Bridging Minds and Machines: Emotional Intelligence as a Mediator of Human-AI Collaboration

Master of Engineering Management
2023 – 2025

Submitted in partial fulfilment of the requirements for the degree of
Master of Engineering Management

NAZARBAYEV UNIVERSITY

School of Engineering and Digital Sciences

In partnership with

Graduate School of Business

Akmaral Abil
Narkes Tynybayeva
Ayazhan Tergembayeva
Aktolkyn Zholtay
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Declaration

We, Akmaral Abil, Narkes Tynybayeva, Ayazhan Tergembayeva, Aktolkyn Zholtay, and Dariga Yeleu, declare that the research contained in this thesis, unless otherwise formally indicated within the text, is the author's original work. The thesis has not been previously submitted to this or any other university for a degree and does not incorporate any material already submitted for a degree.

Signature (s):

Date: 24.04.2025

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Abstract

This study investigates how Emotional Intelligence (EI) and prompting strategies influence Human-AI Collaboration (HAC) in Creative Problem Solving (CPS) tasks. A theoretical model was developed through a literature review and validated by empirical data from a survey, EI test, experiment, and training. Survey results showed clarity as the most used prompting strategy, while emotional expression ($p = 0.047$) significantly improved AI creativity. The EI test confirmed that adaptability and empathy were high among participants, but emotional expression was lower, limiting creativity. The experiment revealed that structured prompting strategies like Role Assignment and Iterative Refinement notably enhanced AI outputs for low-EI users, while high-EI users benefited more from intuitive and mixed interaction. Training results with 22 participants demonstrated increased effectiveness across all strategies, especially in Role Assignment (+37.5%) and Expression of Emotions (+25%). The study proposes a Human-AI Collaboration Framework, highlighting that optimal AI creativity emerges from the combined effect of prompting strategies, emotional intelligence, and iterative refinement. These findings provide a foundation for future training programs aimed at improving HAC through the integration of emotional and non-emotional factors. Although the study's focus on short-term effects and text-based collaboration presents limitations, future research should explore long-term impacts and multimodal Human-AI interactions.

Keywords: Human-AI Collaboration (HAC); Artificial Intelligence (AI); Creative-Problem Solving (CPS); Emotional Intelligence (EI), EI Competencies

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Acknowledgments

The authors would like to thank Professor Mariza Tsakalerou, their supervisor, for her guidance, support, and insightful feedback throughout the project.

The authors would also like to thank PhD student Yevgeniy Lukhmanov for his helpful comments and ideas, which greatly improved the quality and accuracy of this work.

The certified Emotional Intelligence Test was supported by funding from Grant No: 201223FD8810 (FDCRG).

Finally, the authors wish to thank the marketing specialists who participated in the test and survey, as well as the faculty members with different backgrounds and marketing specialists who served as evaluators of the experiment, and the participants of the training for their valuable contributions.

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List of Abbreviations

HAC	Human-AI Collaboration
AI	Artificial Intelligence
EI	Emotional Intelligence
CPS	Creative Problem-Solving

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1. Introduction

1.1 Background

In the modern world, most companies across various industries are adopting new technologies for data analysis, optimization, and forecasting using Artificial Intelligence (AI). Nevertheless, despite significant development of AI, its ability to create truly creative and emotionally relevant responses is still limited, especially in creative problem-solving (CPS) (Ameen et al., 2022; Vinchon et al., 2023).

Emotional Intelligence, including human expressions, is crucial in Human-AI Collaboration (HAC), as it enhances interactions and the efficiency of AI responses (Vinchon et al., 2023). Currently, HAC is considered more as “assisted creativity” as AI is still limited in its capabilities and can act more as a “co-creator” rather than a fully autonomous tool (Ameen et al., 2022; Esling & Devis, 2020; Hemmer et al., 2024). Therefore, human intervention into AI performance is essential in two major stages: problem identification, where users generate prompts, and final verification, where users validate AI's output (Ameen et al., 2022; Vinchon et al., 2023; Shneiderman, 2020). This means that to enhance the creativity of AI’s responses, both humans and AI should improve their interaction, where the users should focus on their Emotional Intelligence (EI) competencies, such as cognitive flexibility, social awareness, and adaptability (Ameen et al., 2022). In this context, ensuring a balance between user-defined constraints and AI’s generative capabilities will enable it to produce original and relevant outputs. Combining creative flexibility and control over factual correctness will improve CPS in AI-assisted innovation (Raz et al., 2023; Karakaya, 2025; Zhang et al., 2024; Sikha et al., 2023).

1.2 Problem Statement

Despite the increasing use of AI in creative industries, there is an absence of a structured framework to determine the factors affecting creativity regarding the use of AI. Among these aspects, both *emotional* (for instance, how to be empathic or adaptable) as well as *non-emotional* (such as how to formulate prompts and cognitive complexity) are included (Khare et al., 2024; Raz et al., 2023). Although EI competencies have been identified as important and impactful for HAC, many things remain unknown about the role they play for HAC in the context of CPS (Zhai & Wibowo, 2023). Unless there is a well-defined approach to introduce EI-driven

strategies to HAC, artificial intelligence will just remain a technical tool instead of a partner in creative tasks (Esling & Devis, 2020; Hemmer et al., 2024; Vinchon et al., 2023).

The absence of a structured framework leads to lower AI literacy among users, which is followed by a poorer ability to collaborate effectively with AI. Low AI literacy, in turn, is associated with misinterpreting AI's capabilities and thus a wrong perception of its creativity level (Beretta, 2023; Ng et al., 2021; Kolomaznik et al., 2024). This highlights the urgent need for targeted training programs and the creation of structured frameworks for Human-AI Collaboration.

1.3 Research Gaps

While recent studies of AI claim to improve the capacity of human creativity in organizations (Ameen et al., 2022), there is a gap in knowledge on how to improve HAC performance in the creative industries systematically. Many studies have noticed that human involvement in artificial intelligence-generated responses is a performance factor; however, there is no deep dive into what qualities of human involvement and prompt engineering methods make the most impact on this collaboration (Khare et al., 2024). Besides, the existing EI measurement tools do not truly provide means for evaluating the actual impact of human emotional intelligence in working with artificial intelligence, and that creates a discrepancy in practical approaches on how a human and an artificial intelligence would interact most optimally (Mortillaro & Schlegel, 2023).

Another distance pertains to the understanding of whether AI systems can recognize and respond to emotional cues, and if understanding creative decisions made through AI systems involves taking emotions into account. Researchers also discuss how some studies focused on AI's abilities to recognize and respond to emotional signals (Vicci, 2024), the effectiveness of AI systems that include emotions in creative decisions has yet to be sufficiently proven. This research seeks to fill in the gaps by identifying key competencies in the area of EI, assessing their roles in collaboration with AI, and developing a structured framework to improve HAC in a marketing context.

1.4 Objectives

The main objective of this study is to create a structured and empirically validated framework for enhancing HAC in CPS through emotional and non-emotional factors. This framework will fill the gap between AI's technical advancements and humans' emotional-intuitive strengths, positioning EI as a critical mediator that influences the

effectiveness of prompt strategies on collaboration outcomes.

In order to create the framework to enhance HAC via factors in CPS, the study has to achieve the following goals:

1. Identify and rank the most common factors, including emotional and non-emotional, for HAC in creative tasks. Their impact will be examined through theoretical insights and empirical data from a survey, controlled experiment, and training.
2. Assess the role of EI in HAC, specifically identifying which EI competencies are the most significant for CPS.
3. Create and validate a Framework for HAC, which will gather all insights obtained in the study.
4. Design and conduct a training program to share the findings of the study with a broader audience and evaluate the practical effectiveness of the identified strategies for enhancing AI creativity.
5. Obtain broader implications from the findings to inform the design of future human-centric AI systems and provide actionable insights for professionals.

1.5 Scope

This project will narrow down the scope to building up EI competencies and other non-emotional factors of HAC in the CPS process, specifically in the marketing industry. The reason for selecting the marketing field was that CPS is of utmost importance for business success, generating competitive advantage, and developing long-term growth and profitability (Ameen et al., 2022; Titus, 2000). AI has enabled marketing to progress by carrying out a higher speed of real-time data analysis, product optimization, trending of products on which the product is on, analysis of user engagement, and making informed decisions regarding content creation (Ma & Sun, 2020; Stone et al., 2020). As a result of this convergence between AI-driven efficiency and human creativity, marketing is a great place to explore Human-AI Collaboration in CPS.

2. Literature review

The core concepts defining this study must be defined first, before proposing a theoretical framework. As such, this literature review subsequently studies the science behind Human-AI Collaboration, Creative Problem-Solving, Prompt Engineering, and

Emotional Intelligence, which are the building blocks towards understanding the factors that impact the effectiveness of HAC in creative tasks.

2.1 Human-AI Collaboration

Human-AI collaboration consists of jointly working entities that mutually support one another until they fulfill shared goals. The human being oversees the AI outcomes under this partnership while adjusting and optimizing the output for better results (Terveen, 1995; Vössing et al., 2022).

The Human-AI team achieves its objectives through both groups operating within their zones of expertise and natural leadership capabilities. The computational power of AI does information analysis and prediction tasks, but humans maintain command over ethical decision-making, along with empathetic and creative processes. The human-led performance remains superior to artificial intelligence systems when tasks need strategic thinking and emotional sense alongside creative skills. The objective demands either routine process work or optimization, which AI possesses better capabilities (Ameen et al., 2022; Cui & Yasseri, 2024; McCormack et al., 2020; Shneiderman, 2020). The collaborative work between humans and AI systems yielded optimal results in Hemmer et al. 's (2024) research, which found that the human-machine team made 0.15 classification errors, but individuals alone recorded 0.30 and 0.25 errors, respectively, which proves the need for HAC.

According to Anantrasirichai and Bull (2021), AI is a tool that replaces laborious work so that humans can be left to more complex and creative processes. In addition, as stated by Ameen et al. (2022), in the field of marketing, interaction between humans and AI goes by the name of “balanced reinforcement” – AI encourages imagination, visualization, and abstract thinking, leading to an improvement of human creativity.

2.2 Defining Creative Problem Solving

A lot of different fields, such as architecture, engineering, public administration, art, entrepreneurship, and many more industries that influence the development of mankind depend on the availability of creative solutions (Cardoso et al., 2011). As stated by Ameen et al. (2022), creativity is generated through a new and valuable idea in product design, branding, and customer service. These tasks demand out-of-the-box thinking and flexibility, making them the same to the problem-solving process. The ability of an enterprising individual to use Creative Problem Solving successfully is fundamental in determining how innovative the individual will be (Benner & Tushman, 2003; Katila &

Ahuja, 2002; March, 1991). Recent studies further emphasize that creativity involves not only generating ideas but also problem finding and estimation processes that require self-regulation and social co-regulation to assess the originality and relevance of solutions (Vinchon et al., 2023).

2.3 Prompt engineering

Prompts are arguably the key way to work with AI, and *prompt engineering* is one of how humans and AI may work together by exploring potential solutions based on purposefully structured instructions. In this process, the queries are framed appropriately so that the model can be guided towards the desired outcome (Brown et al., 2020). AI models have no autonomy, thus, people in the formulation of queries are key to the quality of responses (Zamfirescu-Pereira et al., 2023). Context, instructions, or examples that are well-worded queries help the model reach the desired topic, style, or format. Having an effective way to create queries or prompts helps the model answer more accurately, logically, and usefully within the context of a certain task or knowledge domain (Beurer-Kellner et al., 2023; Lenat & Marcus, 2023).

2.4 Defining Emotional Intelligence

Emotional Intelligence, as stated by Mayer et al. (2004), is defined as "the ability to reason about emotions, and use emotions to enhance thinking". EI involves the identification, interpretation, and control of emotional states and the effects of these emotions on other people's behavior and on the way people react to emotionally charged situations.

