, participants do not recommend implementing intuitive or emphatic AI (Huang and Rust 2018). These types of AI are challenging to replace human beings (Lei et al. 2021). Finally, our results highlight the potential for better identification with the organization (with the AI), more significant commitment and performance. It leads us to the concept of employee engagement proposed by Kumar and Pansari (2016). The results seem to support our second hypothesis, which we formally test in study 2.

5 Study 2: stressing happiness by working with AI

5.1 Procedure

This study aims to analyze the direct effect of benign stress on happiness and the indirect effect via employee engagement. The literature and our first study helped us reach the conceptual model tested in this study (see Fig. 1). Both have pointed out the expected positive effect of non-harmful stress—which we introduce as benign stress—on employee happiness while interacting with AI algorithms and agents, and the potential role of employee engagement as a mediator since the construct—proposed by Kumar and Pansari (2016)—combines some dimensions mentioned by the interviewees. The sample was collected via Amazon's Mechanical Turk in April 2021. This crowdsourcing system has age, gender and ethical diversity, contributing to the generalizability of the findings (Mason and Suri 2012). The sample aggregates 200 participants who work\have worked with AI algorithms and agents at the workplace in service firms (hospitality and tourism-related). Our study compensates the participants €1.25 for a less than ten-minute task. Table 3 shows the sample profile.

Table 3 Sample profile

Demographic characteristics	Frequency	%
Gender		
Male	102	51.0
Female	97	48.5
Prefer not to say	1	0.5
Age		
18 to 24	161	80.5
25 to 34	13	6.5
35 to 44	4	2.0
45 to 54	18	9.0
55 to 64	3	1.5
>64	1	0.5
Level of education		
High school	13	6.5
Bachelor	119	59.5
Master or post-graduation	68	34

The questionnaire was first written in English (because all items were originally in English), translated to Portuguese and then back-translated into English (with the help of two native linguists) in order to ensure that the Portuguese version communicated the same content as the English version (Sekaran 1983). Participants were first asked about working in the tourism industry and having experience using AI at work, and only those who responded positively were invited to respond to the questionnaire. The questionnaire was prepared to minimize recall bias and common method bias to ensure data quality. In this sense, we used commitment techniques (e.g., asking for conscientious responses) and attention questions (e.g., What color is the sky? Make sure to select green for this answer so that we know you are paying attention) and provided memory aids (e.g., asking participants to think about the moment(s) they worked with AI algorithms and agents). The items were kept without unfamiliar words and complex syntax, and items belonging to the same constructs were introduced at a physical distance and asked for conscientious responses and attention questions. The questionnaire was also pre-tested by eight individuals to analyze the content validity.

5.2 Measures

The measures were adapted from prior studies, and all the items were measured using a Likert-type scale from 1 (Strongly disagree) to 7 (Strongly agree). Benign stress was based on the stress scale considering the dimensions of demands and support (Karasek and Theorell 1992) but leaving the control variable aside as it does not focus on the benign effect of stress. Employee engagement was measured based on Kumar and Pansari (2016). Self-esteem was assessed through 5 items adapted from the Rosenberg Self-Esteem Scale (SES) (Rosenberg 1965, 1979), not regarding the

reverse items as the literature suggests that negatively oriented items have a minor impact on instrument quality but influence measurement model and path coefficients (Dueber et al. 2021). Diverse scales have been employed to assess happiness, such as the Subjective Happiness Scale (Nawijn and Peeters 2010) or the Satisfaction with Life Scale (SWLS) (Sirgy et al. 2010; Nawijn 2011; Woo et al. 2015), while another common approach (Van Boven and Gilovich 2003; Bimonte and Faralla 2015) involves a single item. The current research measured employee happiness using three items adapted from Van Boven and Gilovich (2003) and Bhattacharjee and Mogilner (2014).

5.3 Results

Data were treated using SmartPLS 3.0. Partial least squares (PLS) regression is a method based on an iterative combination of principal component analysis and regression to explain the variance of the constructs. It offers the advantage of being an effective analytical tool to test interactions by reducing Type II errors (Chin et al. 2003), reducing the problem by accounting for errors related to the measures, and creating a latent construct representing an interaction term (Echambadi et al. 2006). The conceptual model presents formative constructs, so the two-stage approach was regarded (Hair et al. 2019). Factor loading lower than 0.7 were eliminated (identified with the letter 'a' in Table 4). The values of composite reliability (CR) and Cronbach's alpha (CA) exceed 0.6 demonstrating the reliability of the constructs (see Table 4). Convergent validity was achieved since the average variance extracted (AVE) values of the first-order constructs were higher than 0.5 (Fornell and Larcker 1981).

