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Research Article

Robot Coworkers: The Vision of Future Hoteliers

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The purpose of this study is to understand how future employees in the hospitality and tourism industry envision the use of artificial intelligence in the organizations where they wish to work in the future. Through open-ended questions applied to undergraduate and master's students in the area of tourism and hospitality, we capture their opinions when thinking about the partial or total use of robots in hospitality. Despite the increasing implementation of artificial intelligence in hospitality and tourism, existing research mainly focuses on current hoteliers and/or customers. However, anticipating how digital generations expect their future roles in a close engagement with robots allows researchers to predict and focus their attention on future problems. Their statements were subjected to a qualitative content analysis methodology, based on themes and sentiment. Participants expressed a negative view of the presence of robots in hospitality, mostly associated with a fear of job loss. Many also reported that interacting with robots is negative for both staff and customers due to robots' lack of emotions. However, there is some division concerning the impact of robots on service quality: some believe that the service will be more efficient and with fewer failures; others believe that the limitations of robots will lead to worse service. The findings suggest that the acceptability and desirability of robotization may vary depending on the level of robotization in hotels, on the type of customer, and on the level of service provided.

1. Introduction

Research on the use of service robots in hotels, according to the Wiley Online Library database, started in 2001.This early research suggested that robots may play a central role in social interactions as participating agents [1]. Only from the year 2018 did studies on this topic start to become more frequent, focusing, nonetheless and mainly, on customers' attitudes towards the use of service robots [2–6] and on the threats for workers, considering the benefits for companies [7, 8].

The study of the perceptions of future workers in the hospitality industry is quite recent and was first applied in Russia and Serbia [9, 10]. These research studies provided the background for our research, contributing to the design of the open-ended questions addressed to the 358 participants in our qualitative content analysis study.

The evolution of technology has allowed the creation of numerous opportunities for different sectors to adopt and incorporate it for the sake of service improvement [10]. However, despite the physical component, such as the infrastructure, design, and services offered, it is through human interaction that the main pillars, that largely determine service quality, are established. However, the implementation of technology in the daily life of modern societies, to the detriment of the human component, has changed this dynamic [4].

The combination between hospitality and technology is one of the great challenges of the service sector. The premise

of hospitality is the service offered by humans and the interaction between them, and especially the emotional component, which is reflected in the way of interacting and acting [4, 11, 12]. Tourism and, especially, the hotel sector have always been guided by human interaction between service providers and customers. Hospitality, so characteristic of this industry, enables the creation of value. The introduction of robots confronts the limits of the traditional understanding of hospitality [9] and the boundaries that separate robotics from the human component [5].

Robotics is increasingly prominent in tourism and hospitality [9–11, 13] and strongly influences the provision of services in the various sectors that constitute them [14], particularly in the hotel sector, being able to cooperate with or even replace service providers (humans). The introduction of robotics, and possible partial or total replacement of human work, should be progressive; however, this replacement occurs in tasks and not in jobs; that is, the human component, despite existing, becomes different [15]. The future may culminate in a scenario of total humanization of robots, or on the other hand, in the use of robots with minimal human characteristics. Even in this situation, the psychological capacity of humans to attribute intention and mental states to objects and to display empathetic feelings and behavior towards them will certainly lead to the (partial or total) humanization of technology, a fact that is on the agenda of both creatives and marketers [16]. There are studies that associate the level of general mental capacity of the individual with the level of perceived usefulness of artificial intelligence and that perception, negative or positive, has differentiated impacts on worker satisfaction [8]. However, no study thus far has analyzed how future workers in tourism and hospitality perceive sharing their future workplace with robots. This is a relevant topic particularly due to the ongoing transformation of the tourism sector as a consequence of the COVID-19 pandemic, which inflicted severe losses upon the sector. To cope with the need for social distancing, the sector increasingly adopted new technologies, including robots [13]. Changes in human behavior resulting from the COVID-19 pandemic led to the diffusion of emerging technology and generated opportunities within research that relates human behavior to technology [17, 18]. Hence, the purpose of this study is to understand how tourism and hospitality students, in a disruptive context, envision the interaction between robots, human staff, and customers in their future careers.

2. Theoretical Background

Robots can be referred to as industrial robots or service robots. Industrial robots are used for manufacturing sectors, factories, among others. Service robots are machines that provide full or partial services to humans and can mimic their behaviors [19]. The inclusion of robots is seen as an essential and integral part of the guest experience. Thus, understanding the influence of human-robot interaction in hotel business is crucial [20].

The hotel sector is one of the most competitive. With the increase in supply and consequent growing demand from customers, it is necessary that this supply is differentiated, on the one hand through new products and new experience designs which are increasingly customized and sustainable, on the other through innovation [19, 21] which can be translated by the introduction of robots and the smart hotel concept. A smart hotel can be defined as a hotel that adopts innovative technologies, being more independent of human employees, for the purpose of providing an outstanding customer experience and being highly distinguishable from other hotels due to the extreme degree of embeddedness of innovative technologies in the operation of the hotel [4]. However, the use of technology is not only directed at the technical and functional components of services (design, operationalization, or labor costs) but also intended to create unique experiences [5, 14].

The nature of the service provided, the technical capability of the robots, the interaction between robots and customers, the guest experience and consequent service quality will dictate the success of this innovation; therefore it is necessary for organizations to understand the motivations and expectations of guests, tailoring the robotic offering to the guest profile [19]. Guest perception of the service and consequent acceptance will likely depend not only on the type of service provided and the technology itself but also on the interpersonal, cultural, demographic, and behavioral factors of the users [5, 6, 20]. Human-centered artificial intelligence ought to create systems that can understand humans while simultaneously helping humans understand AI systems, for only this way will intelligent systems understand expectations and needs in order to interact with individuals in everyday and culturally specific contexts [22].

Japan has long been one of the most technologically developed countries. Society has long been familiar with the use of robotics in many services including the hotel sector (e.g., Henna Hotel). Thus, acceptance of the use of these tools is easier and more common. However, in countries where the human component, verbal and nonverbal communication, is crucial to add value to services, this may have an impact on the acceptance and consequent dissemination of their use. While some are willing to accept the insertion of technologies in the various sectors, others continue to resist it. It is necessary that not only the guests but also the hotel companies, managers, and employees themselves adapt, namely, at a cultural level, to accept a new form of interaction and service delivery [20].