Given the lack of emotional and contextual understanding based on typical AI systems, EI becomes crucial in Human-AI Collaboration. In 1995, McCarthy first established AI as the "science and engineering of making intelligent machines" that was capable of processing and making analytical sense of large datasets, and second was "not intelligent enough to attribute emotional refinement" (Lee, 2024). However, this limitation usually involves human emotional intelligence to ensure that outputs are both within the purview of ethical and emotional context, effective, and relevant for use (Cui & Yasseri, 2024; Ray, 2022). Moreover, these challenges shed light on why EI is essential in HAC, especially in CPS.

Emotion perception, emotion understanding, and emotion regulation are the three most important components of EI (Mortillaro & Schlegel, 2023). Emotion perception is recognizing and differentiating emotion; an emotion that is displayed in one instance but

not the other. Emotional understanding is the capacity to understand complex emotional states and the causes of those complex emotional states, in which people may be able to anticipate where emotions might lead to behavior. Then, emotion regulation allows people to properly manage their emotional responses so that positive collaboration and positive innovation can occur. In this paper, they become a vital asset in creative contexts where the ability to creatively respond to challenges and empathetically engage in communication is a prerequisite to efficient solutions.

Furthermore, Hemmer et al. (2024) explain why human emotional intelligence is an asset beyond comparison for decision making. Research shows that human insights grounded in ethical and contextual considerations make a big difference in collaboration environments while making decisions. The blending of human EI and AI's capability for analysis produces a dynamic synergy that gives teams an edge to handle complicated challenges. Additionally, Hemmer et al. (2024) emphasize the responsibility of ethical accountability when it comes to the development of AI systems, especially in critical decisions that involve emotion recognition, as bias in this aspect of artificial intelligence may result in terrible implications.

Introducing emotional prompts into AI workflows appears to be a partial solution to bringing collaboration. In the article published by Li et al. (2023), a novel method composed of emotionally charged language is integrated into AI prompts to boost task accomplishment. The results of their study showed that emotional prompts, i.e., as motivational or reflective statements, enhanced the performance of the large language models (LLMs), e.g., GPT-4, by directing attention and leading to more exact responses. This is a method that points out how emotional intelligence rules may be mixed up with AI capacities to improve synergistic issues and imaginative results for people and their computer partners.

2.5 Factors Affecting Human-AI Collaboration

To build the theoretical model, this study first explores key factors influencing HAC, which are further divided into emotional and non-emotional groups. The following sections investigate how each of these factors contributes to enhancing CPS with AI.

2.5.1 Emotional Factors

Emotional factors reflect how humans apply their emotions during interaction with AI. This section focuses on key EI competencies that are also examined in the EI test described in the 3.2.2 section, such as adaptability, expression of emotions, interpersonal relationships, optimism, emotion regulation, perception, empathy,

self-awareness, and self-confidence. Others were not found in the literature in the context of their influence on HAC, but still, their impact will be examined in the Results and Discussion section.

Since certain EI dimensions assessed in the test were not explicitly addressed in the academic literature on HAC, the study analyzed the most conceptually aligned constructs available. This approach ensured that all EI competencies could still be meaningfully integrated into the theoretical and practical framework of the research.

Adaptability

It was interesting to note that adaptability factors mostly refer to AI's rather than to humans, where it states that AI's should adapt to people's behavior by learning the decision-making process and benefit from collaboration (Knop et al., 2022; Zhao et al., 2022). According to the EI test from ProfDialog, adaptability is the capacity to accommodate changes of the social environment, understand other views, fit into a system of group and social relations, norms, rules, etc. Further, it is found that adaptability is an important component of resilience in socio-technical system design, especially in human–smart machine teams where roles and responsibilities can be easily transferred in reaction to the changing environment. Thus, developing such systems that are dynamic and powerful depends on embedding adaptive capabilities in both human and machine elements, something that results in "adaptive systems with adaptive actors." The integration of AI components that facilitate this continuous learning further enhances the need to re-adapt, since these technologies allow the systems to learn and evolve as new challenges arise. Overall, the ability to adapt is shown to be the major enabler of resilience and flexibility in human–smart machine teams and is identified as a key design consideration in modern socio-technical systems (Kaasinen et al., 2022).

Expression of Emotions

In the context of HAC, the ability of users to express emotions clearly during interaction plays an important role in enhancing AI responses. Although Mallick et al. (2024) focused on AI emotional expression toward humans, their findings suggest that emotional signals, such as expressions of trust, enthusiasm, and encouragement, strengthen collaborative dynamics. Applied to the human side, expressing positive emotions while prompting AI, for example, embedding encouragement, empathy, or enthusiasm into the phrasing, may foster more socially aligned, creative, and human-like AI outputs.

Interpersonal Relationships

The establishment of effective interpersonal dynamics between humans and AI systems

is increasingly recognized as a success factor in HAC. While Mallick et al. (2024) emphasize that emotional expression improves trust and teamwork within human-AI teams, the implication for human users is clear: emotionally attentive communication enhances the relational quality of AI collaboration. When users approach AI with language that reflects empathy, openness, and relational awareness, the resulting outputs may become more responsive, relevant, and socially attuned.

Optimism

Optimism, expressed through positive emotional framing in prompts and interactions, plays a critical role in sustaining productive Human-AI Collaboration. Mallick et al. (2024) showed that positive emotions from AI fostered resilience and satisfaction in human teammates; applying this insight reversely, human optimism conveyed through language choice may enhance AI's generative creativity and improve the collaborative atmosphere. Encouraging, hopeful, and future-oriented phrasing signals to the AI a collaborative context that prioritizes solution-finding and creativity. In dynamic problem-solving environments, maintaining an optimistic tone can help keep the AI's outputs more constructive, open-ended, and aligned with the user's creative goals.

Emotion Regulation and Emotion Perception

Based on the research by Mortillaro and Schlegel (2023), emotion regulation (referred to as self-regulation in the EI test) and emotion perception are essential variables for keeping the focus and encouraging innovation in dynamic contexts.

Empathy

Empathy enables people to consider the impact of AI-driven decisions on human beings, such as tailoring AI-generated content to align with customers' emotions and the experience of employees (Heyns, 2024). Furthermore, empathy increases HAC by enabling individuals to recognize perceived emotions and adjust AI outputs to align better with human emotions and cultural perceptions. Empathetic users, according to research, are more willing to refine content created by AI for it to be not just technically correct, but it can also be socially and emotionally relatable (Kolomaznik et al., 2024).

Self-awareness

Self-awareness (similar to self-regulation in the EI test) is the ability of users to realize their personal strengths and limitations, so that they can come into AI interactions loud and clear. Being aware of emotional reactions allows them to perceive what emotional biases they can bring into the AI-generated insights, and not limit creativity. The emotional alignment between the needs and perspective of humans and AI's outputs increases the relevance and creativity of outputs (Heyns, 2024).

Self-confidence

Self-confidence (similar to self-esteem in the EI test) affects Human-AI Collaboration, especially how users will interpret and respond to AI outputs. According to the results, Ma et al. (2024) showed that calibrating self-confidence improves team performance and increases the rationality of reliance on AI compared to uncalibrated baselines. On the other hand, ethical overconfidence in AI's outputs might prevent rational human reliance on AI, consequently resulting in some missed opportunities or overconfidence in flawed decisions. Even self-confidence plays a significant role in decision-making and receptiveness to advice, whether or not users are willing to heed AI recommendations.

2.5.2 Non-emotional Factors

Non-emotional factors refer to technical strategies that improve human-AI interaction. Based on the literature review, the three most commonly cited factors - clarity, iterative refinement, and role assignment - were selected for this study. Along with emotional factors, these will be examined and ranked through the survey to assess their practical significance in enhancing the creativity and effectiveness of AI-generated responses.

Clarity

Clarity is a broad term used in prompt engineering, as it encompasses several sub-concepts, such as explicit guidelines, step-by-step reasoning, multi-turn prompting, and prompt chaining, which are discussed below.

Clarity, or the ability to write clear and precise prompts, is one of the most important factors mentioned in the literature. It was studied that AI performs better in clear instructions with greater precision and structure, thus providing correct, relevant, and structured responses. Explicit guidelines help in structuring prompts, for example, by providing response format, tone, or length, greatly improve the performance and usability of AI (Raz et al., 2023; Ekin, 2023; Park & Choo, 2024; Lo, 2023; Bansal, 2024). For instance, the following prompt for AI "Summarize three key applications of AI in marketing in two sentences" would be a better alternative for using instead of "Explain what AI is".

In contrast, ambiguous prompts lead to inconsistent AI responses, therefore, an additional strategy to ensure clarity is to ask AI if the prompt is well-defined for it. Requests like "If more details are needed, request them before responding" considerably reduce errors and help to meet user expectations (Lo, 2023; Park & Choo, 2024; Bansal,

2024; Karakaya, 2025).

Another way to ensure clarity is to break the prompt into step-by-step logical sequences, which is the “Chain-of-Thought” strategy. For example, instead of simply asking, “If a car travels at 60 miles per hour for 3 hours, how far does it travel?”, a more effective CoT prompt would be, “Let's solve this step by step. First, recall the distance formula. Then, substitute the values for speed and time. Finally, calculate the total distance traveled.” (Raz et al., 2023; Karakaya, 2025; Wu et al., 2022; Bansal, 2024).

Lastly, chaining prompts are the basis for logical progression in AI interactions, which extends more on the Chain-of-Thought strategy. An example of its usage may be asking a structured sequence like “List three marketing strategies; compare their effectiveness; recommend one for small businesses”. This will allow for better engagement and structured responses in HAC (Bansal, 2024; Sikha et al., 2023; Karakaya, 2025).

Iterative Refinement

Iterative refinement means testing and adjusting prompts based on the received AI outputs, which also helps to achieve progressive improvements in creativity. This factor is usually associated with modifications of wording, context explanation, queries’ restructuring with following users’ requests (Dang et al., 2022; Abdoelrazak, 2023; Rodriguez et al., 2023; Zhang et al., 2024; Sikha et al., 2023).

Research emphasizes that prompt engineering is often a trial-and-error process, and continuous refinement leads to significantly better creative outputs (Abdoelrazak, 2023; Rodriguez et al., 2023). In the context of HAC for CPS, an initial prompt should be viewed as a draft to be honed through cycles of feedback and refinement until the AI output achieves the desired creativity and relevance (Sikha et al., 2023; Zhang et al., 2024). By incrementally guiding the AI with refined prompts, solutions become increasingly innovative and tailored to user expectations.

To apply iterative refinement effectively, users should adopt a deliberate feedback loop. After each AI output, the user should critically evaluate the content, identifying gaps in creativity, detail, or alignment with the task. The next prompt should be adjusted accordingly - clarifying instructions, adding missing context, or requesting more innovative responses (Dang et al., 2022; Rodriguez et al., 2023). Best practices suggest tracking the impact of each refinement to understand which strategies improve results. In creative tasks, complex or open-ended problems benefit greatly from exploratory refinement cycles, which use AI’s rapid response to evolve initial ideas into structured, innovative solutions (Sikha et al., 2023; Abdoelrazak, 2023).

Role Assignment

Role assignment can improve domain-specific accuracy and response relevance of AI. This factor is associated with instructing AI to imagine itself as a specific role, such as writing prompts like "You are a stock expert; provide an investment strategy for beginners". This way, it will apply knowledge that the role would have and provide more structured and insightful responses (Wu et al., 2023; Park & Choo, 2024; Sikha et al., 2023; Karakaya, 2025). Additional context - such as client goals, industry specifics, or audience profiles - further sharpens the AI's outputs (Park & Choo, 2024). Maintaining the assigned role consistently throughout follow-up prompts ensures that the AI's perspective remains aligned across longer interactions. Research has demonstrated that AI systems acting under defined roles deliver higher-quality, more coherent, and targeted outputs, particularly in CPS tasks requiring creativity from multiple viewpoints (Karakaya, 2025).

Role assignment not only improves technical and factual precision but also fosters deeper creativity by enabling users to simulate diverse expert perspectives through a single AI system (Wu et al., 2023; Karakaya, 2025).