Fornell and Larcker and Heterotrait–Monotrait Ratio were employed to analyze the discriminant validity. As shown in Table 3, the square root of AVE values is higher than the inter-correlation values (Fornell and Larcker 1981), and the Heterotrait-Monotrait Ratio values are lower than 0.9 (see Table 5). The variance inflation factor (VIF) values are below 3.33 (see Table 6) (Diamantopoulos and Siguaw 2006). Therefore, VIF values demonstrate no problem with multicollinearity. The predictive validity is measured through R2. The scores reveal that the modeled constructs explain 62.7% of the variance in employee engagement and 55.9% of employee happiness. The values of Q2 (chi-squared of the Stone–Geisser criterion) are positive, so the relationships have predictive relevance (Hair et al. 2019). The model also has a good fit (0.068) (see Table 7).

The structural results in Table 7 reveal that the H1 is not supported since benign stress does not significantly affect employee happiness ($\beta = 0.122$; $p = 0.078$). Still, benign stress can indirectly influence employee happiness through employee engagement, as the specific indirect effect is significant ($\beta = 0.238$; $p < 0.001$), so H2 is supported. The variance accounted for (VAF) ranges between 0 and 100% (Helm et al. 2010). The VAF of 66.1% represents a relatively strong score, indicating that a significant portion of the total effect comes from the indirect path, so employee engagement acts as a mediator. Regarding the control variables, only self-esteem significantly affects employee engagement (see Table 7).

Table 4 Measurement results

Construct	Factor loading
Demands (*α: 0.623, rho_A: 0.622, CR: 0.788, AVE: 0.553*)	
With AI, I need to work very fast	A
With AI, I need to work very intensively	0.731
With AI, I need more effort in my job	0.748
With AI, I have enough time to do my tasks	0.751
With AI, I have conflicts in the team	A
Support (*α: 0.831, rho_A: 0.832, CR: 0.887, AVE: 0.664*)	
There is a calm and pleasant atmosphere working with AI	A
I get on well with my AI co-workers	0.841
My AI co-workers support me	0.818
My AI co-workers understand if I have a bad day	0.813
I get on well with my supervisors in a team with AI	0.785
I enjoy working with AI	0.841
Loyalty (*α: 0.754, rho_A: 0.774, CR: 0.889, AVE: 0.801*)	
I will be happy to spend the rest of my career working with AI	0.916
I do not have an intention to stop using AI at my workplace at this moment	A
My intention to stay is driven by the fact that I like to work with AI	0.873
Performance (*α: 0.762, rho_A: 0.763, CR: 0.894, AVE: 0.808*)	
My performance in a team with AI exceeded expectations	0.902
Working with AI, the amount of opportunity for my performance improvement at my firm is high	0.896
Identification (*α: 0.915, rho_A: 0.917, CR: 0.932, AVE: 0.663*)	
I am proud to tell others that I am part of a firm that uses AI	0.800
I feel a sense of ownership toward this firm that uses AI	0.843
My sense of pride toward the firm that uses AI is reinforced by its message	0.817
While I work with AI, I view the success of the firm as my own success	0.860
While I work with AI, the firm is like a family to me	0.771
If I work in a firm with AI, I will talk about this firm, usually saying "we" rather than "they."	0.778
When someone praises this firm for using AI, it feels like a personal compliment	0.825
Satisfaction (*α: 0.902, rho_A: 0.903, CR: 0.927, AVE: 0.719*)	
When I work with AI, I receive recognition for a job well done	0.830
In a team with AI, I feel close to people at work	0.826
While I work with AI, I feel good about working at the firm	0.876
When I work with AI, I feel secure about my job	0.868
Giving me the possibility of working with AI, I believe management is concerned about me	0.838
Commitment (*α: 0.882, rho_A: 0.891, CR: 0.927, AVE: 0.809*)	
My commitment to the firm increases because of the use of AI	0.866
Working with AI, I am very committed to delivering the brand promise to our customers	0.908
This firm with AI has a great deal of personal meaning for me	0.923
Employee happiness (*α: 0.753, rho_A: 0.770, CR: 0.859, AVE: 0.672*)	
The experience of working with AI contributes very much to my happiness in life	0.730

Table 4 (continued)

