AI-Powered Chatbots and the Transformation of Work: Findings from a Case Study in Software Development and Software Engineering

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Abstract. The recent technological enhancements in the field of large language models and their integration into collaborative processes, for example, as chatbots, are perceived as key drivers for further transformations of work. However, the transformative effects of these technological enhancements have to be more thoroughly investigated in specific work contexts to benefit from the great potential of improvement. This research article provides findings of a case study research on how employees in software engineering perceive the collaboration with AI-powered chatbots, such as chatGPT. We investigate patterns employees develop to cope with the novel demands arising during the collaboration with these technologies and discuss our empirical findings regarding a conceptual framework of AI-related competences and another case study from a different industry. The findings contribute to a better understanding of human actors' AI-related coping patterns as key prerequisites for a more responsible and sustainable usage of this technology in professional work contexts.

Keywords: Transformation · Collaborative work · AI-powered chatbots · Artificial Intelligence (AI) · Human-AI System · Human Factor · Software development

1 Introduction

The recent enhancements in the field of AI-powered chatbots based on natural language processing [1], such as ChatGPT, Perplexity AI, Jasper Chat and Google Bard, are supposed to transform the way in which humans work in collaborative processes in and across organizations [2]. The latest technological developments have already shown that further convergence of these kinds of AI-based technologies will, in the very near future, equip numerous tools that are already in use with even more enhanced capabilities of understanding and responding to human actors' comparably complex communication

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and information processes. However, while there is a lot of controversial discussion about the transformation of work in general and collaborative work between heterogeneous actors and AI- based agents in particular, there is still little precise knowledge about the context-specific transformations that are already going on in practice.

In this article, we seek to contribute to the development of more specific knowledge about the transformative forces of AI-powered chatbots in collaborative work environments. More precisely, we focus on the human actor's perceived (new) role and aim to understand better how humans' day-to-day job tasks are changing due to the introduction and increasing usage of and collaboration with such tools. Therefore, we investigated the specific coping patterns humans perceived as increasingly relevant and novel when working and collaborating with ChatGPT and GitHub Copilot.

We conducted 14 interviews among software developers and team leaders within the software development department of a large insurance company in Germany in early 2023 where the AI-powered chatbots ChatGPT and GitHub Copilot are increasingly used during programming and other software engineering tasks. After transcribing the interviews, we performed a qualitative content analysis to investigate coping patterns the interviewees reported as novel or increasingly important during working and collaborating with the tools mentioned above. We identified a framework of 14 coping patterns that are either cognitive, emotional or social in nature. They range from developing an understanding about how AI works generally through considering the AI agent as a sort of enabler or even a colleague, to engaging oneself in a constant discourse with and, therefore, being able to express oneself comprehensibly towards the AI-powered chatbot. With these findings, we aim to contribute to a better understanding about how humans collaborate with such modern AI-based agents and which coping patterns seem to be rather critical for sustainable and responsible implementation of these new technologies in modern work.

2 Background and Related Work

The application potential of AI-powered chatbots in software development has gained increasing attention in research and practice [3–5]. A chatbot is a computer program designed to simulate conversation [6]. AI-powered chatbots, such as chatGPT or Copilot, are based on AI and are, therefore, seen to be more eloquent and humanlike than their predecessors [2]. GitHub Copilot is a chatbot destined for software developers since it suggests code or entire functions in real-time during programming tasks [7]. It is, therefore, also seen as an AI pair programmer [8]. It has already been shown that AI-powered chatbots can improve the processes of finding and fixing bugs in increasingly extensive programming code and, as a result, can assist human actors in tasks that have great potential for automatization and standardization [5]. Nevertheless, research also shows that it is important to maintain the awareness that, for example, ChatGPT can be a very helpful tool, but so far has to be applied with caution because it is (still) not capable of providing perfect solutions in the field of solving programming bugs [1]. So far, it might, instead, be seen as a helpful counterpart for humans that possesses capabilities in the field of knowledge representation and natural language generation. These capabilities have the potential to complement the capabilities of already existing

and established tools and the competences of human actors in order to enhance and improve the output of the human-AI system as a whole [9]. However, we argue that this development leads to new dynamics in the interaction between humans and AI, which have to be understood better in order to contribute to the sustainability of the recent transformational advancements, implement these new tools more responsibly and consider a more human-oriented perspective in the implementation and management of AI at work.