2.6 Theoretical Model of HAC

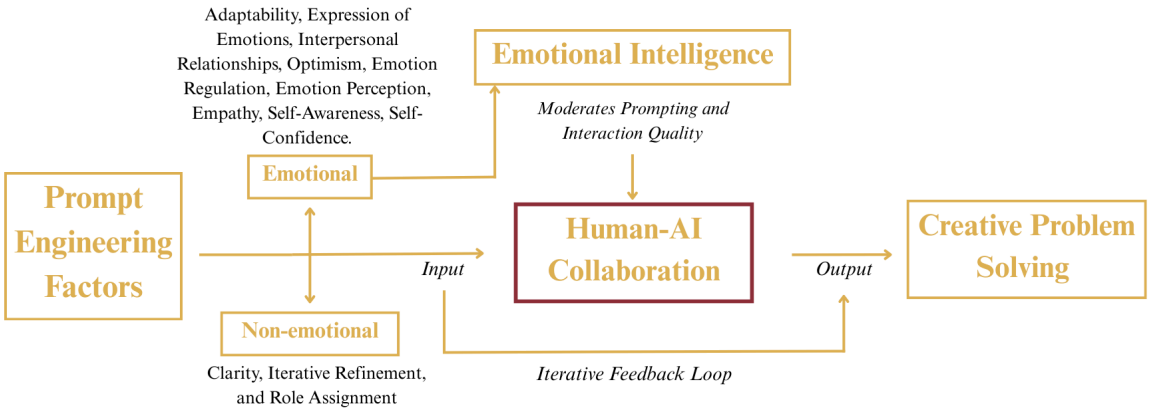

Figure 2.1. Theoretical Framework of EI as a Mediator in HAC

Figure 2.1 presents the theoretical framework developed based on the literature review. It illustrates how the key concepts explored in this study are interrelated. Prompt engineering factors - divided into emotional (e.g., empathy, self-awareness, emotion regulation) and non-emotional (e.g., clarity, iterative refinement, role assignment) - serve as the input for HAC. Emotional Intelligence is positioned as a moderating factor that influences the quality of prompting and the overall interaction. The output of this collaboration process is Creative Problem Solving, which is further refined through an iterative feedback loop, highlighting the dynamic nature of HAC in practice.

3. Methodology

3.1 Literature Review and Theoretical Model

Moving forward to the methodology part, the whole process included 8 main steps, which are shown in Figure 3.1. The study began with a Comprehensive Literature Review that included reliable and recent articles, conference papers, and educational websites that are highly relevant to the topic of integration of AI, Creative Problem Solving, and Human-AI Collaboration. With the defining key terms related to this study, the main factors affecting the HAC were identified. Their list was formed based on their frequency of occurrence in the papers, and the most common ones were added to the Theoretical Model. In the scope of this study, they were split into emotional and non-emotional factors.

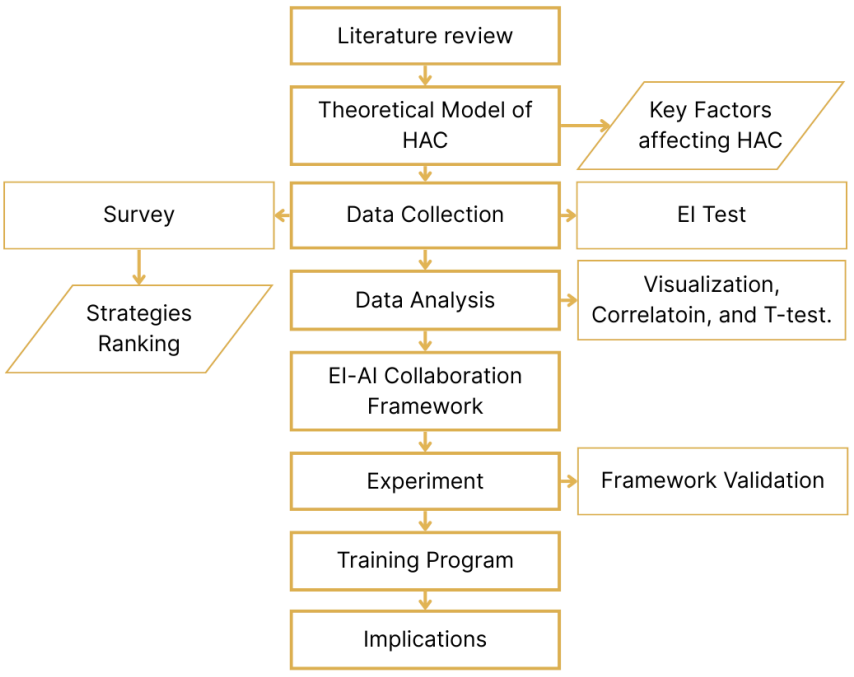

Figure 3.1. Methodology Framework for HAC Study

3.2 Data Collection and Analysis

3.2.1 Survey

The purpose of this survey was to analyze the AI usage of specialists in the field of marketing and to identify correlations between EI competencies and HAC. It consists of six questions (see Appendix A) that focus on the frequency of AI usage during work, and whether the AI-generated responses are creative and correctly address their

prompts. Additionally, the survey includes questions that assess what kind of tasks respondents use AI for and what strategies and skills they apply to obtain the desired response to improve their collaboration with AI. Eventually, participants are required to answer a question about the limitations of AI during their work. The obtained results were analyzed using different statistical methods, including Pearson correlation and t-test.

To simplify the survey for participants without compromising research quality, several closely related emotional factors - such as empathy, openness to experience, and emotional perception - were merged under the broader label of emotional context. This was necessary because many respondents might not fully understand or differentiate between these psychological constructs. Therefore, instead of asking about each EI competency separately, the survey used "emotional context" as an umbrella term to assess emotional strategies. The individual influence of each EI factor, however, was thoroughly examined through the EI test analysis described in section 3.2.2.

Participants of the survey represented a range of industries, as shown in Figure 3.2.

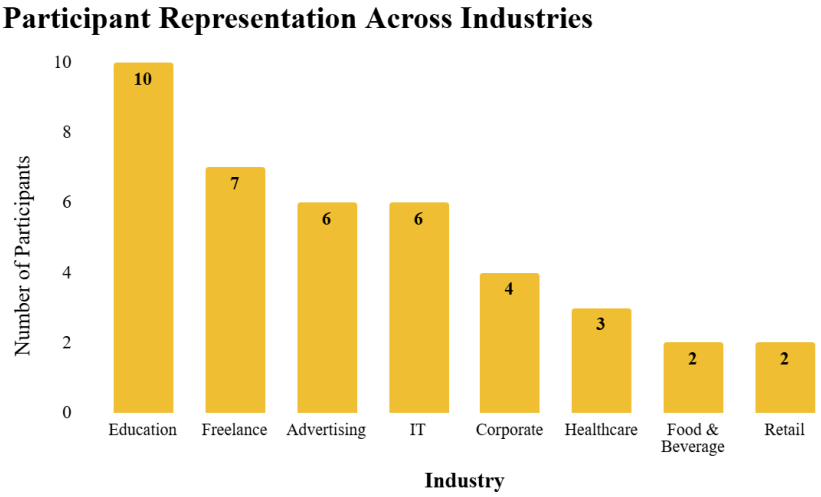

Figure 3.2. Participant Representation Across Industries

3.2.2 EI Test

The study proceeded with the data collection stage, where 40 marketing experts had taken the EI test and survey. While the EI test was required to assess participants' emotional intelligence level, the survey was oriented to get insights about their usage of AI. These two tests were interconnected as their primary goal was to see whether there are any interrelationships between EI and the creativity level of AI usage of respondents.

For the *EI test*, a special online test called EQ ProfDialog was purchased to evaluate the EI of marketing experts. The choice of this specific platform was based on the variety of dimensions it accesses, which included self-awareness, emotional regulation, empathy, adaptability, emotional expression, and interpersonal skills (ProfDialog, 2024). Moreover, as the study was conducted in Kazakhstan, where most professionals know Russian and may be limited in other languages, the language of the test was set to be Russian. In addition, according to their website (ProfDialog, 2024), this test meets all European reliability standards.

The certified Test EQ ProfDialog consists of 117 questions aimed at assessing the 11 EI competencies and 2 other dimensions, which are listed in Table 3.1. All 11 competencies were scored on a scale from 1 to 10 with the following interpretative feedback and recommendations. The left 2 parameters were oriented for built-in validity controls, which included a lie scale and a contradiction detection system. They were essential in the results interpretation since they gave more insights into the validity of the responses.

Noteworthy is the fact that most of these dimensions were explored in the 2.5.1 section and were found to significantly improve HAC. The main aim of this test is to prove their impact in practice and see which one is the most essential.

Table 3.1. Factors influencing the results of the EI test

Name of the factor	**Description of the factor**
Validity	The reliability of the obtained results, closely tied to the sincerity displayed during the assessment and the absence of efforts to present oneself in an overly favorable light.
Inconsistencies	This scale measures the inconsistency in the test-taker's responses when they provide opposed answers to similar questions. Such behavior may indicate that the test was taken superficially, with random button presses, or reflect the individual's inner contradictions, difficulty in understanding themselves, and their qualities.
Emotional Intelligence	The ability of an individual to recognize emotions, intentions, motivations, and desires in both others and themselves, as well as

Name of the factor	Description of the factor
	the ability to manage their own emotions and the emotions of others to solve practical problems effectively. This scale is calculated based on all other test scales, except for authenticity. Thus, emotional intelligence can be seen as a general indicator composed of specific components such as adaptability, emotional perception, self-esteem, etc.
Adaptability	The ability to adjust to changing conditions in the social environment, understand differing perspectives, and integrate into systems of group and societal relationships, rules, and norms.
Self-Assertion	The affirmation of one's value and significance, the ability to defend one's viewpoint, position, interests, and values during interactions. It also involves the drive to achieve and maintain social status.
Emotional Perception	The predominance of emotional perception over rational thinking, where an individual prioritizes sensory and intuitive understanding over logical analysis.
Expression of Emotions	The effectiveness of outward emotional expression, including expressiveness conveyed through facial expressions, voice, gestures, and behavior. It also refers to the ability to use emotional displays to influence others.
Self-Regulation	The ability to manage one's internal emotional state, overcome negative emotions, and shift towards a calm and confident mindset.
Interpersonal Relationships	The ability to build and maintain effective relationships with others
Self-Esteem	The level of self-respect and how highly or lowly an individual evaluates their personal qualities and abilities.
Empathy	The ability to understand what others are feeling, share their emotions, express compassion, and respond appropriately to their emotional states.

Name of the factor	Description of the factor
Influence	The ability to motivate and inspire others, lead them, and affect their behavior.
Optimism	An individual's tendency to hope for favorable outcomes, expect positive results, and maintain confidence in achieving desired goals.

3.3 Human-AI Collaboration Framework

The Human-AI Collaboration Framework was designed to summarize all findings obtained from theoretical and practical research in a structured way. Its main aim was to deepen the Theoretical Model mentioned in the 3.1 section and make it more specific to narrow down identified factors. This framework was the base for the experiment and training program development.

3.4 Experiment

After the Human-AI Collaboration Framework identification, its validation was conducted through an experiment. It involved two marketing specialists, who underwent the experiment itself, and seven evaluators, who were responsible for evaluating their results.

During the experiment, the task was given to two marketing specialists who were sitting in the same room with laptops. The task involved AI usage, specifically ChatGPT, due to existing paid subscriptions, where participants needed to generate the result as creatively as possible. Then, each identified factor in the framework was explained to them, after which they needed to apply it to their prompt. Overall, four factors were taught to them, three tasks given (see Appendix B), and five responses (one without any intervention and four after the factors explanation). All answers were recorded and then inserted into a Google Form, which was further distributed to the evaluators (see Appendix C).

The second stage of the experiment involved scoring each result by seven independent evaluators, where 4 of them were professors and 3 - other marketing experts. All answers were mixed in order to avoid bias, and all names were anonymized. Each response should have been scored from 0 to 100 based on its creativity and relevance to the initial task. Then, all answers were analyzed and presented in the Discussion

section.