As early as 1996, Reeves and Nass, in their research about media equation, presented results from numerous psychological studies concluding that people treat computers like real people and places, being polite, treating female voices differently, and reacting to full-size faces as well as movements [23]. The computers are social actor (CASA) paradigm, whose origin is based on the media equation, has been validated to this day, maintaining the idea that people apply social rules and expectations to computers as if they were human, thus identifying its social potential. However, changes in both people and technologies have revealed changes in the way human-machine interaction takes place [24]. At the sociodemographic level, populations living in urban areas are more receptive to robots [10]. Younger

people and/or those with higher education level are also more receptive to robotics [5, 25], while women are more skeptical [6, 25]. Regarding the reasons for the trip, business travelers tend to be more accepting of the introduction of technology in hotel services [5].

In addition, the safety of human-robot interaction [5], economic factors, and the morphology of robots can condition the receptivity to this type of service. Customers of luxury hotels, according to some studies, consider that there is some incompatibility between robots and the service they demand from these hotels. They require for sophisticated employees, ready to serve guests at any time and able to anticipate and solve certain problems that robots, being programmed a priori, cannot solve [11, 20].

Regarding robots' morphology, they can be anthropomorphic (humanlike), zoomorphic (the shape of an animal), figurative (e.g., robots shaped like a cartoon or a toy), or resemble other functional objects (e.g., autonomous car) [11]. According to some studies, hotels prefer to introduce human-like robots because they facilitate social interaction in tasks that require it. In this way, hotel organizations gain a competitive advantage [4, 25, 26]. However, some guests are more skeptical about the use of anthropomorphic robots, as they consider that their human component is not comparable to that of human beings [20] and that it may be uncomfortable at the moment of interaction [26]. Natural language processing and networked information processing of smart speakers can play an important role, making it possible to assign human characteristics without considering them as neither fully real nor fully inanimate entities [27]. Because it is not consensual, and to avoid possible constraints in the interaction, it is important to have a balance between the robots' design and behavior [4].

The existing literature has focused on technical failures rather than interaction failures in the human-robot relationship, i.e., human errors, communication failures, and cognitive failures, that might help find mitigation strategies [28]. The incompatibility of service robots with other hotels' technology can affect the integration of these systems, as well as the existing infrastructures that sometimes lack the capabilities to support their operations. Therefore, robots are considered relatively limited and often unable to complement employees' tasks [29]. Managers and employees are still expressing doubts about the costs inherent to the use of service robots, namely, related to the time required for training due to the complexity of learning how to use this type of technology [30].

2.1. Disadvantages of Robotization in Hotels. Tourism, as an experience creator, adopts technology as a differentiating factor. Robotics has demonstrated its ability to cocreate positive experiences for customers; however, it is necessary to consider the risks inherent in its use, especially if it is unregulated [14]. The introduction of robots, despite the advances in technology, is not yet something that customers are familiar with, which, in a first instance, creates a feeling of curiosity and novelty that may lead to greater acceptance at first [20]. If, on the one hand, novelty is a motivational and acceptance factor, on the other hand, a longer interaction with robots makes evident the limitations of this interaction [14].

Even with the development and progress in the application of robots, the complementarity between humans and robots in service delivery is necessary, and there are certain situations in which robots are unable to respond; i.e., they cannot solve situations that require decision-making, intuition, urgency, and empathy, for example, with unforeseen situations that could be solved based on wisdom and experience [19, 20]. In addition, lack of trust and sense of loyalty, inability to value customers (e.g., praise), limitations in verbal and nonverbal communication (e.g., smile, look), and less authentic and spontaneous interaction and more limitations in exposing doubts and complaints are some disadvantages experienced [4, 5].

Besides the large initial investment, a major concern of introducing robotics is the partial or, more importantly, total replacement of human labor, leading to unemployment. The uncertainty and lack of knowledge about how robots work and the future dependence on robots have created feelings of skepticism or even rejection by professionals in the industry [25]. However, it could be bridged if the employees had more control over the robots and if they felt that robots are not a threat, but rather collaborators that make their work easier and lessen the workload [19, 25].

Concerning the disadvantages related to the use of this type of technology, we can also verify that despite new technologies are designed to solve problems and bring benefits to human life, and the intelligent use of an emerging technology offers new possibilities to improve human life, both personally and professionally, even when the technologies work properly, their improper use can cause many losses, particularly in security issues, as the input of tampered data can lead to incorrect actions that can translate into losses for users [31].

2.2. Benefits of Robots in Hotels. As previously mentioned, in addition to the skepticism regarding the adoption of this technology, considered as a possible cause of unemployment, there are also advantages in the adoption of robotics in the daily life of services, particularly in a society increasingly familiar with technology [13]. It should also be noted that automation has allowed for not only the creation of better jobs but also the creation of new ones over the past few years [32]. The application of technology in the hospitality and tourism sector has been shown to have several advantages: increased efficiency and effectiveness, for example, faster check in and check out; personalized service, with differentiated, innovative, and fun forms of interaction; decreased turnover in services and service providers; and more consistent services [5].

The idea, at least in the first phase, is not the complete replacement of human labor. Rather, it consists in the division of tasks, to optimize the service. Routine and secondary tasks can be replaced by robots, with alternation between the functions and the places where they are performed [15]. For example, room cleaning, given the specificity, must be performed by humans, but hallway cleaning can be done by robots; general luggage transport can be performed by robots, and fragile luggage by humans, among others [15].

Robots are more objective and are not subject to judgment and/or posture modification depending on the service provider and the customer in front of them [15]. Previous research shows that people attribute less responsibility for service failures to the robot when the service is provided by robots, but on the other hand, they attribute more responsibility to the service company when there are failures in services provided by robots compared to services provided by humans [33]. Furthermore, robots can work without interruptions and perform very tedious tasks, often without complaining or forgetting to do them; they eliminate unnecessary human conflict or miscommunication. In this way, there can be a combination of efforts so that the final service is more efficient and effective. Robots can either be assigned tasks that are generally not assigned to humans, or replace them in certain tasks, thus freeing humans to perform tasks that can only be performed by humans [5, 11, 12], namely, at the level of management [20]. Some people more easily accept the introduction of robots in a perspective of information transmission than in the performance of other tasks (e.g., housekeeping) [32].