It has been shown in a recent study that is focused on programming tasks that ChatGPT solved more than 75% of basic to moderate level programming tasks during the first attempt and, after some natural language feedback, the tool was able to solve more than 97% of the tasks. These results show that in the specific context of life sciences research, a field where the programming of code and software development has, in some cases, been an effortful and time-consuming task, the major part of this task can be taken over by AI language models [4].

This potential of ChatGPT in programming and software development as a more extensively contributing tool has also been shown by other research, where a variety of different tasks and their completion by ChatGPT have been investigated. The researchers conclude that, in addition to finding and fixing bugs in programming code, this tool is also capable of providing the human actor with assistance in "code completion, correction, prediction, error fixing, optimization, document generation, chatbot development, text-to-code generation, and technical query answering" [5].

ChatGPT shows supporting and often leading capabilities of a software architect's role in the area of software architecting. The job tasks of the human actor regarding oversight and decision support for collaborative architecting between the human and the AI are gaining higher importance in that specific case. However, the authors outline that further socio-technical aspects should be investigated on a broader empirical base in this field of application [3] and in software development in general.

In our research paper, we seek to contribute to the further understanding about such socio-technical aspects that are related to human-AI collaboration and provide more knowledge about human actors' coping patterns in collaborative software development where humans are increasingly interacting with AI. First conceptualization and frameworks about the specific dimensions of human actors' job demands and related coping patterns that are gaining more importance in the interaction with AI-based agents at work have already been introduced in recent research. Süße et al. introduced a conceptualization of coping patterns that distinguishes humans' complementary behavior during the interaction with an AI-based agent into the three dimensions of cognitive, social and emotional coping patterns [10]. Additionally, a first empirical exploration of this conceptualization was conducted at a plant of a remanufacturing department of a German automotive supplier, where workers on the shop floor are performing a visual recognition task collaboratively with an AI-based industrial machine [11].

The cognitive dimension refers to patterns that indicate that the person, for example, aims to understand casual relationships, recognize repetitions or deal critically with external input [12]. It refers more specifically to the coping patterns of human actors that represent efforts of creating and sustaining a general and context-specific understanding of how an AI works as well as about the AI in its role as co-worker, critical evaluation

of the AI's contributions, and grasp the way in which the AI agent learns and improves over time.

The emotional dimension refers to coping patterns that are crucial to lead and manage oneself as an individual person. It includes, for example, self-awareness and self-management that are necessary to be able to understand one's own feelings in a given situation and use this knowledge to guide decision-making processes and have a realistic assessment of one's own skills [13]. In terms of collaboration with AI agents, these are patterns that are concerned with the openness for change and innovation, the readiness to work with unfamiliar technologies and the bringing in one's own initiative for self-improvement and the improvement of the actual collaboration processes with the AI.

The social dimension reflects the ability to understand counterparts in collaborative processes and to manage and build relationships with them [13]. Counterparts could be human actors and AI-based agents. This includes, for example, interpreting the signals of counterparts carefully and seeking to understand the point of view of others. This point of view presupposes that the AI agent with which the humans in question are interacting is being anthropomorphized, seen as some kind of partner or, more often, as a colleague [14–17]. The respective coping patterns refer mainly to some sort of sensitivity or intuition for the particular peculiarities in the collaboration or communication with AI agents.

The findings that are derived conceptually and from a study with a rather less interactive AI-based agent that has the appearance of an industrial machine need to be further extended and generalized by other application areas. This is where the following study comes in. The objective is to consolidate the findings identified so far and supplement them with further insights from the field of collaborative software development where AI-powered chatbots, such as ChatGPT and GitHub Copilot, are gaining increasing awareness and already unfolding their potential.