3.5 Training

The next stage of the study was a training program, which was developed based on the framework and experiment, and conducted with 22 master's engineering students. The main aim of the training program was to share the results of the study with a broader audience.

The training began with the pre-survey, where respondents rated each of the identified four factors based on their effectiveness in terms of providing creative AI responses. Then, it proceeded with the explanation of each factor and applied them to the task in the same manner as the experiment was conducted. The format of the training was presented in Appendix D, where two authors explained the concepts to the audience with a presentation. The end of the program was with a post-survey, where participants had the same six questions as in the pre-survey (see Appendix E). This approach was applied to see if there are any changes in the perception of teaching factors. Therefore, the results helped to see the impact of the study on a bigger scale.

3.6 Implications of the Study

Another important outcome of the study was to observe implications of findings across industries, which is described at the end of the Discussion section.

4. Results and Discussion

This section presents and interprets the key findings of the study. It includes analysis of the survey responses, results of the EI test, correlation analysis between EI factors and AI creativity, evaluation of the proposed Human-AI Collaboration Framework, outcomes of the practical experiment, and feedback from the training program.

4.1 Survey Analysis

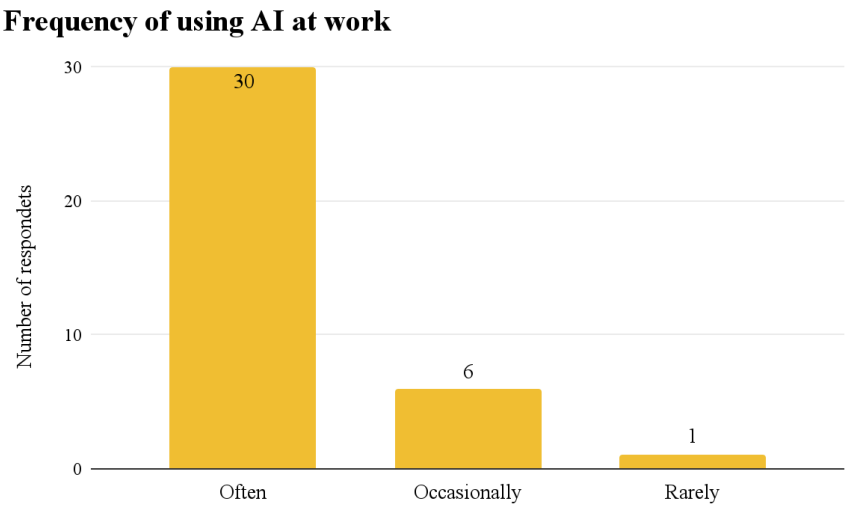

Figure 4.1. The frequency of using AI at work

The results of the survey show that the majority of respondents (30) use AI often in their work, which means they use AI very much in their daily workflow (Figure 4.1). Other respondents in a smaller group (6) used AI occasionally, but just 1 has used AI rarely. Interestingly, "never" was not chosen as an option, which pretty much lets us know that all participants have some form of AI in their workflows. It shows that AI is used across the entire marketing team, most frequently and by the majority of members, and employed less often and by the minority of members with less frequency.

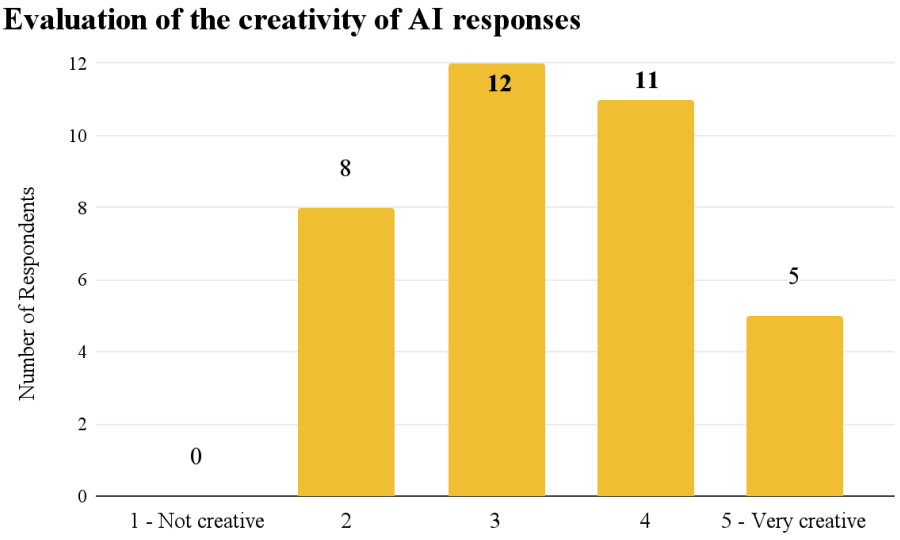

Figure 4.2. Evaluation of the creativity of AI responses

In Figure 4.2, most of the marketing specialists perceive AI's creativity as average to above average, since 64% of respondents think that it is "between 3 and 4" (out of 5),

and only 14% gave a "5" score, which indicated the most creative outputs. Most importantly, no one indicated that AI was entirely uncreative, implying that AI always adds some amount of originality.

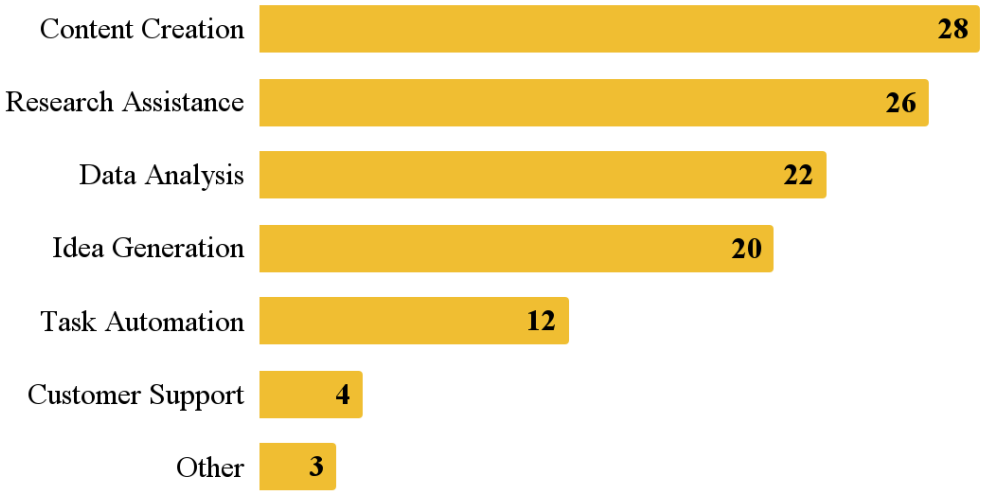

Figure 4.3. Type of Tasks AI is used by respondents

According to Figure 4.3, content creation, research assistance, and data analysis are the main areas of AI employment, followed by using AI for idea generation. It is also less common for tasks automation and customer support. This implies that AI is mostly applied to creative or analytical tasks, but not as much as automation or direct customer interaction.

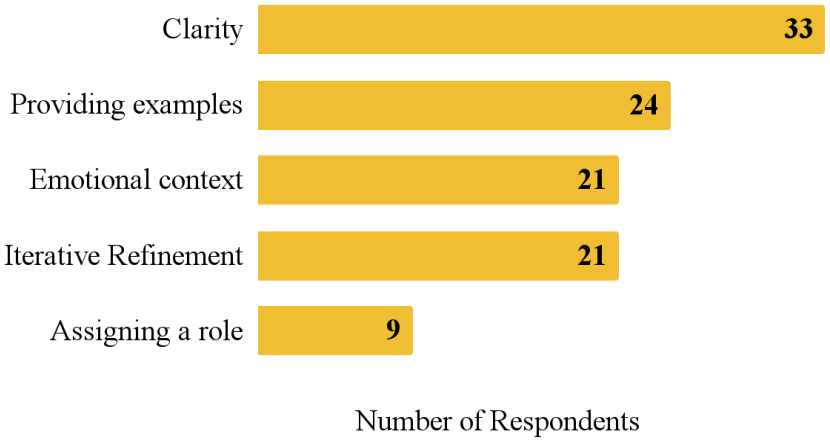

Figure 4.4. Strategies for Improving AI Responses

Figure 4.4 illustrates the number of respondents who reported using each strategy to improve AI responses. Since this was a multiple-choice question, participants were allowed to select all strategies they regularly apply. Therefore, the total count exceeds

the number of respondents, indicating that many users combine several techniques in their interactions with AI.

According to Figure 4.4, clarity was the top choice (33 responses), followed by providing examples (24), emotional context, and iterative refinement (both 21). Assigning a role was the least used (9). This suggests users prioritize prompt precision and examples over role-setting or emotional framing.

Table 4.1. Factors that were ranked by respondents'experience

Factor	Ranking
Clarity	1
Assigning a role	2
Providing Examples	3
Iterative Refinement	4
Emotional context	5

Next, Table 4.1 shows a ranking of factors by the respondents that most influence AI creativity, where clarity, assigning a role, and providing examples were the most important factors (i.e., ranked highest), while emotional context is the least influential (i.e., ranked least influential). This goes against the findings established in the literature, in which Mortillaro & Schlegel (2023) and Ameen et al. (2022), along with Li et al. (2023), point to emotional intelligence as a signifier of how it may increase AI creativity by boosting context relevance and engagement. Two reasons for this discrepancy could have been twofold, where the first reason could be observed in Figure 4.4: emotional context is utilized less frequently, so it could inhibit the responder from realizing the impact the emotional context strategy may or could have in its scheme. The second reason may be due to the misuse of this factor, as respondents may not know how to properly apply it while interacting with AI. The last cause may indicate the need for a training program on emotional context strategy to better understand its applicability in HAC.

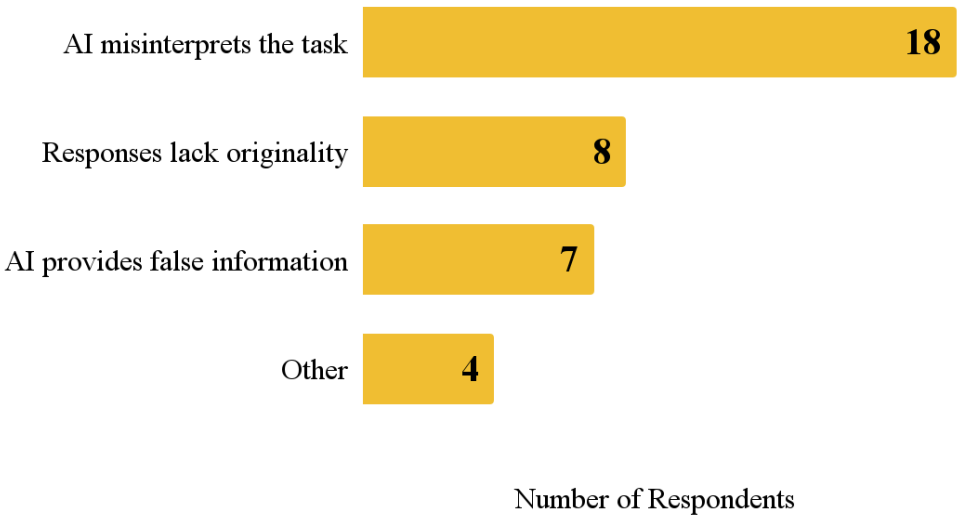

Figure 4.5. Key AI limitations

Misinterpreting tasks or making irrelevant responses is by far the most limiting factor in the use of AI, according to would-be users (Figure 4.5). In addition, issues such as a lack of originality and the creation of false information are not as commonly cited. Some participants added that there are limitations associated with a lack of understanding of the capabilities of AI, which limits the user's creativity. It has also been observed that AI may miss some task requirements when there are multiple conditions. Thus, AI's biggest issue is how accurately it can understand the goal of a user, which can also be solved with the designed training program.