While the industry is excited about the introduction of robots, the literature is still discussing the importance of robots for customers and service providers. It is necessary to understand what the perception of service providers is about the insertion of robots in the hotel sector [9, 20, 34]. Will it create a feeling of rejection on the part of professionals? Will they feel pressure and fear regarding the preservation of their jobs? These questions should be analyzed, as it is not only the possible rejection caused by customers that will dictate the success or failure of the implementation of robots in the industry. The employees' cooperation with the robots and their job satisfaction will also condition the success of the operation. Will the new generations, accustomed to the use of technology in their daily lives, be able to share their tasks with robots, will they accept the performance of other tasks that cannot be performed by robots, or will other professions emerge in the industry?

2.3. Substitution by Robots and Interaction with Robots in One's Future Career. Future hospitality professionals are part of a generation very familiar with technology [9]. Since they will be the future managers and professionals in the sector, it is important to understand their perspective. The management component, such as cost reduction, efficiency, and revenue improvement, is seen as a priority, and they already see themselves as future managers. Thus, there is a consensus in relation to the adoption of robots in services, not least because they argue that it facilitates service delivery, faster and more optimized service, consistency and accuracy, cost reduction, and creation of unique experiences, in such a competitive sector. Although they are aware that robotics in hotels will increasingly be a reality, they defend that its implementation should be considered in services where interactions are not as prevalent. The quality of interactions and job retention are factors to consider. Furthermore, as most students have not yet had the opportunity to work with robots, it is still difficult to accurately assess their perception [9].

3. Materials and Methods

This study is based on a purposive sampling approach. It includes 358 higher education students attending tourism-related programs, aged between 18 and 41, with 70% being women. Most of the participants were undergraduate students (94%), with the remainder being master's students. Additionally, 41% were in their 1st year and the predominant course was Tourism (44%), followed by Hotel Management and Administration (29%). Respondents studied in higher education institutions in the Lisbon Metropolitan Area and in the Western region of Portugal. The rationale for choosing students in tourism and hospitality was related to the increasing adoption of technology innovation in hotels and tourism companies during the COVID-19 pandemic [35]. This pandemic favoured the adoption of new technologies in the sector to ensure social distancing and reduce perceived health risks [35]. The purpose of this study is to understand how tourism and hospitality students, in a context of job losses and abrupt transformations in the sector, perceived the interaction between robots, human staff, and customers in their future tourism careers.

Data were collected during May 2022, a period when there was no lockdown but there were still restrictive measures in place. Data collection occurred face to face, through an online survey distributed in the classroom context. Incentives were not provided for survey completion, and students were asked for consent. No fixed response time was given, and they were asked to write down their responses. The participants were asked to indicate, in their opinion, (i) what kind of impacts the interaction between human staff and robots would have on service delivery in the areas of hospitality and/or tourism, (ii) what kind of impacts the interaction between clients and robots would have on service delivery in the areas of hospitality and/or tourism, and (iii) as future professionals in the areas of tourism and/or hospitality, how would they see themselves working in a reality involving the adoption of robots.

The content analysis approach adopted included the main steps of this type of analysis: a preanalysis of the qualitative surveys, exploration of the written answers, processing of the results, and finally inferences and interpretation of the results [36]. It included three simultaneous workflows of activities: condensing data, displaying data, and drawing conclusions [37] (Figure 1).

Content analysis provides a method for both listening to respondents' answers and drawing out meaning from their perspectives; it unravels the deep levels of meaning present in the responses obtained [38]. To ensure the quality of analysis, all responses were carefully revised to eliminate duplicated answers. Data reduction implied coding using NVivo. NVivo is a computer-assisted qualitative data analysis software that allows a summative approach to qualitative content analysis by identifying patterns complementarily with an analysis of their use in the context of responses [39]. All data were manually coded for sentiment and for theme. Themes were grouped in node hierarchies, as displayed in Results and Discussion. All generated themes were

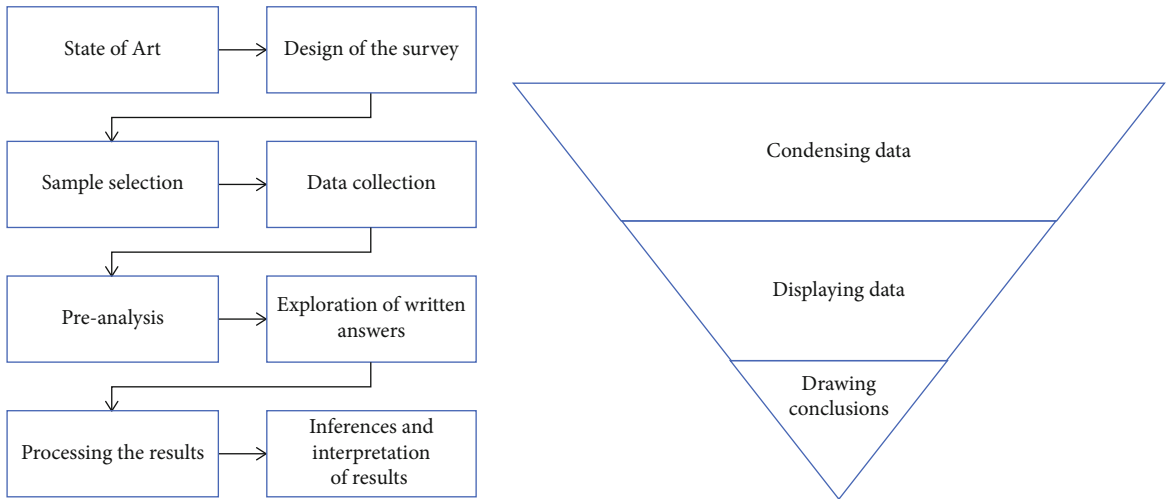

Figure 1: Methodological process. Source: elaborated by the authors.

carefully revised to improve internal consistency by merging or collapsing the initial codes.

4. Results and Discussion

Results and Discussion is divided into three main topics: staff-robot relationship and service delivery; interaction in the context of one's future career; and customer-robot interaction. In reporting the results, firstly we account for students' sentiment concerning each topic and the main themes for each sentiment; then, we analyze themes and subthemes in order of importance (i.e., number of references to it), also reflecting on the sentiment associated with each theme and selecting the quotes that better illustrate the themes.

4.1. Staff-Robot Relationship and Service Delivery. The first topic analyzed concerned students' views on staff-robot interaction and impacts on service delivery in hospitality and tourism. Thematic analysis revealed a mostly negative sentiment (38.7%) concerning this topic. Comments with a negative sentiment mostly concerned the substitution of humans by machines, unpleasant feelings derived from the lack of interaction with humans, and robots' lack of emotions and empathy. The most mentioned theme by those who expressed a reticent sentiment (32.5%) was the importance of the division of labor between humans and robots. Concerning the theme of the substitution of humans by machines, the reticent not only expressed their worries in relation to this theme (as those with a negative sentiment did) but also recognized potential benefits of the introduction of such technologies in hospitality and tourism.

Those who expressed a positive sentiment (23.3%) highlighted how robots would improve service quality and efficiency, while those with a conditionally positive sentiment (5.0%) pointed out the positive benefits of robots provided there is an appropriate division of tasks. Themes are grouped into four sets to facilitate the presentation of results. Figure 2 depicts the themes derived from thematic analysis for this topic.

4.1.1. Impact of Robots on Service Quality. Most themes concerning the topic of staff-robot relationships and service delivery were related to the impact of robots on service quality. The whole range of sentiment is evenly represented in this set of themes; however, while some themes are overwhelmingly associated with a positive sentiment, others are more associated with a reticent or negative one.

A positive sentiment is mostly associated with the theme of how robots can contribute to improving service quality and customer satisfaction ("with the help of robots, the human staff will be able to deliver better quality services"), and the theme of complementarity between human staff and robots ("I think that they complement each other"). The theme of robots' increasing efficiency is marked both by a positive ("it can be positive in terms of efficiency, by speeding up the service delivery process") and a reticent sentiment whenever respondents associated the advantage of efficiency with other negative themes, namely, that of robots' lack of empathy and emotions ("I think it would be easier in terms of waiting, however the service would probably be less personalized and lack 'emotion'"). These three themes are related: robots assist staff and save time—therefore, the staff are freed to perform other tasks where they excel, mainly those related to the customer and the customization of the service experience.

Another slightly less important theme, where positive comments prevailed, despite a significant presence of reticent comments, was related with the importance of good management and balance concerning the relationship between human staff and robots. These comments expressed a belief that robots will contribute to improve performance if there is adequate planning and management ("if the tasks are well divided, and well-coordinated, the impact can be positive"). The importance of functional and numerical balance between human staff and robots is also expressed in some comments, particularly in the ones associated with a

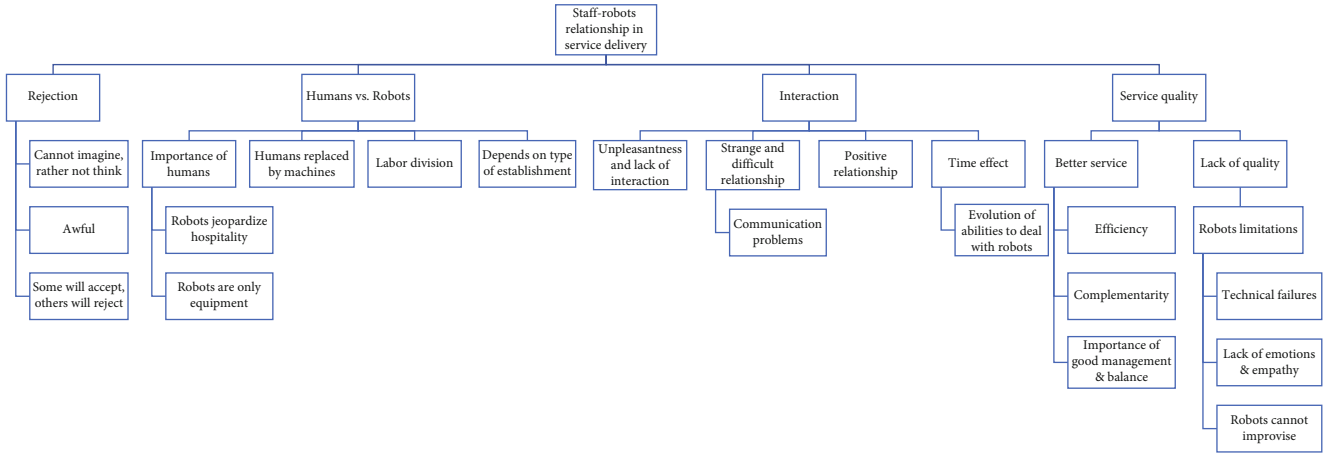

Figure 2: Themes on the topic *staff-robot relationship in service delivery*. Source: elaborated by the authors.

reticent sentiment ("it can be a good collaboration if it doesn't become disproportionate"; "in my opinion, there needs to be a perfect balance, because if robotization overrides human staff, the customer will get lower service quality").

Many themes within service quality were related to a negative or a reticent sentiment. These comments concern the limitations of robots and negative consequences for service quality resulting from such limitations. The most important limitation was robots' lack of emotions and empathy ("they don't bond and have no feelings, so it will become a mechanical job"; "relationships are going to be very non-interactive, unemotional toward customers, and robots will be very limited in terms of responding to customer needs"). There was only one reference where robots' lack of emotions was associated with a positive sentiment, due to robots' greater productivity resulting from a lack of emotional issues. Other limitations mentioned were the lack of improvisation skills ("robots cannot do things that they are not programmed to do"; in practice, it is sometimes necessary to 'improvise', which is something a robot will never be able to do") and the risk of technical failures ("mechanical failures, which call into question the main argument for using robots, which is efficiency"; "I imagine that it is possible to hack a robot, which can be dangerous for the hotel unit"). Both these themes are also mostly associated with a negative sentiment. These limitations of robots, together with staff demotivation resulting from the use of robots, are seen as possibly causes of service failure and lower quality:

> *Customer relationships will be compromised if the human staff is not happy, happiness if fundamental for the organizational climate. Building a good climate relies mainly on the relationships that are established between co-workers. Well, if the co-workers are robots, all of this is compromised.*

4.1.2. Human-Robot Dichotomy. The second most important set of themes concerns the human-robot dichotomy. These themes were mostly associated with a negative or reticent sentiment. Overall, the theme with the most references within this set was related to humans being substituted by machines. This theme was marked by a negative sentiment. Those who expressed a negative sentiment regarded robotization as something worrying and threatening for current and future hospitality workers. There is fear and even resentment concerning the potential loss of jobs because of robotization ("with the increase of robots in hotels, there will be tasks/activities where human staff will not be necessary, which in a way will contribute to unemployment"). To a lesser degree, participants also mentioned other consequences such as the demotivation and devaluing of staff, the lowering of salaries, and the loss of value of hospitality degrees ("loss of jobs, hospitality degrees will lose value because engineers and/or computer technicians will be needed instead of tourism professionals"). Those who were reticent, despite pointing out the negative aspects of the substitution of humans by robots, also recognized some of the benefits that robots might bring ("it will be a love-hate relationship because the robots do things that sometimes we don't feel like doing but on the other hand we won't like going to the unemployment fund").