3 Methods

3.1 Case Company

We conducted a case study within the IT department of an international insurance company headquartered in Germany. The company has around 4,700 employees worldwide, of which approximately 2,200 are employed in Germany. Around 200 of the employees work in the German IT department of the insurance company. The IT department includes, *inter alia*, software application development and the operation of internally developed and purchased software. Application development started working with agile methods in 2019 and now consists of product teams, with each team having a product owner. The teams develop and maintain information systems along the value chain of an insurance company, from product development to collections/disbursements. The teams are assigned to so-called tribes (e.g. Sales Tribe, Operations Tribe). Each tribe has a tribe leader. In the first quarter of 2023, it was decided to provide application developers with GitHub Copilot. GitHub Copilot is an AI-based pair programmer. It draws context from comments and code to suggest individual lines and whole functions instantly. It is powered by Open AI Codex, a generative pretrained language model created by Open

AI. It is available as an extension for Visual Studio Code, Visual Studio, Neovim and the JetBrains suite of integrated development environments. Additionally, the software developers are working with ChatGPT, a tool also created by Open AI. The use of both tools is voluntary. The group of 14 people interviewed is presented below (see Table 1) in terms of their age, job roles, professional experience and personnel responsibility. Seven of the respondents were younger than or equal to 50 years old. The age of the other seven was over 50 years. Six of the interviewees are employed as software developers, three as architects, two have the role of product owners and three are managers. Most of the respondents had between 20 and 30 years of professional experience (six). Only one interviewee had more than 30 years of work experience. Three have between 10 and 20 years of work experience, seven between 5 and 10 years, and 22 % less than five years. Almost one-third of the respondents had leadership responsibility. They had the role of team or tribe leader. One of the product owners had leadership responsibility for a team and, thus, also the role of team leader.

Table 1. Descriptive data of interviewees (in absolute numbers)

age				
20–30 years	30–40 years	40–50 years	> 50 years	
3	3	1	7	
job roles				
product owner	manager	architect	developer	
2	3	3	6	
work experience				
< 5 years	5–10 years	10–20 years	20–30 years	> 30 years
3	1	3	6	1
personnel / leadership responsibility				
yes		no		
4		10		

3.2 Data Collection and Analysis

We gathered empirical data by conducting semi-structured interviews with the employees described in Sect. 3.1. Accordingly, we developed an interview guideline based on a preliminary AI competencies framework deduced from the state-of-the art research on challenges and opportunities in human-AI collaboration [10] and humans' behavioral patterns deduced from the interaction with AI agents in the field of human-AI shared decision-making [11]. The interview guideline contained questions that focused on the participants' individual perceptions and experiences of the collaboration with AI-powered chatbots. A few sample questions are:

- "Please describe the way you are working with or using AI agents in your everyday work?"
- "What are particular challenges you experience when working with the AI agent?"
- "What do you like or dislike when working with the AI agent?"

- "What changes have you experienced since the AI agent was introduced? What have you learned since then?"

The interviews took place in spring 2023. Each of the interviews lasted from about 30 to 45 minutes and was audio-recorded. After conducting the interviews, we transcribed the audio-files and subsequently performed a qualitative content analysis [18]. We applied the software MAXQDA Version 2020 for data analysis. We employed an iterative process during our analysis. Firstly, we analyzed and coded the data independently from each other. After that, we discussed our interpretations, looked for relationships and patterns, and constructed categories and grouped codes. In this process, we applied a mix of deductive and inductive coding [19] by assigning the codes to concepts, which were based on either our theoretical framework or insights which had emerged during data collection and analysis. Additionally, feedback loops took place with some participants of the case company's experts involved. We refined the codes iteratively until consensus was reached among all participating researchers and experts.

4 Findings

By analyzing the empirical data, we identified fourteen distinct coping patterns which provide specific insights into the perceived collaboration with AI-powered chatbots in the case company's software development context. We refer to the AI-related competencies framework [10] and humans' behavioral patterns in the interaction with AI agents [11] for further systematization of our results and clustered the 14 coping patterns into a cognitive, an emotional and a social dimension. The coping patterns and the respective example quotes are illustrated in Table 2.