4.2 EI Test Analysis

The test was conducted among 40 marketing specialists, and the results have been analyzed in Figure 4.6. An average value of 5.6 out of 10 on the Validity scale means that the answers of respondents can be considered reliable, but may have some degree of distortions. Respondents with lower validity scores tended to show themselves better or unconsciously tried to give more "socially desirable" answers. A medium level of Inconsistency, a score of 3.7, indicates that the results are generally valid, but some respondents may have had minor inconsistencies in their responses. This may be due to inattention, haste, or difficulty in self-analysis. About the EI scale, the results are closer to level 7, which means most respondents demonstrated a relatively high level of emotional intelligence. As described in Table 3.1, this suggests specialists are capable of recognizing and managing their emotions efficiently.

It was also revealed that the majority of professionals adapt well to changes (average score of 7.3), easily integrate into a new collective and team, and are able to find a

common language with other people. They demonstrate flexibility and the ability to adapt to changing conditions, which shows their openness to new technologies and changes. In addition, the test results show that the overall level of optimism among marketers is high (7.9). Many experts have demonstrated their belief in optimistic outcomes, confidence in achieving goals, and the ability to remain resilient even in difficult situations. This flexible thinking plays an important role in successful collaboration between humans and AI in marketing. An Empathy level has shown relatively high scores, indicating an average of 8, which demonstrates the ability to empathize with other people and to feel their emotional state. However, as demonstrated in Figure 4.6, almost half of the specialists express emotions weakly, which may limit their influence on colleagues, clients, and the audience.

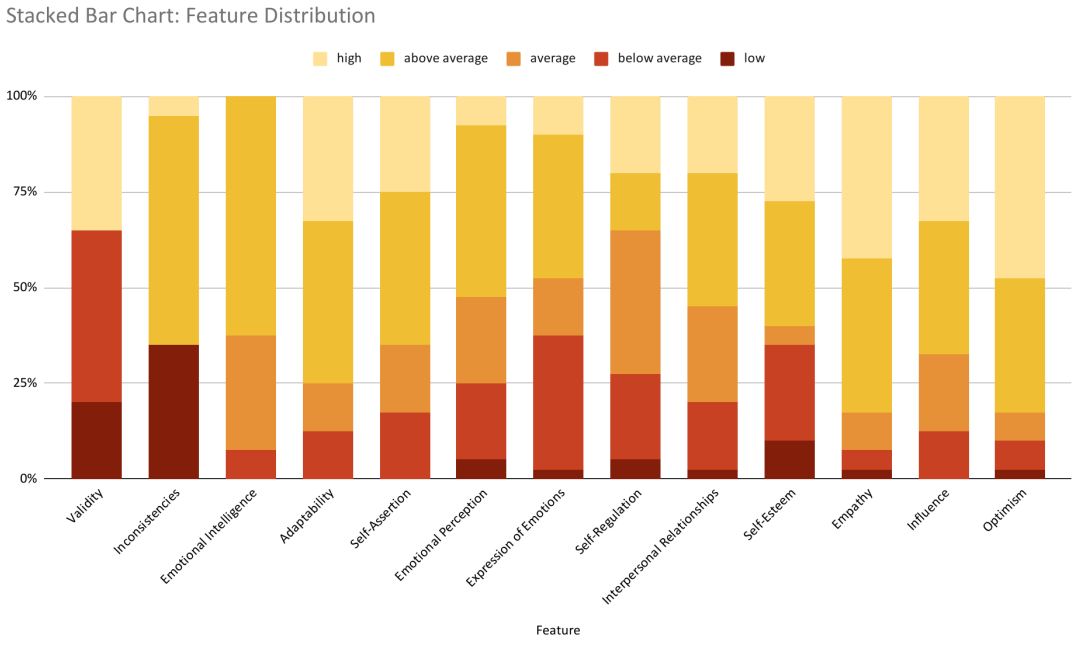

Figure 4.6. Distribution of Features Across Categories

The correlation matrix shown in Figure 4.7 gives an understanding of the relationships between different EI competencies. Some EI competencies may be closely related to others, meaning that improving one competency may improve another one. Results show that specialists who adapt easily to changes tend to build better relationships with others as well. This is confirmed by the high correlation (0.72) between adaptability and interpersonal relationships. In addition, the study showed that the higher the level of emotional intelligence, the more a person can influence others (correlation 0.73). People with high emotional intelligence have a better ability to adapt, which is confirmed by a correlation coefficient of 0.63. However, it was noted that the higher the reliability of

the responses, the lower the level of self-regulation among the respondents. This may indicate that honest respondents are more aware of their weaknesses and are not inclined to overestimate the level of self-control.

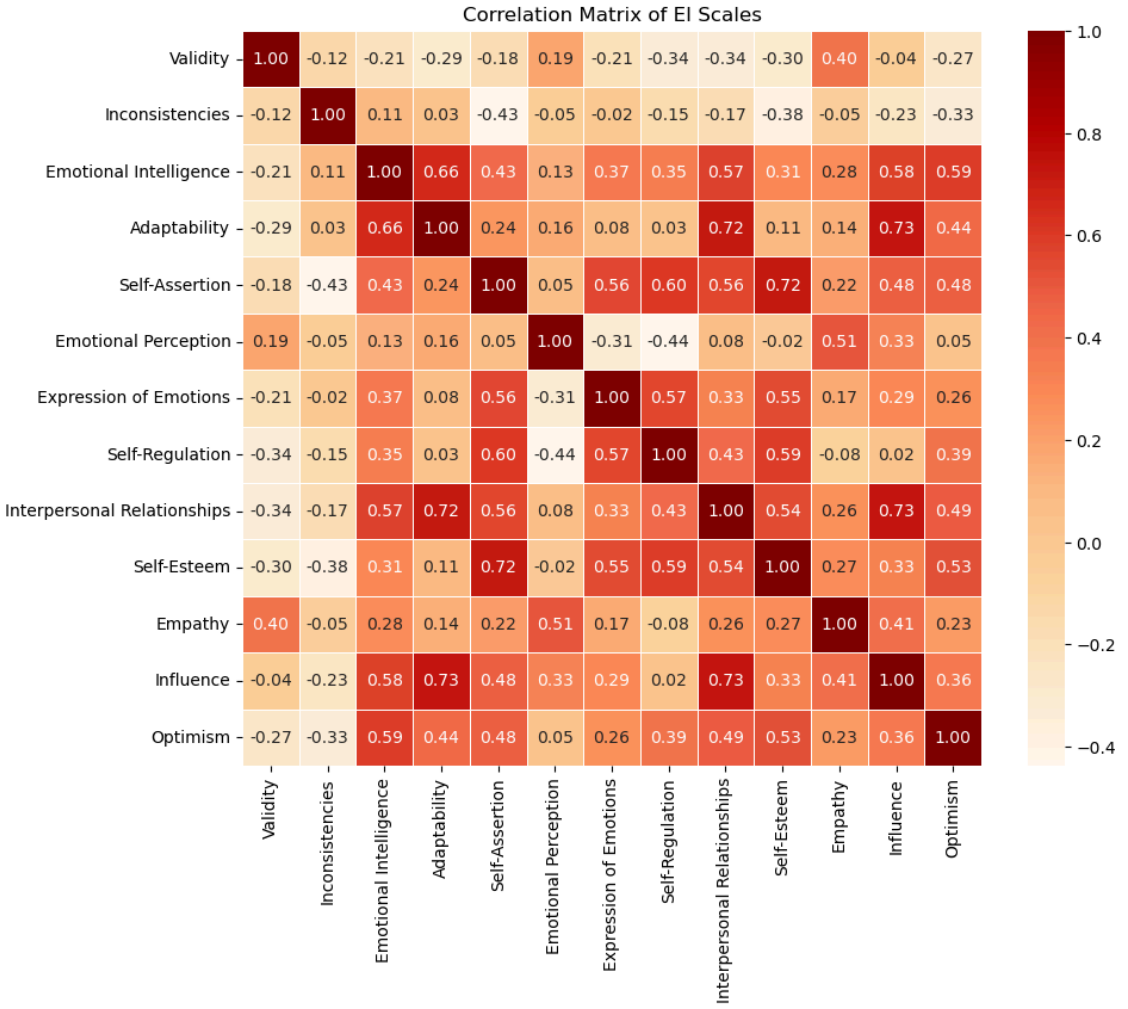

Figure 4.7. Correlation matrix of EI Scales

The test results show that different aspects of emotional intelligence are indeed interconnected, and the test itself works correctly. People with high emotional intelligence adapt more easily, and those who answered honestly were more likely to critically evaluate their self-control. It helps to understand how participants perceive and manage their emotions. These findings may be useful for the training program, as it is not necessary to enhance all dimensions to increase EI; instead, efforts can be focused on improving just one, which will naturally lead to improvements in the others.

4.3 Correlation Analysis

Table 4.2 presents the results of a two-tailed t-test comparing various EI competencies between two groups: participants whose AI-generated responses exhibited low

creativity (C=0) and those with high creativity (C=1). It is noteworthy that the data were not normalized, as all parameters were measured on the same scale (from 1 to 10).

Table 4.2. Two-tailed t-test results

EI Factor	Mean (C=0)	Mean (C=1)	Std Dev (C=0)	Std Dev (C=1)	t-statistic	p-value
Emotional Intelligence	3.579	3.688	0.692	0.479	0.529	0.600
Adaptability	4.105	4.063	0.809	0.998	-0.14	0.889
Self-Assertion	3.632	4	1.116	0.966	1.034	0.309
Emotional Perception	3.211	3.375	1.228	0.885	0.446	0.658
Expression Of Emotions	3	3.625	1.106	1.025	1.722	0.094
Self-Regulation	3.263	3.313	1.408	0.873	0.122	0.904
Interpersonal Relationships	3.579	3.688	1.121	1.078	0.290	0.774
Self-Esteem	3.211	3.813	1.475	1.223	1.299	0.203
Empathy	4	4.25	1.054	1	0.715	0.479
Influence	3.895	4.063	0.937	1.063	0.496	0.623
Optimism	4.211	4.375	1.031	0.619	0.558	0.581

As can be seen in Table 4.2, the Expression of Emotions positively correlates with the Creativity of Responses. Participants with a higher level of emotional expression (average = 3.63) rated the results generated by AI as more creative compared to those with a lower level of emotional expression (average = 3.00). A statistically significant relationship was shown by the value of $p = 0.047$. This result means that people who can effectively express emotions can formulate cues that lead to more innovative and original AI responses. This finding is consistent with previous literature reviews showing that emotionally charged communication improves the quality of artificial intelligence-generated content by making prompts more relevant and engaging in the context of interaction (Hemmer et al., 2024; Li et al., 2023).

Other characteristics of EI, such as adaptability, self-regulation, and emotional perception, did not show significant differences in terms of AI creativity. For example, the average level of adaptability was almost the same (4.105 for less creative users versus 4.062 for more creative users, $p = 0.889$). This means that adaptability is

important for working with AI, but it does not make answers more creative.

4.4 Human-AI Collaboration Framework

Based on the results of our empirical analysis and synthesis of the literature, we propose a structured framework for Human-AI Collaboration that integrates both emotional intelligence and prompting strategies as critical elements influencing the creativity of AI-generated outputs. This framework (Figure 4.8) captures the key mechanisms through which human input contributes to the quality and creativity of collaborative AI interactions, serving as one of the core contributions of this study.

At the foundation of the model lies Human Input, which is divided into two primary domains: Prompting Strategies and Emotional Intelligence. Prompting strategies are further categorized into non-emotional factors (such as clarity, iterative refinement, and role assignment) and emotional factors (such as expression of emotion intelligence operate in parallel, enabling users to effectively express emotions in a way that enhances the human-AI interaction process.