Many students highlighted the importance of humans in service delivery. This theme was mostly related with a reticent sentiment—although there is a recognition of the importance of robots in certain tasks, many emphasized that robots cannot replace humans ("while I admit the inclusion of robots in the provision of services, most of the hotel must be staffed by humans"; "robots should have extra and complementary functions to those of the staff but never replace their work"). Slightly, more than a third of references in this theme had a negative sentiment ("in my opinion a robot will never provide excellent service like a human, and that is why we will always be fundamental in the hotel business"; "a robot will never be able to replace a human being").

Associated with this theme is the theme that robots—particularly the massive use of robots—will jeopardize the concept of hospitality itself. Almost all these comments are related to a negative sentiment ("in the long run, robots would bring about the destruction of hotels as we known

them today"; "the robots' lack of empathy […] calls into question the essence of hospitality"). A few students answered that robots should be reserved to industries where standardized products are manufactured and not used at all in the hospitality industry. A minor subtheme was that robots are not "staff" but simply tools to be used by humans. Two-thirds of the references are associated with a reticent sentiment and the remaining with a negative one ("robots should be seen as tools, not as staff").

The importance of adequate labor division between human staff and robots was the only theme within this set where there were practically no negative comments. For this reason, we present this theme at end of this section, although it was the second most important theme within this set. A half of the comments were positive or conditionally positive, and the other half were reticent. Those comments that either expressed a positive or conditionally positive sentiment described which tasks should be assigned to humans and which should be assigned to robots. Students assigned various tasks to robots (e.g., simple, repetitive, mechanical, and heavy work, mostly in the back-office, e.g., cleaning), leaving mostly tasks related with customer interaction to the human staff ("robots will be responsible for mechanical tasks"; "humans for hospitality and customer interaction").

Finally, a minor theme concerned the suitability of robots for service delivery depending on the type of establishment. This theme is mostly associated with a reticent sentiment. In general, robots are seen as more adequate for budget nonluxury or urban/futuristic types of establishments.

4.1.3. Robot-Staff Interaction. This set of themes is mostly associated with a negative sentiment. Reticent and especially positive sentiments are far less represented here. Unpleasant feeling derived from the lack of human interaction was the most frequent theme. It is associated with an overwhelmingly negative sentiment. Participants associated the interaction between staff and robots with feelings of frustration, solitude, demotivation, sadness, and lack of joy, partly due to the substitution of coworkers by robots. They envisioned a deterioration of the work environment. Therefore, they desired as little interaction with robots as possible ("it will be like working at a car plant"; "feelings of frustration and solitude at work").

A similar number of participants considered that the relationship between human staff and robots would be strange and difficult ("it will always be a confusing relationship that calls into question what we learned in our degree"). The majority expressed a negative sentiment concerning this theme, while a third were reticent. While acknowledging the messiness involved in the relationships between human staff and robots, the reticent who mentioned this theme also believed that such relationships could work under certain circumstances ("confusing but it might work depending on how it will be carried out"). Some also added that robots might become obstacles to the accomplishment of tasks by the staff, namely, due to communication issues between staff and robots. Within this subtheme, two-thirds of the comments were negative ("I imagine that there will be some barriers in communication and other insurmountable emotional barriers"), and the rest were reticent ("there will be no communication […] but communication in this field is extremely important").

The "time effect" was also a theme that gathered many responses. It was mostly mentioned by the reticent and only marginally by those with either a positive or a negative sentiment. The majority of the reticent who mentioned this theme believed that relationships between staff and robots would initially be more difficult, but those obstacles would end up fading out ("it will require a period of adaptation for human staff to be able to work together with robots"). Those who displayed a positive sentiment mostly emphasized how the complementarity between staff and robots and robots' contribution to improved service quality would be clear after an initial period of resistance ("the relationship with the robots at first will be a novelty that many customers and staff will not accept, but overtime robots will be properly integrated"). Only a few believed in the opposite tendency, i.e., that despite an easy introduction of robots more obstacles would ensue afterwards. These comments are comparatively more associated with a negative sentiment ("at first the interaction will be good because it will be something new and will generate a lot of enthusiasm, but over time the human staff will get tired of this interaction").

A similar number of comments were related to the benefits of the relationship between robots and staff. Many respondents simply stated that it would be a positive and beneficial relationship ("I envision an integration of artificial intelligence as a healthy and possible coexistence"; "it will be a positive relationship, of constant learning for the good of all"). The participants who described such benefits in more detail portrayed them in terms of complementarity and better service, which were themes already presented in Impact of Robots on Service Quality.

4.1.4. Rejection of Robots. Some students rejected robotization, stating that they would not imagine themselves working in such an environment ("I don't want to imagine because it's so bad"; "I prefer not to think about it because I'm afraid I'll run into that reality"). A few others described this new reality as awful ("the result of this new reality will be awful for humans: staff and customers"). Such comments were permeated with a negative sentiment. Some of the reticent stated that the interaction with robots is subjective, arguing that some people would appreciate it while others would not ("It depends a lot on cultural factors, age, mentality. We are different, and we can either accept and like it or not accept and not like it").

4.2. Interaction with Robots in One's Future Career. This topic concentrated a similar proportion of reticent (37.9%) and negative (38.9%) comments. In relation to the previous topic, comments with a reticent sentiment increased while those with a positive (19.9%) or conditionally positive (2.9%) sentiment diminished. Negative sentiments are mostly related to "not imagining oneself" working together with robots and other negative feelings toward robots. Reticent sentiments are mainly associated with advocating the restriction of the use of robots for only certain tasks, mostly

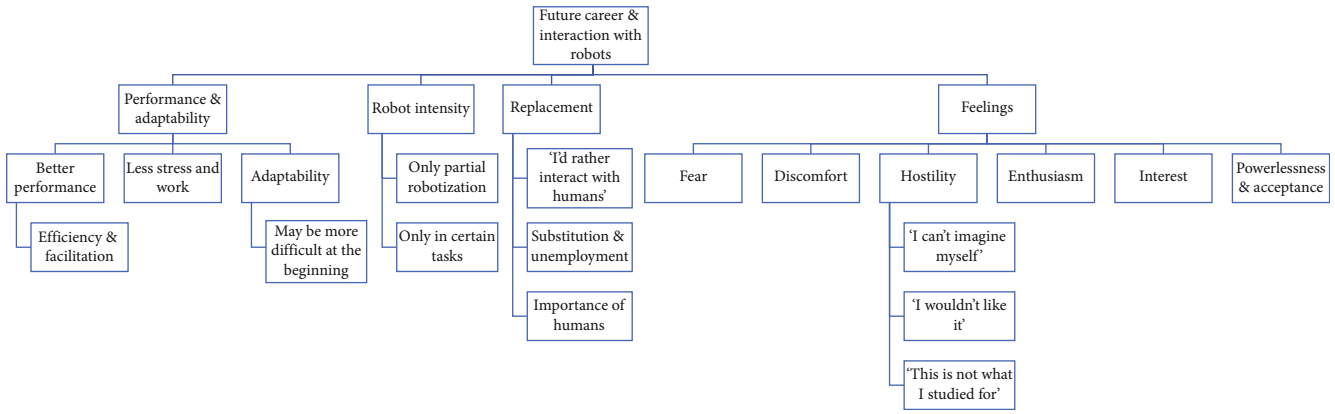

Figure 3: Themes on the topic *interaction with robots in one's future career*. Source: elaborated by the authors.

those where human contact is less important. Finally, positive sentiments are mostly concentrated on themes related with positive feelings toward robots and the belief that robots will improve one's performance at work. Themes were grouped into four sets to facilitate the interpretation of results. An overview of the themes concerning this topic is depicted in Figure 3.

4.2.1. Feelings. The feelings that students expressed toward the idea of interacting with robots in their future workplace were dominated by negative sentiments. The most significant feeling was one of hostility. This theme comprehended three subthemes "I don't imagine myself working with robots", "I wouldn't like to work with robots," and "this is not what I studied for":

> *I do not see myself working in the future in an area that involves robots, which ultimately calls into question my choice regarding the area of study I am pursuing.*
>
> *I would not want to work in a reality that involves (totally or partially) the adoption of robots.*

The second most significant theme, which was marked by a reticent sentiment, concerned powerlessness but acceptance in face of the inevitability of robotization ("I regard it as inevitable"; "there's no way to row against the tide, we have to adapt"; "this reality is inevitable, but I don't completely agree"). The four comments with a positive sentiment grouped under this theme refer more to respondents' willingness to adapt than to a feeling of powerlessness.

Other minor themes with negative and reticent sentiments were fear ("scared to think that a machine can do a better job"; "I am motivated, but always afraid that the involvement between humans and robots will not be as expected") and discomfort ("strange environment that clashes with my idea of hospitality"; "I can see it being possible, but initially it will be quite awkward as human communication and the concept of 'face to face' will be missing").

Some feelings were almost only associated with a positive sentiment. Some students regarded robotization at hospitality in a positive way, with feelings of interest ("I think that it would be a different and interesting experience") and enthusiasm for the challenges and novelties ahead ("It will undoubtedly be an authentic and differentiating experience, both for the human staff and the customers"; "belonging to this 'technological generation', I would be very curious to understand and, of course, work with this different reality").

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4.2.2. Substitution by Robots. When asked about their future interaction with robots at work, many students revealed once again concerns about the substitution of humans by robots. Comments concerning the set of themes explored in this section are divided between a negative and a reticent sentiment. The replacement of human jobs by robots was comparatively more associated with a negative sentiment, which pervaded two-thirds of the comments ("I see myself threatened and feel that, at this rate, a computer science degree easily gives me more options to work in any area"; "I see myself unemployed"). While these comments reveal a good deal of pessimism, some students emphasized the importance of humans in this industry, whose human characteristics cannot be replaced by robots. In some comments, humans are portrayed as the key for the success of the hospitality industry ("there is nothing that can replace the role of the human being in tourism, because success is in us, it is inside us. Why change what has always been done if it

has always been done well?"). Although there are comments with a negative sentiment in this theme, two-thirds are reticent ("I think [robotization] would be interesting, but there is nothing more valuable than the customer-employee relationship"). Finally, a slightly less important theme was students' concern about the replacement of coworkers by robots, which could worsen their performance at work:

> *I do not see myself working beside a machine at all, but beside people, having the possibility to interact with my co-workers, to exchange ideas and help each other, to be able to offer the customer the best possible product.*

4.2.3. Performance and Adaptability. This set of themes is related to participants' views of how their own performance would be influenced by the presence of robots in the workplace, and their ability to adapt to this new reality. The most prevailing sentiments were positive and reticent, with only a few negative comments. The main theme concerns robots' contribution to improving participants' performance at work and boosting efficiency. While some believed that the outcomes would be positive ("easy adaptation and opportunity to produce a higher quality service"; "reduce errors and failures"), others mentioned some drawbacks, namely, a greater risk of technical failure and the lack of humans, which could have a negative impact on service performance ("there is a certain romanticism around the robotization of hotels, but in practice everything will be different"; "I would like to try it, but in my opinion it would not be a reliable option"). Another theme was related to how robots could facilitate work and thus contribute to stress reduction. The sentiment concerning this theme was mostly positive ("I 100% support the idea since it would be a less stressful and more interesting environment to work in"), but also partially reticent ("I see myself with some tasks made easier, yet I fear that one day they will replace me with robots").

Finally, the last theme concerned adaptability to a robotized workplace. Comments with a positive sentiment emphasized the belief in one's own ability to adapt ("I think I will get used to new technologies and changes, because everything in life is constantly changing and we have to learn to deal with that"). Comments with a reticent sentiment also expressed a belief in one's ability to adapt despite the reluctance to accept this new reality ("I would be able to adapt but it would be a huge change, it could affect the connection between people").

