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# An analysis of the literature about the application of Artificial Intelligence to the Recruitment and Personnel Selection

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*ABSTRACT*. L'intelligenza artificiale (IA) applicata ai processi di ricerca e selezione del personale (R&S) è la nuova frontiera della gestione delle Risorse Umane, che ha permesso da un lato di velocizzare alcune attività più meccaniche e dall'altro di introdurre modalità innovative come l'analisi di grandi quantità di dati e delle caratteristiche para-verbali dei candidati. Il contributo presenta una rassegna della letteratura sull'introduzione della IA nei processi R&S, considerando aspetti etici e pragmatici, potenzialità e limiti, oltre che la percezione dei candidati e gli impatti sull'immagine aziendale.

*SUMMARY. Artificial intelligence, aiming to develop machines solving cognitive problems and thinking like humans, has become one of the most promising solutions to improve certain HR functions. Currently, it primarily affects Recruitment and Personnel Selection. Despite the wide interest of researchers and organizations in recent years there are still many questions to be analysed. The literature review provides an overview of the changes related to the use of AI in these HR processes, analyzing scholarly research on Human - AI tools Interaction, considering AI's pragmatic and ethical aspects as well as the wider HRM processes. We focus on sustainability for people and organizations. Results regard issues of potential AI activities in Recruitment and Selection, AI tools users' perception and acceptance, and ethical concerns*

**Keywords:** *Artificial intelligence, Human resource management, Personnel selection, Review*

## INTRODUCTION

The Fourth Industrial Revolution, or Industry 4.0, is altering the dynamics of jobs, workers, and organizations.

To remain competitive in this revolution, companies search for highly qualified and specialized employees. Consequently, their ability to attract new talents is a major function to take the possible advantages and opportunities from these changes (Ghislieri, Molino & Cortese, 2018). For this purpose, they are investing in new technologies to optimize and increase recruitment and personnel selection effectiveness and efficiency.

The organizational practice of recruiting and selection (R&S) is usually divided into the following phases: job analysis, candidate profile definition, date scheduling, interview, psychological test, individual or group trials, delineation of a shortlist of candidates, interview, signature of the contract and insertion in the work environment (Chamorro-Premuzic & Furnham, 2010; Cortese & Del Carlo, 2017).

In the last decade Artificial Intelligence, as a broad discipline that studies and realizes systems that simulate human behaviour and thinking (Russel & Norvig, 2012), has become one of the most promising solutions to improve R&S processes.

AI-enabled tools, due to the latest technological advances can perform tasks beyond human capability (Lucci & Kopec, 2016). In the R&S, these include Big Data Analytics, Intelligent Robots, Face Recognition, Voice Interaction (Jia, Guo, Li & Chen, 2018). Nowadays AI systems can attend, even if partially, to tasks that previously were considered only done by humans (Jarrahi, 2018). Activities such as data extraction from curricula, analysis of the professional profile, candidate engagement, job interview, contract proposal are theoretically to be performed by AI algorithms. Through these tools, some researchers have even supposed that it will be possible to automate the entire process and replace humans in decision- making.

High-performance computing is the ability to process data and perform complex calculations at high speeds. It allows AI tools to optimize the R&S process in time, cost saving, and quality (Geetha & Bhanu Sree Reddy, 2018).

Current investigations are often difficult to compare and put questions about reliability, validity, ethical concerns, personal data treatment (van den Broek, Sergeeva, & Huysman, 2020), in user's perception (van Esch & Black, 2019).

In this scenario, Psychological Sciences should define, in collaboration with other disciplines, the theoretical and methodological aspects related to the application of Artificial Intelligence in Human Resource Management. It can highlight opportunities and advantages, as well as risks and limits.

## AIM

The literature provided a basic understanding of the changes related to the use of AI in the R&S processes but more generally in Human Resource Management (HRM). To survive this purpose a sustainability perspective focused on people and organization well-being was adopted. Publications in the field of the interaction between human and AI tools were considered with a focus on the practical and ethical aspects but not on technical ones.

## METHOD

The present study is completely based on literature reviews. The library database used was Scopus (https://www.scopus.com/home.uri). The main keywords used to the research include Recruitment, Personnel Selection, Human Resources and Artificial Intelligence. The time period of the selected articles was from 2010 because the articles prior to this timeline were considered not representative of the current technological scenario. The total number of articles included in this literature was 262. The query is dated September 2020.