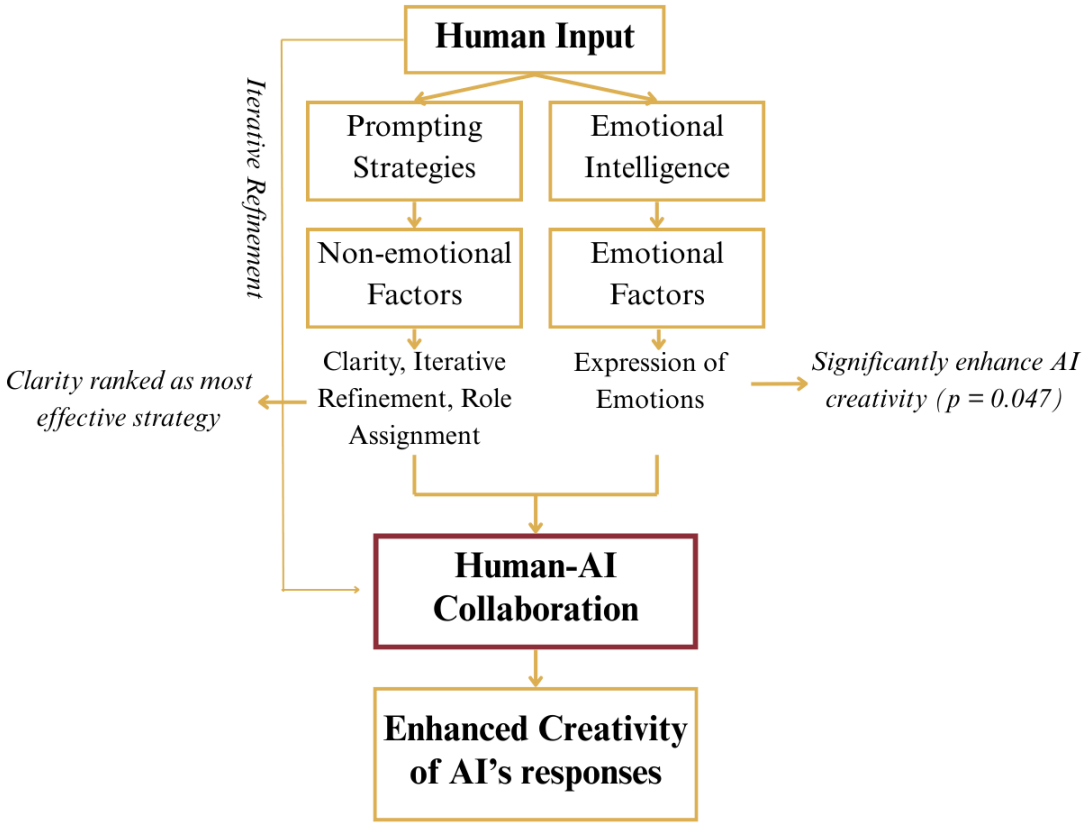

Figure 4.8. Framework for HAC

Among the non-emotional strategies, clarity was ranked as the most effective by

participants, reflecting its importance in guiding AI systems toward more accurate and creative outputs. In terms of emotional strategies, emotional expression was found to significantly enhance AI creativity ($p = 0.047$), confirming its moderating role and practical value in creative tasks.

These inputs feed into the Human-AI Collaboration process, which is not linear but iterative. As shown in the framework, there is a continuous refinement loop - users observe the AI's output and adjust their inputs accordingly, which is also considered as iterative refinement in this study.

Ultimately, the output of this interaction is the enhanced creativity of AI responses, which serves as the core goal of this collaboration. The framework also highlights that optimal creativity emerges not from technical precision alone, but from the combined effect of emotional intelligence, prompt structure, and user adaptability.

This framework not only synthesizes our theoretical insights and empirical findings but also lays the groundwork for the training program. It can serve as a foundation for future educational programs aimed at improving professionals' ability to collaborate effectively with AI tools.

4.5 Experiment

The experiment was conducted to define how the application of strategies influenced the outputs compared to initial results, which strategies helped to gain the most creative result, and how the strategies affect responses of people with different EI levels (Appendix B). As illustrated in Figure 4.9, Specialist 1, with an above-average EI level (8/10), showed higher results even before applying any strategies, which confirms that high EI levels naturally support creativity and emotional depth in responses. The basic prompts were intuitive, emotionally rich, unconstrained, and free, and the work style demonstrated flexibility and emotional involvement in the process.

Despite the high initial results, Specialist 1 showed a slight deterioration after applying the strategies. In non-emotional strategies, such as Clarity and Role Assignment, the results decreased. This can be interpreted by the fact that an intuitive approach is more important for individuals with high EI, and strategies that require strict adherence could limit natural creativity and the ability to express emotions. Moreover, looking at the initial prompts, it is clear that a mix of various factors was already employed, which could have contributed to the initial outstanding results.

On the other hand, Specialist 2, with a low EI level (4/10), had much lower results before trying the strategies. This is typical for people with low EI because the inputs

were more logical and structured, and the outputs were less emotional. Generating high-quality answers was more difficult, but as the specialist noticed, familiarization with the strategies increased performance quite significantly. The use of the Iterative Refinement (mean value = 67) and Role Assignment (mean value = 63) methods especially showed high results. Specialist 2 also observed that before the experiment, it was not considered that the Expression of Emotions could help achieve more creative results, which suggests that awareness and embedding emotion can improve outcomes, especially in creative industries.

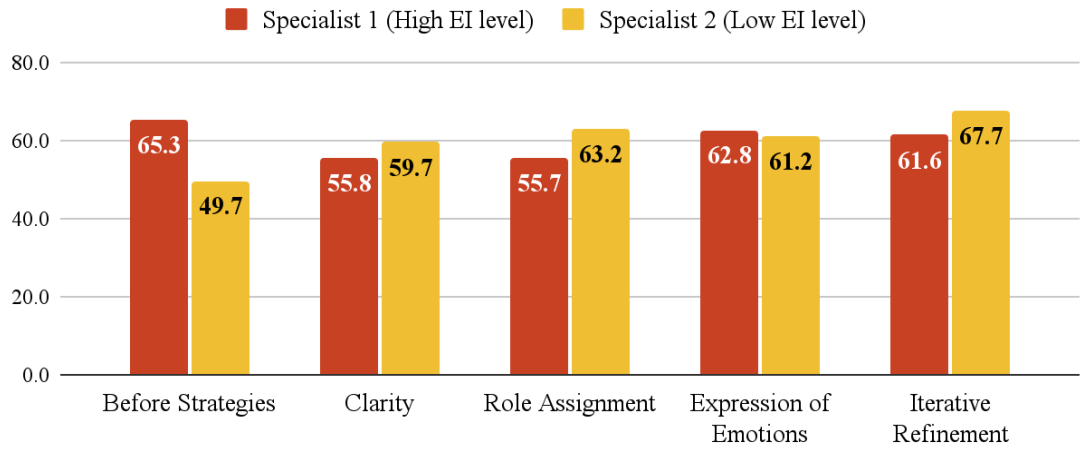

Figure 4.9. Impact of Strategies on Creative Results

For both participants, the Expression of Emotions and Iterative Refinement strategies led to higher outcomes, showing the effectiveness of these strategies. After the application of the Clarity strategy, neither of the individuals showed significant growth in results. This can be explained by the fact that Clarity requires a very structured, clear, and formal expression of thought, and could limit freedom of interpretation and rigidly formulate queries. This reduces creativity because rigid frameworks suppress intuitive, non-standard ideas, especially in people with high EI (who work better through emotions and intuition).

Our experiment shows that even for people with low EI, CPS can be increased if they are familiar with emotional and non-emotional strategies and have the opportunity to practice.

4.6 Training

The results of the training program revealed the impact of training on the way participants interacted with the AI tool and the quality of the output generated, following the application of four prompting strategies. The results showed that the most

effective technique was Role assignment and that Clarity remained a fundamental element of a strong prompt.

According to the pre-training survey, more than 79% of participants use AI tools daily. However, as indicated in the pre-survey, only 25% rated AI-generated responses as Excellent in terms of creativity, while strategies such as role assignment and emotional expression were less used or misunderstood, with 12.5-16.7% rating them as low impact or never tried them.

Clarity

Many participants reported how Clarity was already a well-known and intuitive term for them, which led to the relatively high baseline ratings on the pre-survey and small changes (+8.4% on an 80-100% effectiveness rating) after the training. The training helped solidify its importance, but did not introduce a novel method for most.

Role Assignment

The most dramatic shift occurred with Role Assignment, where participants rated its effectiveness as high, more than twice as often post-training (from 29.2% to 66.7%). Many participants reported that when they were tasked with creating a promotional poster for the Engineering Management Master's program, they were able to assign a role to the AI by asking it to act ‘like a programme director’ or ‘like a professional recruiter’, and it was an approach that helped them achieve *more* imaginative and contextualised results.

Iterative Refinement

Effectiveness ratings for Iterative Refinement rose from 29.2% to 58.3% post-training. Feedback from participants indicated that most of these participants had been implicitly practising repetition prompts before attending the training, and had been re-creating prompts (and sometimes submitting new prompts) without knowing it.

The training led them to think of iteration as a structured and deliberate collaborative loop rather than a trial-and-error process. This shift in perspective not only improved the quality of the AI's responses but also changed the participants' mindset from passive users to active co-creators who guided the AI towards more sophisticated outcomes.

Expression of Emotions

After the training, the perceived effectiveness of the Expression of Emotions strategy increased from 29.2% to 54.2%, marking a significant change in how participants evaluated the role of emotion-oriented prompts in improving AI creativity. Before the training, many participants viewed this strategy with a bit of skepticism, expressing uncertainty about whether emotional framing, such as excitement or empathy, would

make a real difference to AI quality. However, during the activity, most of them found that emotionally framed prompts (e.g., "Make it inspiring", "Highlight the student experience" or "Use a passionate tone") led to more engaging and creative content. Although they initially thought the emotional tone was insignificant, they gradually realized its value in influencing the voice and human image of AI-generated text, especially in contexts that require creativity, storytelling, or audience engagement. This confirms that emotionally enriched interactions can act as a cognitive lever in creative tasks of artificial intelligence, increasing the creativity of its results, as well as user satisfaction and perception of collaborative activities.

Table 4.3. Effectiveness Gain of Prompting Strategies After Training

Strategy	% Change in Top Ratings (80–100%)	Key Takeaway
Role Assignment	+37.5%	Most impactful after training
Iterative Refinement	+29.1%	Strong second; helped deepen outputs
Expression of Emotions	+25.0%	Improved trust in emotional tone boosting
Clarity	+8.4%	Already used - training reinforced its value

Overall, the results given in Table 4.3 show that the training significantly influenced the interaction of participants with AI tools in order to achieve better results. While Clarity served as a necessary foundation, it was the Role assignment that most significantly changed both the perceived effectiveness and the practical effect.

Table 4.4. Comparison of Pre- and Post-Survey Metrics

Factor	Pre-survey Mean	Post-survey Mean	t-statistic	p-value
Clarity	2.230	2.410	-0.890	0.383
Role Assignment	2.910	2.360	2.238	0.036

Factor	Pre-survey Mean	Post-survey Mean	t-statistic	p-value
Iterative Refinement	3.050	2.320	3.167	0.005
Expression of Emotions	2.910	2.910	0.000	1.000

Most notably, the training helped participants to reshape their expectations of what AI can do. Based on their feedback, it was discovered that after applying the prompting strategies in practice, they realized that AI can actually achieve very creative and high-quality results. This shift is also reflected in Figure 4.10, where the average evaluation of all four prompting strategies increased after the training. However, the results are provided in Table 4.4, where the t-statistics and their p-values demonstrate the insignificance of two of the factors, such as Clarity and Expression of Emotions. It is also important to mention that the number of samples is only twenty-two, which might affect the p-value results; therefore, the absolute percentage change in rankings is provided in Table 4.3.

These results are in line with previous research suggesting that users often underestimate the creative potential of AI due to their limited knowledge of how to interact effectively with AI. As Beretta (2023) notes, low AI literacy can lead to misinterpretation of AI capabilities and, as a result, a limited perception of its value in creative tasks.