4.2.4. Robot Density. Several themes were related to the degree of robot intensity in establishments, with students commenting on what they considered acceptable or not. In all these themes, a reticent sentiment prevailed. One of these themes concerned the tasks or jobs that students considered robots could perform. These tasks were mostly the ones that do not require direct contact with the customer, staff support tasks, trivial and simple tasks, and more physical tasks such as cleaning or room service ("only [tasks in] some specific areas where human presence is not vital"). Another theme gathered participants' comments on acceptance of robots in their future workplaces provided that robotization is limited (i.e., excluding total robotization), however without students specifying which tasks should be assigned to robots and to humans ("I think I can see myself working with some robots as long as it is less than 50%").

4.3. Customer-Robot Interaction. This section addresses students' opinions on the impacts of customer-robot interaction in service delivery in hospitality and tourism. Of all the three main results sections, this was the one where a negative sentiment was most visible (54.2%). About a third of the references were associated with a reticent sentiment (32.3%) and only 13.5% with a positive or conditionally positive sentiment. Comments with a negative sentiment mostly concerned the theme of lack of emotion and empathy in the customer-robot interaction, distantly followed by the theme of service quality, where comments with a negative sentiment mostly referred to possible service failures and lower customer satisfaction. As with negative sentiments, reticent sentiments were also most visible in the theme of lack of emotion and empathy in the customer-robot interaction. A positive sentiment was most visible in the theme of "novelty and experience". Themes were grouped into four sets to facilitate the interpretation of results. The themes related to this topic are represented in Figure 4.

4.3.1. Customer Experience. When asked about customer-robot interaction in hospitality and tourism, students commented extensively on robots' lack of emotions and empathy and consequences thereof for service delivery and the customer experience. Another important yet less pervasive theme was the novelty of customer-robot interaction and its impacts on the customer experience.

Concerning the theme of lack of emotion and empathy in customer-robot interaction, more than two-thirds of the comments in this theme expressed a negative sentiment, and practically all the remaining expressed reticence. Lack of emotion and empathy in customer-robot interaction is regarded as an aspect that will deeply hurt customer experience. Students mainly described customer-robot interaction as cold, mechanical, dehumanized, and undesirable, i.e., the opposite of hospitality ("lack of emotion, of humanity, of socialization. Interactions will be cold, mechanical, essentially functional, but not hospitable"). It is worth noting a few comments that referred to a possible future humanization of robots could possibly bridge the gap between customers and robots ("humanizing robots is the key to bridging the gaps in social interaction with customers").

Concerning the theme of "novelty and experience," about a fourth of the comments on this theme expressed a positive sentiment. According to these comments, the introduction of robots would attract curious customers due to their novelty, innovativeness, and uniqueness ("it will undoubtedly be a different and innovative experience"; "customers are curious about this innovation, so they will look for hotels and service robots to have an innovative experience"). This aspect could contribute to improve the customer experience ("I think customers would enjoy the interaction with robots […] it is a new experience, and they

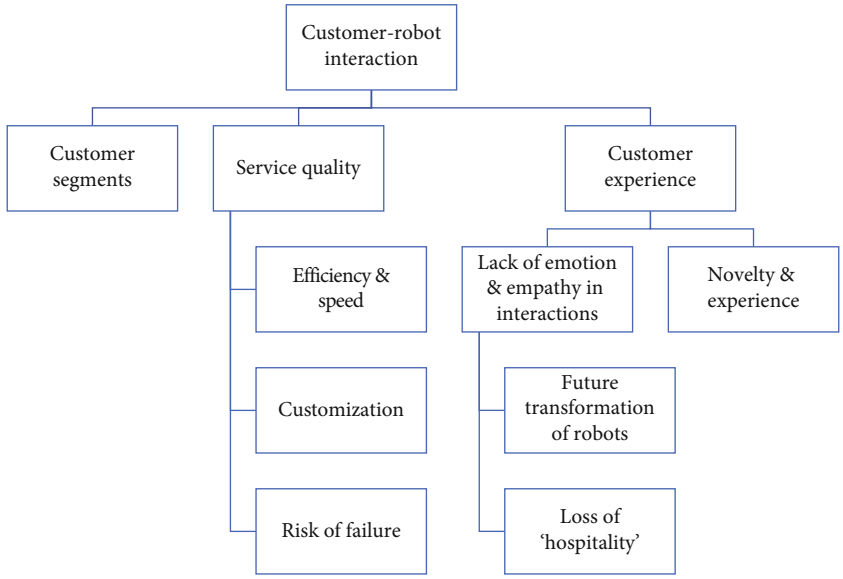

Figure 4: Themes on the topic *customer-robot interaction*. Source: elaborated by the authors.

would be amused, as it is not yet a very usual service these days"). However, more than half of the comments on this theme had a reticent sentiment. Most of those with a reticent or a negative sentiment believed that robots' novelty would wear out after some time ("I think it would be interesting at first because it would be new and technology is a fascinating world, but later on […] it would be boring to be only in contact with a machine"). Only a few mentioned the opposite trend: that, after an initial discomfort, customers would start to get used to robots and accept them ("it will create discomfort and raise doubts for many customers […] at least in the early days, until it becomes commonplace").

4.3.2. Service Quality. Service quality was one of the most important themes in terms of number of references. A half of the comments on this theme were negative. For those with a negative or reticent sentiment, there is an idea that robotization increases the probability of failure and thus leads to lower service quality, as a result of robots' limitations in terms of improvisation, communication, empathy, and inability to act beyond what they were programmed for ("[robots] are programmed to perform specific tasks and not to deal with the unexpected, which is part of everyday life in this industry"; "if someone's life is at risk and they try to explain it to a robot, it won't be able to evaluate the situation").

Some comments pertain to a positive impact of robots on service quality, for example, in terms of efficiency, speed, privacy, and ability to interact in a wider range of foreign languages ("the customer interacts with an innovative technological environment that brings security and privacy to the customer, such as room service and check in/out"; "availability of information and other services in a faster and more precise way").

Comments on the customization of service are mainly negative, since robots are not regarded as having the same abilities as humans to customize service ("the service won't be customized, it will be standardized"). Only in two comments was there a belief that robotization favors customization.

4.3.3. Customer Segments. This set of themes is related to how students believed that different segments of customers would have different levels of acceptance or even enjoyment of robotization. Hence, a reticent sentiment prevails here. The segments that are described as more welcoming of robotization are those of customers who value fast service instead of interaction and who enjoy technology, are younger, or are introverted:

> *There are people who just want to be served as quickly as possible and do not care if there is interaction or not with the employee.*

> *This will be a plus for introverted customers. I think that customers who are more into technology will love the idea.*

> *Younger customers are usually looking for whatever is most technologically advanced.*

In contrast, those who are older value customized service, and human contact might be less open to this new reality:

> *Something beneficial for customers who like technology, but for all the others who value social interaction more it will be detrimental.*

> *We still find older customers who do not have an easy time with robots, if robots have been inserted into a task such as check-in and check-out it may not be fully functional.*

5. Theoretical Implications

This study contributes to theory by analyzing how tourism and hospitality students envision the possibility of sharing their workplaces with robots in the future. Few studies have analyzed the perspectives of these tourism stakeholders on robotization [9, 10]. Hence, this study provides a relevant contribution to the field.

The CASA paradigm maintains the idea that people apply social rules and expectations to computers as if they were human, thus identifying their social potential [24]; however, the difficulties most identified in this study are related to the difficulty of maintaining hospitality and emotions as robots replace employees in the hotel industry.

This research has shown that fear of job loss coupled with suspicion of robots' ability to deliver quality services was the most important concern of tourism and hospitality students. These fears and doubts led many of them to reject robots, an attitude also identified in the previous studies [25]. Previous research has shown that social responses to the use of service robots are influenced by cultural differences between the western and eastern cultures, notably with more competitive and less cooperative responses from western participants [40]. This study shows that fear of losing job opportunities maintains this stigma of competitiveness among our study participants who fit culturally into a western cultural pattern implicit in theories of the human mind. These findings call for action to be taken with current tourism and hospitality students so that robots are not seen as a threat [19, 25]. In fact, automation has led to the creation of new and better jobs in the last years [32].

This research made visible a lack of trust in robots explained by students' perceptions concerning the limitations of robots in terms of improvisation, communication, empathy, and the inability to act beyond what they were programmed to do, demonstrating that these fears are common to those experienced by customers according to the previous studies [4, 5]. Participants also advocated that human interaction and thus the concept of "hospitality" should not be jeopardized, as in [9]. The value of human interactions should thus be carefully evaluated by the industry.

Although a negative sentiment prevailed among participants, it was not widespread. Many students had a positive attitude towards robots. The benefits of robots highlighted by students were in line with those found in previous studies with customers [5]. This study clarifies the importance of a gradual phase-in for this type of technology, promoting a balanced integration with the future generation of tourism and hospitality professionals, in line with previous literature that underlines the complementarity between robots and human labor [5, 11, 12, 15].

6. Practical Implications

The practical implications of this study concern several stakeholders. First, hotels and tourism businesses should carefully evaluate the introduction of robotization in a phased approach, prioritizing the replacement of tasks recognized by the actors as more advantageous.

Therefore, considering that the lack of emotions of robots was one of the main concerns revealed by future hospitality and tourism professionals, the designers of robots for the tourism industry should increasingly focus on the development of social robots, i.e., robots that are able to engage on a social level and interact with humans in a socially acceptable way.

This study made visible the need for higher education schools in the field of hospitality and tourism to adapt to a scenario that will certainly include, in the future, partially or fully robotized environments. This adjustment should occur in the curricular structure of courses, starting to include a familiarization with new technologies, but also in the development of skills and knowledge to complement any kind of robotization in the tourism industry. A culture of acceptance of robotized environments should be promoted in the curricula of tourism and hospitality courses, emphasizing the tasks that can be facilitated by technologies, so that future professionals face the future with confidence.

While the investment in technology may be high, the tourism and hospitality industry will quickly recognize the return on that investment. Businesses should promote complementarity between robotic functions and human staff so that this change does not occur in a disruptive manner. Better working conditions, better remuneration, and the recognition of staff's qualifications will be key to promoting a peaceful transition between the today's environments and the robotic environments, in a win-win model. These types of work-related issues have been addressed in the literature as fundamental in this sector [41–43].

7. Conclusions

Research that analyzes the opinion of future hoteliers towards the full or partial implementation of artificial intelligence in the hotel industry is recent but shows how important it is to anticipate this scenario [9]. The sample is essentially composed by millennials who are more inclined to accept and engage with technologies [44]. This research reveals the challenges that the hospitality industry will face, in the near future: future hoteliers recognize the benefits that the adoption of robots can bring, but their perspective on their use is still reticent.

Numerous factors can influence the willingness to implement service robots in the hospitality and tourism sectors [9]. It is important to build a confidence foundation in robots from facts, since the general attitude toward robots is influenced by fictional information from media exposure [45].

Another finding was that the benefits of robots should be maximized, and this is a favorable point identified by the participants of this study. Therefore, it is essential to change the role of artificial intelligence by eliminating barriers between humans and robots, using more scientific collaboration and investing in interdisciplinary and transdisciplinary research [46].

Our findings suggest that students expressed a negative view of the presence of robots in hospitality, mostly associated with a fear of job loss. Many also reported that interacting with robots is negative for both staff and customers due to robots' lack of emotions. However, there is some division concerning the impact of robots on service quality: some believe that the service will be more efficient and with fewer failures, and others believe that the limitations of robots will lead to worse service. The findings suggest that the acceptability and desirability of robotization may vary depending on the level of robotization in hotels, on the type of customer, and on the level of service provided.

8. Limitations and Future Works

The main limitation of this study concerns the use of a non-probability sampling method. This limits the generalization of our findings to a broader population, in particular, to individuals who are not tourism and hospitality students in Portugal. Nonetheless, our findings may provide useful insights for researchers analyzing sectors severely impacted by the COVID-19 pandemic and/or sectors where the usage of robots scaled up during the pandemic. Future studies could address similar issues in other fields, such as a healthcare, among other service industries. The evolution of the sentiments towards robots should also be monitored longitudinally as the pandemic fades. It remains to be seen whether negative sentiment will decrease or increase. The impact of robots on service quality, including on efficiency and failure rates, is another relevant topic. Finally, our findings reveal the importance of studying how the acceptance and desirability of robotization may vary within the same industry, depending on the type of customer and the level of service provided.

Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.

Conflicts of Interest

The authors declare that there is no conflict of interest regarding the publication of this paper.

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