Construct	Factor loading
The experience of working with AI is very meaningful	0.895
The experience of working with AI is very personally fulfilling	0.826
Self-esteem (*α: 0.843, rho_A: 0.858, CR: 0.887, AVE: 0.612*)	
On the whole, I am satisfied with myself, interacting with AI at my workplace	0.849
In a team with AI, I take a positive attitude toward myself	0.783
I feel that I have a number of good skills to interact with AI	0.712
I am able to interact with AI at my workplace as well as most other people	0.741
In a team with AI, I feel that I'm a person of worth	0.819

In the questionnaire, we explain that AI represents algorithms and robots with artificial intelligence (i.e., diverse types of algorithms and agents with artificial intelligence)

A item eliminated; below the threshold, *α* Cronbach's alpha, *CR* composite reliability, *AVE* average variance extracted

Table 5 Discriminant validity

	1	2	3	4	5	6	7	8
1. Commitment	0.899	**0.546**	**0.755**	**0.762**	**0.675**	**0.508**	**0.770**	**0.708**
2. Demands	0.390	0.744	**0.329**	**0.364**	**0.343**	**0.315**	**0.466**	**0.529**
3. Employee happiness	0.618	0.239	0.820	**0.784**	**0.784**	**0.784**	**0.784**	**0.784**
4. Loyalty	0.706	0.268	0.583	0.895	**0.595**	**0.595**	**0.595**	**0.595**
5. Performance	0.558	0.268	0.575	0.460	0.899	**0.694**	**0.694**	**0.694**
6. Support	0.440	0.259	0.584	0.388	0.550	0.815	**0.729**	**0.729**
7. Identification	0.697	0.354	0.648	0.622	0.617	0.636	0.814	**0.797**
8. Satisfaction	0.635	0.414	0.674	0.544	0.576	0.661	0.625	0.848

Bottow-left Fornell Lacker criterion; top-right in bold Heterotrait–Monotrait Ratio (HTMT) criterion

5.4 Discussion

Stress is traditionally regarded as harming individuals, particularly in the workplace (Karasek and Theorell 1992; Nixon et al. 2011; Schwepker and Dimitriou 2021). Incorporating AI algorithms and agents in the workplace demands adaptations and represents support. From a positive perspective, human employees can benefit from the interaction. This positive perspective is seen in this research as benign stress (Penney and Spector 2005). When human employees acknowledge AI algorithms and agents' support in the workplace (Karasek and Theorell 1992), they tend to form more positive feelings about it. However, this feeling is strengthened when human employees reveal that they are engaged with the organization. This study demonstrates that employee engagement plays an important role in developing feelings of happiness in the workplace.

Secondly, concerning the formative index of benign stress, created based on Karasek and Theorell (1992) and following the recommendations of Hair et al.

Table 6 Collinearity assessment for structural model

VIF	Employee engagement	Employee happiness
Employee engagement		2.082
Employee happiness		
Self-esteem	1.874	
Benign stress	1.908	2.082
First-order constructs	Second-order constructs	
	Employee engagement	Benign stress
Commitment	2.729	
Loyalty	2.148	
Performance	1.834	
identification	3.141	
satisfaction	2.824	
Demands		1.072
Support		1.072

VIF variance inflation factor < 3.3

(2019), support appears as the most relevant (weight = 0.886) followed by demands (weight = 0.287). Therefore, when human employees recognize that working with AI means that they have the support and empathy of the AI—even if the work demands more effort—humans tend to feel benign stress and that stress does not cause the same psychological and physical damage as is expected based on Lazarus and Folkman (1984).

Thirdly, identification (weight = 0.414), followed by satisfaction (weight = 0.314), are the most relevant dimensions (as proposed by Kumar and Pansari (2016))—to form the index of employee engagement for the context of this research. Therefore, human employees will be engaged with the service firm mainly when they feel a sense of ownership and pride in belonging to a service firm operating with AI algorithms and agents. Humans also become engaged if they receive recognition for the job well done by working with AI and feel in a good mood for the whole environment of cooperation in the service firm. The other dimensions are also significant—commitment, loyalty, and performance—but each weight is lower (see Table 7).

Finally, as a control variable, self-esteem is revealed to significantly affect employee engagement (Sonnentag and Fay 2018). As expected, human employees who feel high self-esteem working at a firm with AI employees tend to become more engaged with that firm. Thus, human happiness depends on human beliefs and feelings about their self-worth and the engagement mechanism developed in the workplace with AI algorithms and agents.

Table 7 Structural results

Relationship	β	SD	T statistics (|O/STDEV|)	P values	2.5%	97.5%	$f2$
Direct effect							
Employee engagement → employee happiness	0.655***	0.064	10.255	0.000	0.528	0.771	0.468
Benign stress → employee engagement	0.363***	0.052	7.034	0.000	0.261	0.463	0.210
Benign stress → employee happiness	0.122ns	0.069	1.767	0.078	− 0.021	0.248	0.016
Control variables							
Gender → employee engagement	0.084ns	0.041	2.049	0.053	0.007	0.166	
Age → employee engagement	0.036ns	0.032	1.126	0.261	− 0.026	0.100	
Self-esteem → employee engagement	0.510***	0.054	9.454	0.000	0.389	0.606	
Specific indirect effect							
Benign stress → employee engagement → employee happiness	0.238***	0.040	5.918	0.000	0.164	0.315	
Second-order formative							
Demands → benign stress	0.287***	0.063	4.530	0.000	0.142	0.386	
Support → benign stress	0.886***	0.041	21.710	0.000	0.799	0.963	
Commitment → employee engagement	0.199***	0.010	20.160	0.000	0.181	0.218	
Loyalty → employee engagement	0.118***	0.007	17.922	0.000	0.105	0.131	
Performance → employee engagement	0.119***	0.008	15.573	0.000	0.104	0.134	
Identification → employee engagement	0.414***	0.013	31.772	0.000	0.391	0.441	
Satisfaction → employee engagement	0.314***	0.013	23.553	0.000	0.289	0.339	
		R^2Employee engagement	0.672	Q^2Employee engagement	0.527	VAF	66.1%
		R^2Employee happiness	0.559	Q^2Employeehappiness	0.369		
		Model fit					
		SRMR	0.068	Chi-square	156.159		
		d_ULS	0.304	NFI	0.855		
		d_G	0.142				

ns not significant, *f2* effect size, *VAF* variance accounted for

***$p < 0.001$

6 Overall discussion

Current research has shed light on understanding the phenomenon of benign stress and employee engagement and happiness in a working environment with AI algorithms and agents. Two studies were conducted aiming (i) to understand if service employees consider or not be positive to work side by side with AI algorithms and agents and (ii) to analyze the direct effect of benign stress on happiness and the indirect effect via employee engagement. The findings lead us to discuss three main aspects.

First, incorporating AI in the workplace can generate stress and affect human well-being (Belanche et al. 2021a; Ali et al. 2022). On one side, AI algorithms and agents can negatively affect human employees. The emotional states developed in humans associated with the fear of change and the unknown can explain this negative effect. Individuals tend to fear what they do not master, which will influence their daily tasks and duties at the workplace (Mirbabaie et al. 2022). Human employees fear the loss of human relationships in the workplace and do not believe that AI can relate to humans as humans do. Human employees may not feel confident working with non-human agents because they assume they will gradually have fewer skills than their non-human peers (Belanche et al. 2020b; Flavián and Casaló 2021). Humans also tend to fear being replaced by AI, leading to an increase in unemployment. These negative aspects are deeply associated with the lack of information and uncertainty about the future of AI work evolving in terms of technical and soft skills (Deshpande et al. 2021; Mirbabaie et al. 2022). On the other side, the positive aspects of incorporating AI in service firms can lead to benign stress when humans recognize that AI algorithms and agents can facilitate and support them on tasks, creating higher overall performance (Huang and Rust 2021; Lei et al. 2021). This positivity may allow for collaboration and interdependence between human and non-human employees. Therefore, AI can be a motivational factor instead of a concern (Li et al. 2019; Kong et al. 2021).

Second, the engagement process between employees and service firms in the presence of AI plays an essential role in mediating the relationship between benign stress and happiness. Human employees who accept the presence of AI, understand its abilities and have positive psychological effects from working with AI benefit from this interaction and become more identified and satisfied with working for that firm (Ashfaq et al. 2020; Ali et al. 2022). Humans who can handle mental or emotional pressure by working with and engaging (Kumar and Pansari 2016) with AI will be happy and intend to continue working in that firm. Finally, self-esteem also plays a role in increasing engagement with the company. Humans with high levels of self-esteem while working with AI will also tend to be more engaged. Self-esteem can be psychologically reinforced (Rosenberg 1979) when humans receive technical training and psychological support during implementation and adaptation to use and cooperate with AI algorithms and agents (Belanche et al. 2021b; Kong et al. 2021).

7 Conclusions and implications

According to the literature, the quality of human–AI algorithms and agents' relationships are highly relevant in the service industries (Huang and Rust 2021; Loureiro et al. 2021b). Based on it, this paper aims to analyze the humans' perceived positive and negative aspects when working with AI algorithms and agents in service firms. We also intend to assess if employee engagement can mediate the relationship between benign stress and employee happiness. It is possible to underline several research outcomes based on the data collected and the results achieved.

7.1 Theoretical contributions

From a theoretical point of view, this research's contribution is threefold. First, it extends the knowledge of job stress on human–AI interaction by proposing a positive viewpoint due to benign stress. Job stress is an unstable situation in the workplace if humans feel they do not have the resources to handle the demand (Elmadağ and Ellinger 2018; Huang and Rust 2021). With the support of AI, humans can acquire more resources to undertake tasks at work and feel happy about it. Second, we show that employee engagement can mediate the relationship between benign stress and happiness. Working in a service environment alongside AI algorithms and agents can contribute to developing an identity and a sense of satisfaction. These two later dimensions are the most relevant to influence engagement and reinforcing the effect of benign stress to create a meaningful and fulfilling experience at the service firm. Finally, in this research, we assume that psychological factors can influence employees' attitudes and behaviors and have questioned whether self-esteem could influence these relationships. Based on our findings, we claim that implementing AI algorithms and agents requires psychological factors from human employees, such as self-esteem (Yagil and Medler-Liraz 2019; Loureiro et al. 2021b), helping to increase employee engagement and happiness, with the service firm.

7.2 Managerial implications

As the implementation of AI at work is relatively new, from a managerial perspective, there is only nascent evidence of its risks and benefits. Yet, this research intends to provide some benefits and risks managers should familiarize with. First, we identify the risk of job stress for employees who need to interact with AI algorithms and agents in services in service firms' workplaces. Managers should consider it while deciding about adopting it in firms, as in industry 4.0, unacceptable risks may lead to overwork and stress (Gaiardelli et al. 2021). Managers must assist employees' needs in terms of training and support to transform stress into benign stress. Employees may feel awkward, ill at ease, and self-conscious facing the unknown, but gradually they may overcome it with training and support. Second, implementing AI algorithms and applications in the workplace will require developing skilled and prepared employees through training, experience, and naturally occurring

adaptation ability. It implies that employees need to be trained to work, interact, and share everyday tasks in the workplace with AI algorithms and agents, but they also need to be qualified to work in ways to cultivate talents that only humans (at least, for the time being) can offer in ways that are useful for firms.

Third, AI algorithms and agents can help to oversee employees by fostering employee engagement. It may occur by motivating employees. Managers should consider several employee engagement variables, such as loyalty, performance, identification, satisfaction, and commitment, as they can perform a relevant role in defining whether AI will effectively create employee engagement over the long run. AI may improve workplace relationships between employees and with AI applications whenever the potential for partnership is evident. In sum, it is noteworthy that AI technology itself may not create job stress or workplace happiness for workers. Managers should consider how it is implemented and how smooth the transition from an AI-accessible to an integrated (blended) workplace environment is to ensure the successful integration of AI in the workplace.

7.3 Limitations and future research

This research has limitations, which could also be avenues for future research. First, finding older participants for the samples in both studies was challenging. For that reason, only 11% of the sample in the second study is older than 45, and more than 80% of the participants are younger than 24 years old. Future research can compare behaviors between age groups with a similar number of participants but balance the age group size. Second, AI is here to stay, inevitably, and a reality for the future. Its introduction in the workplace needs to be prepared to avoid rejection by possible human co-workers. Future research can study ways to train and educate employees about AI algorithms and applications in the workplace. Third, in this research, we study the employee-AI interactions in one culture. Studying different cultures or performing cross-cultural research can be an exciting research path (Hofstede 2001). Furthermore, we are living in a (near post) pandemic situation. The world economies suffered, and the loss of revenues is one of the pandemic costs for the service sector. People fear social contact and avoid being exposed to other humans. AI (particularly robots) can be seen as a form of avoiding those contacts (Huang and Kao 2021). However, job replacement is an objection and one of the main negative aspects from employees' point of view that negatively influences engagement. Future research can focus on overcoming these objections and building employees' trust in artificial algorithms and agents.

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