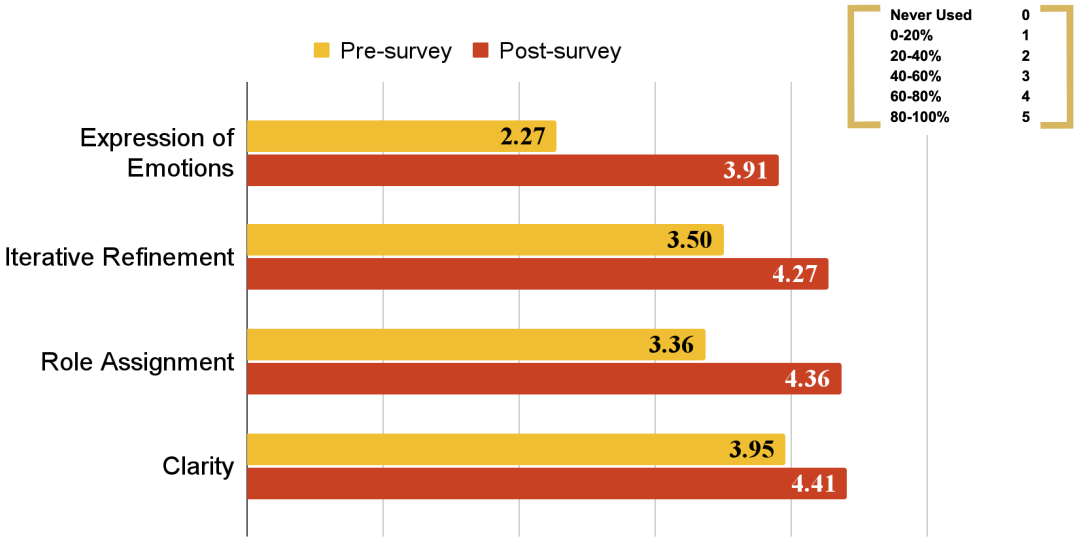

Figure 4.10. Average Evaluation of Factors Before and After Training

In our case, by learning to engage more strategically with AI, participants transitioned from passive use to active co-creation, supporting Ameen et al. (2022)'s argument that human intervention, especially in rapid design and final validation, is essential for creativity in HAC. Our results therefore reinforce the importance of introducing emotional intelligence-focused strategies to HAC and demonstrate that with proper knowledge, users not only improve AI performance but also redefine their role as creative collaborators in the process.

4.7 Implications of the Study

Even though this study had a focus group of marketing specialists, the developed HAC framework has broad relevance across a range of industries. Its key concepts are applicable in education, consulting, healthcare, and other areas, where blending of EI with AI can improve innovation, decision-making, personalization, and user engagement (Ameen et al., 2022; Hemmer et al., 2024; Kolomaznik et al., 2024; Zhang et al., 2024; Zhai & Wibowo, 2023).

To fully realize these benefits, organizations should invest in targeted training programs that teach professionals how to apply emotional intelligence and strategic prompt engineering when working with AI. Without structured education, users risk misinterpreting AI capabilities or relying on AI outputs superficially (Beretta, 2023; Ng et al., 2021). Training should focus on building skills in emotional framing, iterative prompt refinement, and managing the emotional tone of interactions to optimize collaboration outcomes.

Furthermore, there is a strong recommendation to promote prompt engineering literacy as an emerging design skill (Karakaya, 2025; Sikha et al., 2023). Professionals across industries should be equipped to craft clear, context-rich prompts and adapt them dynamically based on AI responses. Additionally, developing emotional framing awareness—how tone and affect influence AI outputs—can further strengthen collaboration and foster more trust-rich, human-centered interactions (Kolomaznik et al., 2024).

Finally, fostering a culture of continuous learning and ethical awareness around AI use is essential. Organizations should encourage teams to share effective techniques, openly discuss AI’s limitations, and remain attentive to potential biases (Shneiderman, 2020). By adopting these practices, businesses can transform AI from a technical tool into a collaborative partner that amplifies creativity, empathy, and human effectiveness across diverse fields.

5. Conclusion

This study aimed to examine the influence of EI and prompt engineering strategies on HAC in CPS. This research provides multi-dimensional insights on how human emotional and cognitive factors shape the creativity of AI's outputs by combining findings from the literature review and empirical evidence from the survey, experiment, and training program.

After creating the theoretical framework with the inclusion of all found factors affecting HAC, the study proceeded with the survey, which in turn showed that while AI is widely adopted by marketing professionals, its creative capabilities are still limited. Moreover, while non-emotional factors (clarity, role assignment, and iterative refinement) were proven by respondents in their effectiveness, emotional ones were underutilized, despite the strong theoretical support for their impact. The gap between theory and practice highlighted the need for a structured framework and training.

Based on the correlation between EI competencies obtained from the EI test and survey results, the Expression of Emotions was significantly associated with higher creativity in AI-generated responses ($p = 0.047$). Other factors, such as adaptability and self-esteem, did not show a statistically significant relationship with increased creativity. Insights obtained from the EI test and survey were the foundation of the HAC framework, which was the main goal of the study.

The experiment with two marketing specialists has provided more valuable information to the framework. Its results demonstrated that individuals with high emotional intelligence had already naturally high creativity of AI's outputs, and their results were not significantly different when prompting strategies were introduced to them. In contrast, low-EI individuals got significantly improved results after training, where the Role Assignment and Iterative Refinement were the most efficient.

Conducted training programs have replicated improved results, but on a bigger scale. Responses of 22 participants were considerably improved, with +37.5% improvement in Role Assignment, +29.1% in Iterative Refinement, and +25% in Expression of Emotions factors. These results indicate the effectiveness of the identified factors themselves and the training program as a whole.

Despite the strong contributions of the study, two key limitations need to be acknowledged in future research. First, the study, specifically the training program, measured more immediate shifts in participants' perception and only self-assessed creativity of AI's outputs, which demonstrated only short-term effects. Secondly, only

text-based Human-AI Collaboration was considered under the scope of this study. Therefore, longitudinal studies should be conducted in the future, where training effects persist over time and lead to sustained improvements in human-AI interactions. Furthermore, integrating multimodal collaboration settings (e.g., combining text, voice, and visual creativity) would offer valuable insights into the future of emotionally intelligent AI-human teaming.

References

Abdoelrazak, S. (2023). Creativity behind the prompts: Automated creativity assessment in prompting for text-to-image models (Master's thesis, Utrecht University). *Utrecht University Repository*. https://studenttheses.uu.nl/handle/20.500.12932/47677

Ameen, N., Sharma, G. D., Tarba, S., Rao, A., & Chopra, R. (2022). Toward advancing theory on creativity in marketing and artificial intelligence. *Psychology & Marketing*, *39*(9), 1802-1825. https://doi.org/10.1002/mar.21699

Anantrasirichai, N., & Bull, D. (2021). Artificial intelligence in the creative industries: A review. *Artificial Intelligence Review, 55*(1), 589–656. https://doi.org/10.1007/s10462-021-10039-7

Bansal, P. (2024). Prompt engineering importance and applicability with generative AI. Journal of Computer and Communications, 12(10), 14-23. https://doi.org/10.4236/jcc.2024.1210002

Benner, M. J., & Tushman, M. L. (2003). Exploitation, exploration, and process management: The productivity dilemma revisited. *Academy of Management Review, 28*(2), 238–256. https://doi.org/10.5465/amr.2003.9416096

Beretta, B. (2023). The impact of AI literacy on the emotional reaction to AI mistakes in human-AI collaboration (Bachelor's thesis). *University of Twente*. https://purl.utwente.nl/essays/98115

Beurer-Kellner, L., Fischer, M., & Vechev, M. (2023). Prompting is programming: A query language for large language models. *Proceedings of the ACM on Programming Languages*, *7*(PLDI), 1946-1969. https://doi.org/10.1145/3591300

Brown, T., Mann, B., Ryder, N., Subbiah, M., Kaplan, J. D., Dhariwal, P., Neelakantan, A., Shyam, P., Sastry, G., Askell, A., Agarwal, S., Herbert-Voss, A., Krueger, G., Henighan, T., Child, R., Ramesh, A., Ziegler, D., Wu, J., Winter, C., … Amodei, D. (2020). Language models are few-shot learners. *Advances in Neural Information Processing Systems, 33*, 1877–1901. https://papers.nips.cc/paper_files/paper/2020/hash/1457c0d6bfcb4967418bfb8ac142f64a-Abstract.html

Cardoso, C., & Badke-Schaub, P. (2011). The influence of different pictorial representations during idea generation. *The Journal of Creative Behavior, 45*(2), 130–146. https://doi.org/10.1002/j.2162-6057.2011.tb01092.x

Cui, H., & Yasseri, T. (2024). AI-enhanced collective intelligence. *Patterns*, *5*(11), 101074. https://doi.org/10.1016/j.patter.2024.101074

Dang, H., Mecke, L., Lehmann, F., Goller, S., & Buschek, D. (2022). How to prompt? Opportunities and challenges of zero- and few-shot learning for human-AI interaction in creative applications of generative models. In Proceedings of the CHI'22 Workshops. ACM. https://doi.org/10.48550/arXiv.2209.01390

Ekin, S. (2023). Prompt engineering for ChatGPT: A quick guide to techniques, tips, and best practices. TechRxiv. https://doi.org/10.36227/techrxiv.22683919.v1

Esling, P., & Devis, N. (2020). Creativity in the era of artificial intelligence. *ArXiv*. https://doi.org/10.48550/arXiv.2008.05959

Hemmer, P., Schemmer, M., Kühl, N., Vössing, M., & Satzger, G. (2024). Complementarity in Human-AI Collaboration: Concept, Sources, and Evidence. *ArXiv*. https://doi.org/10.48550/arXiv.2404.00029

Heyns, B. (2024, November 22). Effective human-AI collaboration strategies for enhanced productivity and innovation. SmythOS. https://smythos.com/artificial-intelligence/human-ai-collaboration/human-ai-collaboration-strategies/#understanding-the-core-principles-of-human-ai-collaboration

Kaasinen, E., Anttila, A., Heikkilä, P., Laarni, J., Koskinen, H., & Väätänen, A. (2021). Smooth and Resilient Human–Machine Teamwork as an Industry 5.0 Design Challenge. *Sustainability*, *14*(5), 2773. https://doi.org/10.3390/su14052773

Karakaya, K. (2025). Human-AI interaction with large language models in complex information tasks: Prompt engineering strategies. Asian Journal of Distance Education, 20(1), 25-33. https://doi.org/10.5281/zenodo.14585787

Katila, R., & Ahuja, G. (2002). Something old, something new: A longitudinal study of search behavior and new product introduction. *Academy of Management Journal, 45*(6), 1183–1194. https://doi.org/10.2307/3069433

Khare, S. K., Blanes-Vidal, V., Nadimi, E. S., & Acharya, U. R. (2024). Emotion recognition and artificial intelligence: A systematic review (2014–2023) and research recommendations. *Information Fusion, 102*, Article 102019. https://doi.org/10.1016/j.inffus.2023.102019

Knop, M., Weber, S., Mueller, M., & Niehaves, B. (2022). Human factors and technological characteristics influencing the interaction of medical professionals with artificial intelligence–enabled clinical decision support systems: literature review. *JMIR Human Factors*, *9*(1), e28639. https://doi.org/10.2196/28639

Kolomaznik, M., Petrik, V., Slama, M., & Jurik, V. (2024). The role of socio-emotional attributes in enhancing human-AI collaboration. *Frontiers in Psychology, 15,* Article 1369957. https://doi.org/10.3389/fpsyg.2024.1369957

Lee, N. (2024). Artificial intelligence and data mining. In *Counterterrorism and cybersecurity: Total information awareness* (pp. 379–398). Springer International Publishing. https://doi.org/10.1007/978-3-031-63126-9_13

Lenat, D., & Marcus, G. (2023). Getting from Generative AI to Trustworthy AI: What LLMs might learn from Cyc. *ArXiv*. https://doi.org/10.48550/arXiv.2308.04445