We identified six patterns that can be classified as cognitive. An important aspect the participants of the study pointed at is that one should know how an AI system works "inside," that AI algorithms are based on data and the outputs, therefore, depend on how this data is preselected or labeled. We refer to this coping pattern with *"Developing a general understanding on how AI works."* Many of the software developers also mentioned that it is important to know enough about the specific subject or task the AI is entrusted with or even to be an expert in this task to be able to evaluate the AI's output, such that *"Possessing expertise on the task or topic the AI agent is assigned to"* can be listed as another cognitive pattern. "*Interpreting and evaluating AI agent's outputs context-specifically"* basically lines up here, as this pattern is also concerned with being able to interpret and evaluate the AI agent's output in the respective context to make sure that it "makes sense." Another interesting aspect is that the interviewees pointed out that they think carefully about which tasks they leave to the AI and which they prefer to do themselves. This, of course, also depends on the users' perception of the AI's capabilities. We argue that the capability of *"Determining the division of tasks between the AI and oneself"* plays an important role when working with AI-agents. Of course, many of the study participants argued that one should be careful with trusting the AI agent's output completely. Instead, *"Dealing with the AI agent's outputs in a reflective manner"* was seen to be essential when working with such systems. Last but not least, some developers indicated that data protection should always be taken into

Table 2. Humans' coping patterns in the interaction with AI-powered chatbots

Pattern title	Example Quote (s)
Cognitive	
Developing a general understanding on how AI works	"It is also important to understand a little bit how an AI might work inside, to be able to anticipate what it would spit out." "Basically, in my eyes, such a neural network is nothing more than a very, very complex function that is no longer completely understood. And that is trained with input data. Yes, and then it can generate output data based on the input data."
Possessing expertise on the task or topic to which the AI agent is assigned	"It could be a problem if you only rely on these tools without knowing enough about the topic, for example, if you ask a question, have no idea about the subject and just blindly trust that it is right." "It needs people who are actually mentally above such a tool"
Interpreting and evaluating AI agent's outputs context-specifically	"Of course, you have to make sure that what is generated [by the AI] makes sense in the context." "After all, we have to get people to the point where they have the skill to evaluate whether what the AI outputs is correct or not in the context."
Determining the division of tasks between the AI and oneself	"I can't use it when I have to fix a bug or implement a new little thing. Then the AI somehow lacks the understanding. Then I can, instead, just do it myself. Rather, I like to use it very much to answer a small question or maybe to establish a rough approach for a solution."
Dealing with the AI agent's outputs in a reflective manner	"Hopefully, it [the AI] gives us the right answers. But I still have to question. I must never be too lazy to question." "So, I see challenges in there that the things that the AI generates that I think you should definitely question those and not just blindly use them."

(*continued*)

Table 2. (*continued*)

Pattern title	Example Quote (s)
Complying with data protection rules	"Of course I have to see that what I enter there is anonymized accordingly and that I put uncritical things there because that is normal data protection, which I should and must generally take into account at this point."
Emotional	
Considering the AI agent as an enabler	"The AI helps to save extremely a lot of time, one advances faster with the basic software development tasks. Yes, and that saves time and one has possibly more time for other more complex topics."
Considering the AI agent as a sort of a virtual colleague	"The ChatGPT, or whatever it's called, or the Copilot, it's part of my working world and it's a valid, a valid medium and I treat it more like a special colleague." "And now with a Copilot you have a pair programmer actually next to you."
Being able to adapt and be open for change and innovation	"You have to keep up with the times a bit and offer a modern working environment." "You will just have to adapt accordingly and perhaps find other fields for yourself."
Feeling confident to work with new and unfamiliar technologies	"Today, you have to be much more agile in the acquisition of new tools, much more open, as far as that is concerned."
Social	
Complying with ethical and moral standards	"There, the AI that is equipped, of course, with much more knowledge than we, but it does not have to follow the correct ethical way."
Appreciating the AI agent's support	"Usually, I search on the Internet, then I find a solution on, for example, Stack overflow. This work can now be done by co-pilot and it does it very, very well. And that also saves time, of course."

(*continued*)

Table 2. (*continued*)

Pattern title	Example Quote (s)
Engaging oneself in a constant discourse with the AI agent	"Then I figured out where maybe something wasn't as it should be, or where Chat GPT got something wrong, and then I just tried to correct that by formulating the next sentences in another way, in the same dialog […] and so on. It was an iterative process."
Expressing oneself comprehensibly towards the AI agent	"Of course, now you have to learn to describe your problems reasonably so that the AI understands you and you get the appropriate answer." "But, nevertheless, this ability to understandably express my needs to the AI, at least currently, is definitely a bit of a skill thing and that is this prompt engineering."

account when working with AI systems, such as like ChatGPT or GitHub Copilot. Thus, *"Complying with data protection rules"* is listed as another important cognitive pattern.

Regarding the emotional dimension, we identified four patterns. The first one *"Considering the AI agent as an enabler"* indicates that the employees consider the AI agent's help or support as time-saving and that gives them *"more time for other more complex topics"* and, thus, enables them to do more challenging tasks. Another interesting but also rather surprising aspect is that some of the employees even considered the AI agent as a *"valid medium,"* a *"partner,"* a *"pair programmer"* or even as a *"special colleague*," which is summarized in the pattern *"Considering the AI agent as a sort of a virtual colleague."*. The last two emotional patterns, *"Being able to adapt and being open for change and innovation"* and *"Feeling confident to work with new and unfamiliar technologies,"* are concerned with the importance of being open to innovation and change, which comes with the adoption of modern smart technologies. Furthermore, it is also important for having the courage to work with these unfamiliar technologies.

Finally, we identified four coping patterns in our data, which can be grouped into a social dimension of coping patterns that more generally refer to a human's objective of creating and maintaining a positive relationship to a counterpart, which can also be an AI-based agent. *"Complying with ethical and moral standards"* is concerned with the ability to conform to and observe moral or ethical standards within collaborative work, which is an important aspect of sociability [17]. Furthermore, *"Appreciating the AI agent's support"* reflects a kind of acknowledgement or even gratitude for the AI agent's supportive and helpful inputs. Surprisingly, many of the participants reported how they discussed topics with the AI-powered chatbot as if it were a human being and that they tried to express themselves understandably to the AI-based agent or even engaged in a discourse with it in order to achieve the best possible result. These aspects are expressed through the two patterns *"Engaging oneself in a constant discourse with the AI agent"* and *"Expressing oneself comprehensibly towards the AI agent."* This supports

the emotional pattern identified already that the AI-powered chatbot the interviewed employees are interacting with is considered more as some kind of a (new) social actor which is comparable to a kind of a partner or colleague [14].

Overall, it can be inferred from looking at the coping patterns mentioned above that working with AI-powered chatbots in collaborative software development can demand an augmentation of the human counterpart's skills and competencies to a higher level. This can be seen in the cognitive patterns that demand a shift and an increase in the cognitive capability of understanding more complex relationships, of being able to interpret the AI agent's outputs very context-specifically, to assign the appropriate task in an effective manner to the AI-based agent (prompt engineering) as well as to deal critically with the output of AI-powered chatbots. Some of the study participants emphasized this circumstance directly by themselves by underlining that when using AI-powered chatbots at work, they have extra time for more complex, more interesting and rather higher-value tasks.

5 Discussion

We performed a case study with 14 employees at an insurance company in Germany who are performing software development tasks and have recently become involved with AI-powered chatbots at work. We identified 14 coping patterns in the employees' interaction with the AI-powered chatbots, which can be grouped into cognitive, emotional and social areas.

When comparing the patterns identified in the present study with the ones from the conceptual development of an AI-related competence framework [10] and the ones from the case study research within a quality control department of a remanufacturing plant where the respondents worked on the shop floor [11], certain context-specific differences are noticeable. The coping patterns from the conceptualization of the AI-related competence framework (I), the results of the study of AI in remanufacturing (II) and the current findings with AI-powered chatbots in software development (III) are illustrated in Table 3. This enables a structured comparison of the results and helps to identify complementary facets of AI-related coping patterns. The "x" in Table 3 represent that we identified this specific coping pattern in the respective research referring to column I, II or III.

By considering the details shown by Table 3, it can be seen that there are different compositions of patterns present based on the different empirical studies of columns II and III compared with the earlier conceptualization of the AI-related competence framework shown by column I.

On the one hand, the conceptual framework of column I can be extended and enhanced by the two empirical studies and, on the other hand, there are differences in the composition of coping patterns between the two empirically based case studies. We argue that the differences result from the variety in AI types as well as the AI application areas [20]. The two empirical studies differ basically in the point that the *AI-based machine in the remanufacturing* study is concerned with an AI deployed on a production floor possessing the appearance of an industrial machine and is collaborating with shop floor workers, and the *AI-powered chatbot in software development* study explores the

collaboration between mostly academics and an AI agent that is perceived to be more intelligent.

Due to the two empirically based studies, the cognitive patterns *Developing a general understanding of how AI works*; *Developing a basic understanding of how the AI agent learns and improves*; *Possessing expertise on the task or topic the AI agent is assigned to*; and *Determining the division of tasks between the AI and oneself* have been added to the conceptually developed set of cognitive patterns. Our results may show that possessing a general understanding of how the AI works and learns can be seen as prerequisites for *Evaluating the intelligence and capabilities of AI agents*. This pattern, together with *Possessing expertise on the task or topic the AI agent is assigned to* can be considered more as kind of prerequisites for being able of *Determining the division of tasks between the AI and oneself in a meaningful way*, since for that, the person in question has to be able to evaluate the intelligence and capabilities of the AI counterpart. It should be mentioned that it seems to be more important to be able to understand how the AI agent learns and improves in the case of the AI-based machine in remanufacturing, since here, the workers were involved in the training process of the AI agent. *Complying with data protection rules* and *Determining the division of tasks between oneself and the AI* can, however, only be found in the AI-powered chatbot case. One reason for that might be due to the fact that the employees in the remanufacturing case did not have the possibility of determining their own division of tasks. Furthermore, data protection played a minor role since, contrary to the software development case no personal or sensitive data was involved as it might be the case for software development within an insurance company.

By considering the emotional dimension, it has to be pointed out that the three patterns *Considering the AI agent as an enabler* or a *helpful counterpart* or even as *a virtual colleague* can be grouped into one category. In that case, some augmentation from the AI-based machine in remanufacturing to the AI-powered chatbot in software development becomes visible in that sense that the shop-floor workers tend to consider their AI-counterpart more as a "helper" or an "assistant" and the software developers perceive "their" chatbot even as a sort of a "colleague." This observation seems plausible, since chatbots, such as ChatGPT, are perceived as increasingly eloquent and intelligent or, in some cases, even smarter than humans [1, 21]. *Taking one's own initiative for improvement* seems to play a greater role in the AI-based machine in the remanufacturing case, whereas *Asserting one's own recovery phases* has been found to be more important in the AI-powered chatbot case. The reasons for that can be seen in the circumstance that it is rather common in more academic jobs that employees self-initiate personal improvement processes and therefore this aspect has probably not been worth mentioning for the respondents in that particular case. Furthermore, regarding digital knowledge work, it is well-known that people are more likely to tend to disregard their own recovery phases [22], whereas in a shop-floor work setting, recovery phases or breaks are often incorporated into the working day and, therefore, probably play a more important role, for example, as a well-established routine for the workers. Another observation regarding the emotional dimension is that by conducting the two case studies, this dimension could be extended by five additional patterns when comparing the two empirical cases with the conceptual framework presented by column I.

Table 3. Humans' coping patterns in the interaction with AI agents

		I	II	III
		Conceptual development [10]	AI-based machine in remanu-facturing [11]	AI-powered chatbot in software development
cognitive	Developing a general understanding of how AI works		x	x
	Developing a basic understanding of how the AI agent learns and improves		x	
	Possessing expertise on the task or topic the AI agent is assigned to		x	x
	Interpreting and evaluating the AI agent's outputs context-specifically	x	x	x
	Evaluating the intelligence and capabilities of AI agents	x		
	Determining the division of tasks between the AI and oneself			x
	Dealing with AI agent's outputs in a reflective manner	x	x	x
	Complying with data protection rules	x		x
emotional	Considering the AI agent as an enabler			x
	Considering the AI agent as a helpful counterpart		x	

(*continued*)

Table 3. (*continued*)

		I	II	III
		Conceptual development [10]	AI-based machine in remanu-facturing [11]	AI-powered chatbot in software development
	Considering the AI agent as a sort of virtual colleague	x		x
	Being able to adapt and be open to change and innovation		x	x
	Feeling confident about working with new and unfamiliar technologies		x	x
	Taking one's own initiative for improvement		x	
	Asserting one's own recovery phases	x	x	
social	Complying with ethical and moral standards	x		x
	Appreciating the AI agent's achievements		x	
	Appreciating the AI agent's support			x
	Developing a sort of sensitivity and care toward the AI agent		x	
	Cultivating an intuition for the AI agent's peculiarities		x	

(*continued*)

Table 3. (*continued*)

		I	II	III
		Conceptual development [10]	AI-based machine in remanu-facturing [11]	AI-powered chatbot in software development
	Being patient with the new and inexperienced colleague		x	
	Engaging oneself in a constantly constructive discourse	x		x
	Expressing oneself comprehensibly towards the AI colleague	x		x

Concerning the social dimension, there have been three patterns developed during the initial conceptualization of the AI-related competence framework (column I). Five additional patterns have been investigated by conducting the two case studies. All three patterns that have been developed conceptually also appeared in the AI-powered chatbot case study but not in the AI-machine in remanufacturing setting. The absence of *Complying with ethical and moral standards* in the remanufacturing case can be justified by the fact that the task the human-AI system was assigned to in the remanufacturing case may have had a rather underrepresented degree of moral dimension and was simply a matter of evaluating technical elements according to their quality. The reason for the pattern *Appreciating the AI agent's achievements* appearing only in the remanufacturing case can be seen in the fact that the AI agent had been trained while it was in operation and, therefore, improvements of the latter have been directly seen by the shop-floor workers. Thus, it can be argued that a more explicit training and learning process between human and AI affects coping patterns at the social dimension. We argue that the three patterns *Developing a sort of sensitivity and care toward the AI agent*, *Cultivating an intuition for the AI agent's peculiarities* and *Being patient with the new and inexperienced colleague* that are present in the remanufacturing case can be classified into the same category as the two patterns *Engaging oneself in a constantly constructive discourse* and *Expressing oneself comprehensibly towards the AI colleague* that occur in the AI-powered chatbot case in software development. Some slight differences in meaning in the nuances of these coping patterns could be explained by the fact that interaction with the chatbot is usually via text or speech, whereas interaction with an industrial machine is more physical.

We can draw some important conclusions based on this case study's empirical results and their interpretation by conducting a systematic compression to a conceptual framework of humans' AI-related competence and a former case study in a different context

concerning a different AI-based agent at work. Firstly, we could show that the three dimensions of an AI-related competence framework named as cognitive, emotional and social can be regarded as a fruitful general model which provides a systematization of humans' coping pattern when interacting or collaborating with AI. More importantly, based on our empirical research so far, this framework seems to be relevant in different work contexts and for different types of AI-based systems or agents. Secondly, while the AI-related coping patterns identified by case study research might be structured or grouped into the three dimensions of cognitive, emotional and social competence, we have shown that this framework allows work context-related and AI-specific configurations, so that the idiosyncrasy of different work environments and human-AI systems can be taken into account. We find that this is very important for the successful implementation of AI. Thirdly, and also very important for practice, this means that the three-dimensional framework can provide both general guidance for developing skills and competencies and empowering human actors, and a framework for work context-specific investigations and interventions in organizations. The framework can be seen as a guideline for managing the human-AI system more responsibly and sustainably from a more human-centered perspective, for example, by making how work demands are changing due to the proliferation of new AI-based tools, such as chatbots, more transparent.

6 Conclusion and Limitations

The present study provides some relevant insights into the human part in human-AI collaboration related to AI-powered chatbots, such as ChatGPT and GitHub Copilot, in the application area of software development, which we describe in detail throughout our manuscript. We think that more comprehensive work is needed on how humans and AI can work together fruitfully in the future in various fields of applications, and, thus, our work can be seen as an inspirational starting point. It is an important first step toward more extensive investigations in the context of human-AI interaction. Of course, further empirical studies from other fields of practice including more heterogeneous groups of study participants are required in the future and are already planned by the authors.

Since the participants of the study have all been recruited from only one company and the database is rather small, consisting of only male participants, the opinions and experiences may not be fully representative of a larger population of employees working with AI agents, especially since a female point of view is missing so far. Interpretations are limited due to the authors' personal experience and knowledge, which is hard to avoid in qualitative studies, and this also leads to the fact that our findings cannot be fully generalized but certainly provide some inspiration for future research and practice.

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