To identify and access the relevant publication, information related to the title and the abstract were analysed and papers not related to the objective were excluded. Furthermore, articles from ICT and Engineering fields, or in any case purely technical nature, were eliminated. The result is 19 papers overall.

Date of publication is from 2017 and the most recent is from 2020. In detail of the reviewing papers involved in the study are 2017 (2 papers), 2018 (2 papers), 2019 (13 papers) and 2020 (2 papers).

The selected journals come from India, China, Europe, Bahrain, New Zealand, USA and Russia. The publications, where indicated, were from the field of HR services and IT companies.

# RESULTS

The research about the application of AI and selection processes within organizations involves a large number of disciplines with different theoretical and methodological perspectives. The result is the overlapping of different theories and hypotheses that are difficult to compare themselves. To provide an overview from a psychological view, the results are discussed on these issues: i) potential AI activities in the Recruitment and Selection phases; ii) AI tools users' perception and acceptance; iii) ethical concerns.

## Potential AI activities in the Recruitment and Selection phases

Van Esch and Black (2019) asserted "three related drivers have moved AI-enabled recruiting from a peripheral curiosity to a critical capability" (p. 730). First, the increase of the applicants' time spent in digital spaces implies that companies have to recruit new talents in digital space with digital technologies and tools. Therefore, the number of applicants per position from 100 per job in 2013 to 250 in 2018 forced companies to adopt AI-enabled tools to screen ever-growing numbers of job applicants. Finally, AI-enabled tools have improved to the point where their superiority to humans in terms of both efficiency and effectiveness, especially in the early stages, of recruiting is beyond debate.

AI technologies can provide a large contribution to deal with different activities of the R&S: collect and order data to specific criteria, update, and maintain information on the database, interact with applicants simulating the human behaviours. The greatest advantage of their use is the time and cost-saving that contribute to improving the efficiency and effectiveness of the entire process. The high-performance computing of the AI-enabled tools allows them to reduce human efforts in some decision-making (Nawaz, 2019a, 2019b). They can analyse information about the experience and applicants' skills to select the right candidate for the commitment (Chakraborty, Giri, Aich & Biswas, 2020).

Natural Language Processing (NLP) techniques and computer vision can be used to evaluate candidates' glossary, tone of voice, way of speaking, and body language to analyse their integrity and personality traits (Gupta, Fernandes & Jain, 2018; van Esch & Black, 2019). It is also possible to automate the data collection, grow the number of applicants per position thanks to an easier and more appealing process; screen the candidates; answer most common issues and questions; provide feedback; schedule the interviews (Nawaz & Gomes, 2019).

Recruiters agree to consider the application of AI especially to the early stages of R&S process to analyse information and schedule calendars. The controversial issue of the AI role in HRM is still open for the stages where human-machine interaction is needed (Nawaz, 2019a, 2019b). Despite the ability of AI-enabled tools to make decisions, currently most of the applications involve a human verification of the output (Jia et al., 2018).

## Users' perception and acceptance of AI-enabled tools

HR staff and candidates have a central role to drive the HR transformation process. Evaluating their perception and acceptance is a way to postulate what will be the impact of these transformations.

Deloitte (2018) highlighted that even if 72% of the managers agree to apply innovation tools, only 31% assert their companies are able to achieve potential benefits (Deloitte Insights, 2018). A LinkedIn research in 2019 shows that HR profession is one the five professions with the highest turn-over (Rąb-Kettler & Lehnervp, 2019). The reason may be that HR activities (e.g. screening hundreds of curricula, schedule and conduct interviews) are often repetitive, with high effort and few occasions of recognition and gratification. AI-enabled recruiting allows HR to focus on the monitoring and decision-making aspects, reducing their cognitive stress and boredom. As a result, it can reduce the level of turnover within the HR area (Bhardwaj, Singh & Kumar, 2020). Other studies instead alert of the possible negative effects for recruiters, who may feel easily replaced by current technologies (Simonova, Lyachenkov & Kravchenko, 2020). Anyway, to take advantage from the AI application it is necessary for the HR to know the tools. Tambe, Cappelli and Yakubovich (2019) highlighted that the 41% of the CEOs are not confident about their ability to use new tools and analyse data. Only the 4% said to be highly prepared.

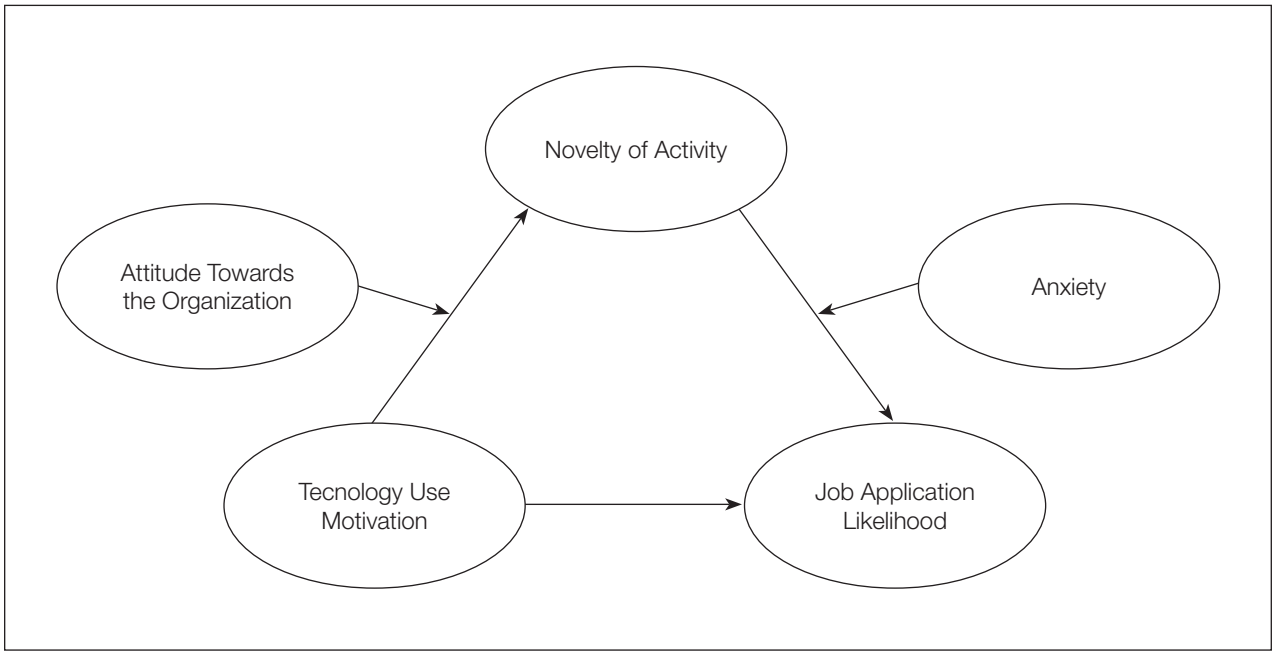
Van Esch and Black (2019) evaluated which factors influence new-generation candidates (i.e. social media users job seekers from 18 to 35 years old) to engage with and completely digital, AI-enabled recruiting. The 293 participants

were enlisted through a crowdsourcing platform; they were invited to read a job application scenario and to answer some questions. Authors found a positive relationship between the use of social media, intrinsic rewards, fair treatment, and perceived trendiness on the intention to engage with a completely digital, AI-enabled recruiting process.

Van Esch, Black and Ferolie (2019) created a theoretical framework to explain the job applicant likelihood in an AI-enabled process. The factors involved in the relationship between technology use motivation and job applicant likelihood, in order of relevance, were the novelty of the activity, attitude towards the organization, and anxiety (see Figure 1).

Specifically, there is a positive effect on the relationship between technology use, motivation, and job application likelihood ($\beta$ = .38, $p$<.01). The novelty factor of using AI in the recruitment process mediates and further positively influences job application likelihood ($p$<.01, 95% CI = .13-.33). Novelty of activity is another measure of intrinsic motivation and like technology use, motivation is a measure of anticipated intrinsic benefits of using AI in the recruitment process. The investigation of conditional indirect effects further supports attitude towards the organization as a moderator and anxiety as a moderator of job application probability. Attitudes towards organizations that use AI and anxiety significantly influence the plausibility that potential

**Figure 1** – Conceptual framework (van Esch et al., 2019)



candidates will complete the application process. Anyway, job applicant anxiety towards the use of AI recruitment is secondary to an applicants' attitude towards the hiring organization. Attitude towards the organization significantly predicted novelty of activity ($\beta = .22$, $t_{(528)} = 5.53$, $p = .01$), as did technology use motivation ($\beta = .50$, $t_{(528)} = 16.55$, $p = .01$). Anxiety significantly predicted job application likelihood ($\beta = -.16$, $t_{(528)} = -5.07$, $p = .01$), as did novelty of activity ($\beta = .80$, $t_{(528)} = 16.30$, $p = .01$).

Furthermore, as additional benefits, AI recruiting technologies allow candidates to set any time anywhere for the interview. That increases the potential positive effect on the candidate experience. An additional incentive would be represented by the perception of candidates to adhere to a fast selection process, with fewer biases (van Esch et al., 2019).

A better candidate experience during the application process would allow to further increase the talent pool of an organization.

Job Vite report (2017) shows that only the 8.52% of job applicants, when they visit a job posting site, completes all the steps necessary to conclude the application process and most of them, if they do not receive a feedback following application, will not apply for other positions in the same company.

## Ethical concerns

The R&S transformation implies new constraints about personal data's protection and treatment. Especially, it emphasizes different ethical concerns for the HR area.

The General Data Protection Regulation 2016/679 (GDPR) is a regulation in EU law on data protection and privacy. While it provides general guidelines, recent updates have introduced applicable regulations on how data is processed using digital tools.

Articles 9 and 22 are often involved in the application of the AI in the R&S processes. The article 9 concerns the processing of special categories of personal data. It prohibits the processing of personal data revealing racial or ethnic origin, political opinions, religious or philosophical beliefs, trade union membership, and the processing of genetic data, biometric data for the purpose of uniquely identifying a natural person, data concerning health or data concerning a natural person's sex life or sexual orientation.

If, during the recruitment process, organizations gather that kind of additional characteristics, they could use that information to further categorize candidates and to discriminate, where possible, in terms of job selection. This raises several ethical and privacy concerns, not to mention the determination of both an organization and the values of candidates (van Esch et al., 2019).

Artificial Intelligence has been shown to not only be able to detect a person's data as gender and ethnicity but also more personal data: Wang and Kosinski (2017) showed that deep neural networks can detect sexual orientation from faces. In particular, given a single facial image, a classifier could correctly distinguish between gay and heterosexual men in 81% of cases, and in 71% of cases for women. Human judges achieved much lower accuracy: 61% for men and 54% for women. The accuracy of the algorithm increased to 91% and 83%, respectively, given five facial images per person. Facial features employed by the classifier included both fixed (e.g., nose shape) and transient facial features (e.g., grooming style).

The main purpose of the aforementioned article was not to stereotype people with different sexual orientation but to highlight the link between facial features and psychological traits and the ability of the AI tools to detect them. As a consequence, it signals the need for guidelines for the AI tools in the human-computer interaction, especially when applied in any type of selection process.

The article 22 establishes automated individual decision-making, including profiling. It forbids the use of data subject to be subject to a decision based solely on automated processing, including profiling, without human intervention.

In any case, paragraph 1 does not apply if the decision is necessary for the conclusion or execution of a contract between the data subject and data controller or is based on the explicit consent of the data subject. Such consensus during a selection process, however, could be questioned. Furthermore, the digital environment is very difficult for the police to control. Data can be easily moved across borders, stolen, or recorded without users' consent (Wang & Kosinski, 2017). In conclusion, even in the presence of articles on the GDPR that protect the improper use of personal data, there remains the need to rethink this regulation on the basis of these new technologies.

Another controversial topic concerns the biases of AI tools. If machines think and act like humans, probably they have the same cognitive prejudices (Osoba & Welser, 2017). Biased decision-making is certainly not unique to AI, but

the growing reach of AI makes addressing it particularly important.

Those who object to the decision of Artificial Intelligence systems often argue that humans have consciousness and are potentially able to avoid being swayed by bias during the research and development process. The opacity and lack of transparency of the operating mechanisms of Artificial Intelligence systems make these tools perceived unreliable and dangerous. On the other hand, it is also true that this distinction is only valid when human beings are aware of their prejudices and this does not happen very often. A common bias in the selection process is the halo effect: a cognitive bias in which a single positive trait or characteristic of someone influences judgment on other factors that are not correlated. It can be based on characteristics such as appearance, communication skills and usually occurs on an unconscious level.

In the hiring process there are some procedures to avoid this type of bias such as blind recruitment, a process of removing all identifying details from the candidate's resume and application.

In this direction, Zou and Schiebinger (2018) in the article "AI can be sexist and racist: it's time to make it fair" have mapped several possible strategies to provide systematic solutions to the omnipresent nature of the problem. For example, they suggested developing algorithms to avoid the use of biased data, tagging the content of training datasets with standardized metadata, and accompanying the training data with information about how it was collected and annotated, incorporating constraints and essentially pushing the machine learning model to ensure it achieves fair performance between different subpopulations and between similar individuals, by modifying the learning algorithm to reduce its dependence on sensitive attributes, such as ethnicity, gender, and income.

However, the authors have concluded with some questions: "Should the data be representative of the world as it is, or of a world that many would aspire to? Likewise, should an AI tool use to assess potential candidates for a job, evaluate talent or the probability that the person will assimilate well into the work environment? Who should decide which notions of fairness to prioritize?" (Zou & Schiebinger, 2018, p. 326).

The concept of ethics can be associated with an approach aimed at avoiding discrimination and prejudice, increasing sustainability etc. However, analysing this concept, it emerges that it may not be so uniform and may have different facets depending on the point of view. Van den Broek and colleagues (2020) studied ethical issues within a multinational company after the implementation of AI tools in research and development processes. They found out the use of AI did not always improve or worsen the ethical values of hiring but rather they observed a several of mismatches between the notions of fairness.

In particular, prior to the AI application, the HR team considered it correct to set a cut-off threshold for the evaluation of candidates: "We need a very structured process, because we are dealing with so many candidates. And everyone is assessed in the same way. We need to be objective - Field notes weekly HR team meeting" (van den Broek et al., 2020, p. 6).

However, during their day-to-day work with the AI, the HR professionals experienced that the fixed threshold did not allow for differentiation between situated contexts of the programs, locations and temporary changes in supply, and demand.

Furthermore, candidates contested the notions of fairness. The HR team was confronted with several candidates who expressed during recruiting events, selection events, or via email that they did not feel they had a fair chance to prove their worth. In contrast, the HR team was also confronted with candidates who aimed to gain an unfair advantage over other candidates in the selection process by "gaming the system". HR professionals found out that several candidates bypassed the system by creating a new account with a different email address, in the hope to improve their AI scores. For example, a candidate expressed about a specific game in which he/she had to memorize changing figures: "You could actually cheat on those games. If you would do the game with two people, hold your phone in your hand, and both make a picture [of the figure you have to memorize], I am sure you would pass the game - Candidate 1" (p. 7).

Finally, the managers of the other areas also experienced feelings of frustration following the application of AI when it did not allow the hiring of their favourite candidates. Some managers have also reported that in their opinion the application of AI would result in a lower rate of diversity within the organization, as the algorithms would tend to search for attributes similar to those indicated as ideals in the candidates: "We will have less diversity because we will hire more of the same profile, right? - Field notes group panel" (p. 7).

## DISCUSSION

Although the hypothesis relating to a possible replacement of man in the process of research and selection through AI tools appears to be suggestive, it is not supported by data in the literature.

Forecasts converge considering these tools, in the short term, valid support in the analytical phases of the selection process, e.g. publication of job advertisements, extraction, and categorization of data from curricula. So currently there is an agreement in considering the potential offered by AI tools to support and not replace human work.

The users' perception and acceptance have been investigated by a small number of studies and consequently, it is not possible to formulate hypotheses on the factors involved.

Rynes, Colbert and Brown (2002) showed how often the practices of professionals differ from the suggestions of researchers, especially with regard to the area of personnel selection. Specifically, HR professionals were quite sceptical about the use of intelligence or personality tests to evaluate employee performance even though these tools were widely supported by data in the literature.

Factors that influenced professionals' beliefs about research results were the seniority within organizations, the SPHR certification (Senior Professional in Human Resources), and the general knowledge of the academic literature. Probably, the acceptance of AI tools by HR professionals may depend on the same factors.

The positive perception of candidates that emerged from the results of van Esch and colleagues (2019) is in line with what emerged from the study by Sylva and Mol (2009) that suggested that candidates appear more satisfied with technologically advanced recruitment.

However, if the adoption of advanced technologies such as AI would end war for talent, van den Broek and colleagues (2020) highlighted the risk of gaming the systems, where candidates circumvent artificial scoring systems for their advantage. In this scenario, the HR would find themselves engaged in an attempt to detect these using time and energy and thus the advantage of adopting innovative tools.

Analysing the processing of personal data and the studies that have investigated ethical concerns, it emerges that with the practical adoption of artificial systems is necessary to create guidelines in order to understand the specificities related to AI tools and the risks associated with them.

The use of AI in recruitment and selection processes can bring a quantitative added value in an initial phase, e.g. simplifying and speeding up activities such as screening of CVs and analyzing job seekers' social interactions. However, the use of these tools, to date, cannot replace the qualitative value that a human relationship can allow, in particular the knowledge job seekers can find in a two-way contact, a human-level exchange, asking the recruiter (during the interview) for some information regarding organizational culture, values and climate. These dynamics are also important from an Employer Branding perspective (Ambler & Barrow, 1996), as the recruiter, managing the exchange with the candidate, is able to communicate the company image, focusing on the most important value propositions (Backhaus & Tikoo, 2004).

## CONCLUSIONS

AI takes and will play an increasingly central role within organizations to cope with the changes imposed by digitalization to attract talent, reduce time and costs, and improve the matching between supply and demand.

Recent evidence shows that the hypotheses of a total human replacement are currently unfounded. HR should not be afraid of the automation of R&S. On the contrary, they should exploit the potential of the AI tools to encourage the development and growth of internal resources within the organization.

The use of AI for recruiters could make the job more meaningful and focused on the candidate and allows them to use their psychological and managerial knowledge. Human intuitive, understanding, and adaptation abilities are skills that not even the most sophisticated robot can simulate.

But, the lack of data regarding the feeling of perception and acceptance does not allow us to fully understand the point of view of the users involved in this transformation. A hypothetical aversion towards AI tools, that we cannot exclude *a priori*, could cause a failure to exploit the potential of the tools currently on the market. Indeed, the fact that these tools are objectively effective in terms of reliability and validity does not imply that they are perceived or experienced as such.

In order to avoid risks, a crucial aspect is the training and sharing of information material within the human resources

departments. If HR professionals will not be trained to grasp the potential offered by technological advancements, the management of processes that are currently overseeing the HR area will be supervised by other company areas (for example, ICT area).

The positive perception of candidates toward AI tools, emerged in the study by van Esch and colleagues (2019), would translate the application of innovative tools into an opportunity for companies to create value both within, from an employer branding perspective, and outside the organization, increasing the pool of talents.

However, there is a need for digital ethics and data management that can be processed automatically. Data masking is a partial solution and not always applicable. While some data represent a potential source of bias, they could be necessary also for an in-depth evaluation and for the establishment of decision-making strategies such as cognitive heuristics, shortcuts extrapolated from reality, which guarantee faster decision making and for this reason, sometimes, even more effective.

We believe it is essential that AI developers interact with social scientists and experts in the humanities to gain the completeness of the dynamics they will have to face for the elaboration, and development of valid, reliable and above all ethical software.

From this perspective, Psychological Sciences can and should follow technological progress hand in hand to understand how to support this transformation without risking forgetting the value of individual and organizational psychological well-being.

Among the limitations present in the literature to date, we can mention the small number of studies examining the effectiveness of AI in R&S processes performed with tools with robust statistical properties according to Psychological Sciences. Although there are early attempts at a more psychological approach to the study of AI, such as, for example, the acceptance of an entirely AI-managed R&S process (Wright & Atkinson, 2019), these studies lack in presenting more robust tools about, for example, their reliability.

Future studies could continue to investigate in parallel both the effectiveness of AI from an instrumental point of view (simplifying processes perceived as more mechanical) and from a psychological one (such as greater engagement of the job seeker). Taking into consideration the use of AI with respect to human capital, studies on the acceptance by job seekers, on the one hand, and on the respect of ethical principles, on the other, show how it is complicated, as well as expensive, to date, to create an AI capable to take into account all these dynamics. On the contrary, psychological literature shows that an expert (human) recruiter is able to understand and to manage these interactional aspects, thus becoming the vehicle spreading a positive employer image (Cortese & Del Carlo, 2017).

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