Li, C., Wang, J., Zhang, Y., Zhu, K., Hou, W., Lian, J., Yang, Q., & Xie, X. (2023). Large language models understand and can be enhanced by emotional stimuli. arXiv. https://arxiv.org/abs/2307.11760

Lo, L. S. (2023). The art and science of prompt engineering: A new literacy in the information age. Internet Reference Services Quarterly, 27(4), 203–210. https://doi.org/10.1080/10875301.2023.2227621

Ma, L., & Sun, B. (2020). Machine learning and AI in marketing: Connecting computing power to human insights. *International Journal of Research in Marketing, 37*(3), 481–504. https://doi.org/10.1016/j.ijresmar.2020.04.005

Ma, S., Wang, X., Lei, Y., Shi, C., Yin, M., & Ma, X. (2024). "Are you really sure?" Understanding the effects of human self-confidence calibration in AI-assisted decision making. In *Proceedings of the 2024 CHI Conference on Human Factors in Computing Systems* (pp. 1-20). https://doi.org/10.1145/3613904.3642671

Mallick, R., Flathmann, C., Lancaster, C., Hauptman, A., McNeese, N., & Freeman, G. (2024). The pursuit of happiness: the power and influence of AI teammate emotion in human-AI teamwork. Behaviour & Information Technology, 43(14), 3436-3460. https://doi.org/10.1080/0144929X.2023.2277909

March, J. G. (1991). Exploration and exploitation in organizational learning. *Organization Science, 2*(1), 71–87. https://doi.org/10.1287/orsc.2.1.71

Mayer, J. D., Salovey, P., & Caruso, D. R. (2004). Emotional intelligence: Theory, findings, and implications. *Psychological Inquiry, 15*(3), 197–215. https://doi.org/10.1207/s15327965pli1503_02

McCormack, J., Hutchings, P., Gifford, T., Yee-King, M., Llano, M. T., & D'inverno, M. (2020). Design considerations for real-time collaboration with creative artificial intelligence. *Organised Sound*, *25*(1), 41-52. https://doi.org/10.1017/S1355771819000451

Mortillaro, M., & Schlegel, K. (2023). Embracing the emotion in emotional intelligence measurement: Insights from emotion theory and research. *Journal of Intelligence, 11*(11), Article 210. https://doi.org/10.3390/jintelligence11110210

Ng, D. T., Leung, J. K., Chu, S. K., & Qiao, M. S. (2021). Conceptualizing AI literacy: An exploratory review. *Computers and Education: Artificial Intelligence, 2*, Article 100041. https://doi.org/10.1016/j.caeai.2021.100041

Park, J., & Choo, S. (2024). Generative AI prompt engineering for educators: Practical strategies. Journal of Special Education Technology, 0(0), 1–7. https://doi.org/10.1177/01626434241298954

ProfDialog. (2024). Тест эмоционального интеллекта для персонала. Retrieved December 26, 2024 from https://prof-dialog.ru/test-eq

Ray, P. P. (2022). ChatGPT: A comprehensive review on background, applications, key challenges, bias, ethics, limitations and future scope. *Internet of Things and Cyber-Physical Systems*, *3*, 121-154. https://doi.org/10.1016/j.iotcps.2023.04.003

Raz, T., Reiter-Palmon, R., & Kenett, Y. N. (2023). The role of asking more complex questions in creative thinking. *Psychology of Aesthetics, Creativity, and the Arts, Advance online publication*. https://doi.org/10.1037/aca0000658

Rodriguez, A. D., Dearstyne, K. R., & Cleland-Huang, J. (2023). Prompts matter: Insights and strategies for prompt engineering in automated software traceability. Proceedings of the 31st IEEE International Requirements Engineering Conference Workshops (REW), 455-464. https://doi.org/10.1109/REW57809.2023.00087

Shneiderman, B. (2020). Human-Centered Artificial Intelligence: Reliable, Safe & Trustworthy. *International Journal of Human–Computer Interaction, 36*(6), 495–504. https://doi.org/10.1080/10447318.2020.1741118

Sikha, V. K., Siramgari, D., & Korada, L. (2023). Mastering prompt engineering: Optimizing interaction with generative AI agents. Journal of Engineering and Applied Sciences Technology, 5(6), 1-8. https://doi.org/10.47363/JEAST/2023(5)E117

Stone, M., Aravopoulou, E., Ekinci, Y., Evans, G., Hobbs, M., Labib, A., Laughlin, P., Machtynger, J., & Machtynger, L. (2020). Artificial intelligence (AI) in strategic marketing decision-making: A research agenda. *The Bottom Line: Managing Library Finances, 33*(2), 183–200. https://doi.org/10.1108/bl-03-2020-0022

Terveen, L. G. (1995). Overview of human-computer collaboration. *Knowledge-Based Systems, 8*(2), 67–81. https://doi.org/10.1016/0950-7051(95)98369-H

Titus, P. A. (2000). Marketing and the creative problem-solving process. *Journal of Marketing Education, 22*(3), 225–235. https://doi.org/10.1177/0273475300223006

Vicci, H. (2024). Emotional intelligence in artificial intelligence: A review and evaluation study. *SSRN Preprints*. http://dx.doi.org/10.2139/ssrn.4818285

Vinchon, F., Lubart, T., Bartolotta, S., Gironnay, V., Botella, M., Bourgeois-Bougrine, S., Burkhardt, M., Bonnardel, N., Corazza, G. E., Glăveanu, V., Hanson, M. H., Ivcevic, Z., Karwowski, M., Kaufman, J. C., Okada, T., Reiter-Palmon, R., & Gaggioli, A. (2023). Artificial Intelligence & Creativity: A Manifesto for Collaboration. *The Journal of Creative Behavior*, *57*(4), 472-484. https://doi.org/10.1002/jocb.597

Vössing, M., Kühl, N., Lind, M., & Satzger, G. (2022). Designing transparency for effective human-AI collaboration. *Information Systems Frontiers, 24*(3), 877–895. https://doi.org/10.1007/s10796-022-10284-3

Wu, N., Gong, M., Shou, L., Liang, S., & Jiang, D. (2023). Large language models are diverse role-players for summarization evaluation. In *Lecture Notes in Computer Science* (pp. 695–707). Springer. https://doi.org/10.1007/978-3-031-44693-1_54

Zamfirescu-Pereira, J. D., Wong, R. Y., Hartmann, B., & Yang, Q. (2023). Why Johnny can't prompt: How non-AI experts try (and fail) to design LLM prompts. In *Proceedings of the 2023 CHI Conference on Human Factors in Computing Systems* (Article 437, pp. 1–21). ACM. https://doi.org/10.1145/3544548.3581388

Zhai, C., & Wibowo, S. (2023). A systematic review on artificial intelligence dialogue systems for enhancing English as a foreign language students' interactional competence in the university. *Computers and Education: Artificial Intelligence, 4*, Article 100134. https://doi.org/10.1016/j.caeai.2023.100134

Zhang, X., Talukdar, N., Vemulapalli, S., Ahn, S., Wang, J., Meng, H., Bin Murtaza, S. M., Leshchiner, D., Dave, A. A., Joseph, D. F., Witteveen-Lane, M., Chesla, D., Zhou, J., & Chen, B. (2024). Comparison of Prompt Engineering and Fine-Tuning Strategies in Large Language Models in the Classification of Clinical Notes. *AMIA Summits on Translational Science Proceedings*, *2024*, 478. https://pmc.ncbi.nlm.nih.gov/articles/PMC11141826/

Zhao, M., Simmons, R., & Admoni, H. (2022). The Role of Adaptation in Collective Human–AI Teaming. *Topics in Cognitive Science*. https://doi.org/10.1111/tops.12633

Appendix A: Survey's Questions

Q1. How often do you use AI in your work?

- Frequently – almost every day
- Occasionally – several times a week
- Rarely – a few times a month
- Never

Q2. How creative do you find AI's responses to your requests?
(Considering originality, depth, and unconventional approach)
Rate on a scale from 1 to 5:

1 – Not creative at all
5 – Very creative

Q3. For which tasks do you use AI in your work? (Select all that apply.)

- Content creation (posts, blogs, scripts, videos, audio, images)
- Research assistance (article summaries, fact-checking, information retrieval)
- Data analysis (processing, forecasting, reporting)
- Idea generation (creative concepts, strategies)
- Task automation and programming (routine process automation, script writing, and optimization)
- Customer support (chatbots, automated replies, FAQ handling)
- Other: ____

Q4. What strategies do you often use to improve AI responses? (Select all that apply)

- Clear and detailed query formulation (avoiding vague wording, specifying details, and concise explanations)
- Providing examples (demonstrating an "ideal" response, using tables, images)
- Re-submitting queries with refinements (gradually modifying the prompt for better results)
- Adding emotional context (phrases like "this is very important to me" or "I'd really appreciate it")
- Assigning a role to AI (e.g., "act as an expert," "analyze this as a marketer")
- Other: ____

Q5. Rank the factors influencing AI's creativity from most (1) to least effective (5):

- Clarity of instructions (concise and avoiding vague phrasing)
- Providing examples (demonstrating the desired output)
- Emotional context (highlighting importance or emotions)
- Refining queries with additional details
- Assigning a role to AI (e.g., "analyze this as an expert")

Q6. Which AI drawback affects your work the most?

- AI misinterprets tasks or provides irrelevant responses
- AI responses are repetitive, cliché, or lack originality
- AI generates false information, citing nonexistent or unreliable sources
- Other: ____

Appendix B: Experiment's tasks

1. As a marketing specialist for a travel agency, write a captivating hotel description for the luxury hotel Four Seasons in Greece. The description will be used on travel websites like HT.KZ or Booking.

2. Create a powerful slogan for Patagonia, an eco-friendly clothing brand. It should be suitable for Instagram, its website, stores, and ads.

3. Develop a creative social media video concept for Umami Café in Almaty to promote their new craft ice cream flavors (mint-choco, lavender, and cookie dough) and boost engagement.

Appendix C: Experiment

Figure C.1. The Picture obtained during the Experiment

Appendix D: Training

Figure D.1. The Photo obtained during Training

Appendix E: Survey questions during the Training

Q1. How frequently do you use AI tools in your academic work, group projects, personal assignments, or daily life?

- Often - almost every day
- Sometimes - several times a week
- Rare - several times a month
- Never

Q2. How would you evaluate the **Creativity** (*originality and depth*) of the AI-generated answers that you usually get?

- Very poor - Lacks any creativity or insight
- Poor - Answers are generic, not helpful enough
- Neutral - Slightly better, but still lacks originality
- Good - Answers are relevant but not deep
- Excellent - Deep, creative, and directly answers the question

Q3. On a scale from 0% to 100%, how effective do you think the **Clarity** strategy in your prompts is improving the creativity of AI-generated responses? (Clarity means a *specific and detailed request so AI can better understand what you're asking for*.)

- 0-20%
- 20-40%
- 40-60%

- 60-80%
- 80-100%
- I've never used this strategy before

Q4. How would you rate the effectiveness (on a scale from 0 to 100%) of applying the **Role Assignment** strategy (*e.g., telling AI phrases like "Imagine you are a professor"*) in your prompts to enhance AI's creativity?

- 0-20%
- 20-40%
- 40-60%
- 60-80%
- 80-100%
- I've never used this strategy before

Q5. How would you rate the effectiveness (on a scale from 0 to 100%) of applying the **Iterative Refinement** strategy (*asking AI to refine its answers iteratively*) in your prompts to enhance AI's creativity?

- 0-20%
- 20-40%
- 40-60%
- 60-80%
- 80-100%
- I've never used this strategy before

Q6. How would you rate the effectiveness (on a scale from 0 to 100%) of applying the **Expression of Emotions** strategy (*e.g., highlighting the importance of the question to you or saying something like, "I will be so happy"*) in your prompts to enhance AI creativity?

- 0-20%
- 20-40%
- 40-60%
- 60-80%
- 80-100%
- I've never used this strategy before

Notes: