

*Article*

## **Creativity in the AI Era: Humans vs. ChatGPT in Unprompted Playful Language Tasks**

**Tan Bee Tin**

University of Auckland, New Zealand

Received: 25 November, 2024/Received in revised form: 15 January, 2025/Accepted: 20 January, 2025/Available online: 15 February, 2025

### **Abstract**

Creativity is undergoing significant transformation with the growing adoption of AI-powered text generation tools like ChatGPT. Nowadays, teachers are faced with pseudo-creativity scenarios where students can use AI to produce texts of various kinds and present them as if they were their own. To envision the future of creativity in the AI era, it is important to reflect on what creativity was like in the pre-ChatGPT era, what aspects of creativity might be affected in the AI era, and whether AI can compete with humans in demonstrating unprompted playful language use even in a mundane ordinary task. In this paper, I revisited a past pedagogical task employed with students in the pre-ChatGPT era and compared their behaviour with ChatGPT's performance. The task involves filling in a missing line in partially incomplete texts and reflecting on the process involved. The findings show that although ChatGPT's responses could mimic students' responses regarding exploratory creativity, the ability to demonstrate unprompted transformational creativity (a higher form of creativity) is observed only in human responses. Despite producing similar outcomes, the processes underlying students' responses differ, shaped by their unique personal, socio-cultural and emotional experiences and different thinking styles. While both students and ChatGPT show cognitive fixation at an individual level, students as a group display a variety of thinking styles, reflecting collective diversity. Improper use of AI tools such as ChatGPT can result in collective novelty decay and deprive us of valuable cognitive opportunities to reflect on, draw from, and reshape our personal, emotional and socio-cultural experiences and to engage in unprompted creativity when performing a language task.

### **Keywords**

Creativity, constraints, ChatGPT, AI and human creativity, unprompted playful tasks.

## 1 Introduction: Creativity in the AI Era

The increasing use of AI-powered text generation tools, such as ChatGPT (Chat Generative Pre-trained Transformer), has raised concerns about creativity in education and reignited discussions about the nature of creativity (Carvalho & Ribeiro, 2023). Students can now use AI to produce various texts, presenting them as original work (e.g., Vinchon et al., 2023). This development poses a significant threat to the traditional view of creativity as a uniquely human ability and a key educational objective. Researchers have questioned whether ChatGPT and other AI tools can be used to genuinely mimic human creativity (e.g., Giannuzzo, 2023; Hutson & Schnellmann, 2023). Scholars and educators have called for the adoption of alternative models of creativity that integrate AI with humans. Before we embrace alternative models of creativity for education, including language education, and gaze into the future, it is important to look back at what we know about creativity, what creativity was like in the pre-AI/ChatGPT era, and what aspects of creativity might be affected with the increasing use of AI.

## 2 Conceptualization of Creativity

The meaning of creativity as the ability to produce new valuable ideas is widely adopted in various discussions. To fully understand creativity and its future in the AI era, in addition to product features, we must investigate the processes, strategies, and thinking types that individuals use during production and how these processes might be affected. Product and process are “two key constructs that must be understood before human and artificial creativity can be reconciled and perhaps integrated.” (Cropley et al., 2022, p. 22).

Boden’s (2001) model, widely adopted in studies of AI creativity (see Lamers, 2023), identified three creative thinking types: exploratory (exploring all possibilities within the current conceptual space or a set of rules), combinational (making unusual connections between unrelated ideas) and transformational (changing the rules of the current conceptual space to produce new ideas). Researchers have shown that although AI can outperform humans in exploratory creativity, it is currently difficult for AI to achieve combinational and transformational creativity, which is regarded as a higher form of creativity (e.g. Lamers, 2023).

The search for a new, valuable idea, using exploratory thinking, involves exploring all the possibilities within a conceptual space using existing rules (Boden, 2001). Unlike AI, humans have limited capacity, time, and effort to search for all the possibilities, especially when the search conceptual space is large and has many possibilities. Such conditions lead to using simple cognitive shortcuts or strategies known as heuristics. Heuristics can be divided into two major categories: general heuristics and creativity heuristics (e.g., see Tin, 2022). General heuristics are simple cognitive strategies people use consciously or unconsciously, ignoring part of the information to make decisions quickly, frugally, or accurately. Examples are making a choice based on familiarity and choosing the first alternative that comes to mind (Gigerenzer & Gaissmaier, 2011). Creativity heuristics, on the other hand, refer to transformational strategies used to produce new valuable ideas, assisting individuals with jumping to a new conceptual space by directing a search among the unfamiliar while avoiding a search among the familiar (e.g., Yilmaz et al., 2010). Examples of creativity heuristics are “do the opposite,” “make the familiar strange,” “investigate paradoxes”, and “use constraints (limitations and rules)” (e.g., see Tin, 2022; Tromp, 2022).

## 3 Studies Comparing AI and Human Creativity

Studies have compared AI and humans in areas such as divergent thinking (e.g., Gilhooly, 2024; Koivisto & Grassini, 2023), combinational creativity (e.g., Chen et al., 2023), and writing stories and poems (e.g.,

Begus, 2023; Hutson & Schnellmann, 2023). These studies have shown both strengths and limitations of AI. While AI can compete with average humans, some humans outperform AI (e.g., Koivisto & Grassini, 2023). AI can produce “original and effective” outputs but lacks several features of human creativity (Runco, 2023, p. 1). AI-generated texts offer “less imaginative scenarios and rhetoric than human-authored texts” (Begus, 2023, p. 1) and use “superficial and trivial language” (Hutson & Schnellmann, 2023, p. 9).

Although these findings reassure us that humans can still outperform AI, a significant concern for educators and language educators is that AI can mimic various writing styles and often perform better than average humans. While AI may not match the highest levels of creativity, it is challenging to distinguish AI from humans at the lower or average levels. Farina et al. (2024, p. 10) noted that students can use AI to “produce texts that seem competent enough to satisfy lecturers without making an original contribution to the discipline.” This situation can lead to pseudo-creativity in educational contexts where assessments are based on unsupervised written texts. Proposals have been made to legitimatise AI use or adopt an AI-human collaborative model. Amidst these changes, considering how creativity will be affected if the traditional view of pre-AI creativity as human ability is abandoned is important.

Many creativity studies comparing AI and humans have focused on product creativity. Although AI outputs may reflect aspects of product creativity (novel and valuable products), Runco (2023, p. 1) argued that “products say little about the underlying process” and that the creative process used by humans may be impossible for AI to imitate. More research is needed to identify the “several things that characterize human creativity” (Runco, 2023, p. 1), especially process creativity, and how it might be affected in the AI era.

Many creativity studies comparing AI and humans have used tasks focusing on prompt-directed creativity. For example, in a study by Chen et al. (2023), participants, including novice designers and AI, were prompted to use combinational creativity based on specific textual descriptions (e.g., “Design a green clock in the shape of a pentagon”). Although AI can produce virtually any combination of ideas when prompted, this does not constitute combinational creativity. To demonstrate combinational creativity, “systems must find interesting combinations of concepts themselves based on similarities of their inherent conceptual features, instead of producing combinations for which they were explicitly prompted by a human” (Lamers, 2023, p. 331). Researchers have noted that humans can demonstrate creativity and creative language use even in ordinary contexts (e.g., Carter, 2004) and mundane, pedagogical activities that teachers do not frame as fun and playful (e.g., Pomerantz & Bell, 2007). This raises the question of whether AI can compete with humans and demonstrate unprompted and higher levels of creativity without explicit solicitation and what can happen to unprompted creativity with the increasing use of AI.

#### **4 A Study Comparing Humans (pre-AI) and AI in an Unprompted Creative Language Task**

To help understand the future of creativity in the AI era and, in particular, what aspects of human creativity may be affected by the increasing use of AI tools such as ChatGPT, it is important to revisit what creativity was like in the pre-AI/ChatGPT era. In this section, I engaged in a pedagogical excavation of my past experience concerning students’ performance in an unprompted creative task I employed in the pre-ChatGPT era in 2015. This human data was compared with the AI performance in 2023 of the same language task (filling in partially incomplete acrostics and writing reflection notes concerning the process involved).

#### 4.1 Materials and methods: The partially completed acrostic task

The acrostic, a widely used poetic form, imposes two explicit constraints: the formal rule (each line must start with a letter of the key word) and the semantic rule (the entire poem must be about the key word). Additionally, there is a constructional constraint. The type of language constructions (e.g., noun phrases, prepositional clauses) used in each line is not predetermined but emerges as the language user creates the acrostic within these constraints.

The acrostic task is selected in the study as the task's internal features (constraints of various kinds) can facilitate creativity and help us observe creative behaviour. Acrostics provide opportunities for playful language use, exercising freedom within several constraints: semantic, formal, and constructional. Task constraints have been proposed as enabling creativity (e.g., see [Tin, 2011, 2024](#); [Tromp, 2022](#)).

In the study, the acrostic task is presented as an ordinary, mundane, gap-filling task without explicit instructions to be creative. Language users are presented with partially completed acrostics on HOPE and MOTHER and must fill in the missing 'E' line (see Appendix 1). This task allows for constructional combinational creativity and exploratory thinking, essential skills for creativity, within the constraints of the acrostic. Users must find constructions starting with a specific letter (e.g., 'E') and combine the 'E' line with other given lines while meeting the semantic requirement that the poem is about the key word. The task design also provides an opportunity to observe unprompted language creativity.

In this context, language creativity is defined as the ability to insert a new, valuable idea into the missing line using familiar language in an unexpected but appropriate way, deviating from a frequent, expected pattern used by most of a specific community. Such deviation and unexpectedness are crucial features that make texts creative, making them stand out. The term violation-based salience (e.g., [Schmid & Günther, 2016](#); [Tin, 2022, 2024](#)) refers to the unexpected yet meaningful use of language that draws attention by breaking norms or expected patterns. In contrast, confirmation-based salience refers to linguistic items frequently used and expected within a particular construction (e.g., [Tin, 2022, 2024](#)).

The task used here is an ordinary, mundane task (filling in a missing line), though it belongs to a creative genre (poetry). The instructions do not explicitly ask participants to be playful or produce original ideas. Although the acrostic task does not represent broader contexts of creativity and language learning tasks, the task design helps us understand whether AI can compete with humans and demonstrate unprompted and higher levels of creativity without explicit solicitation in a situation with high task constraints.

The human data in this study were collected in 2015 from 18 postgraduate language teacher education students. The task required students not only to fill in blanks in six incomplete acrostics about HOPE and MOTHER but also to reflect on the process involved (see Appendix 1). Students in the previous year wrote the acrostics used. All blanks started with the letter 'E.' The task was provided in a sealed envelope, to be opened only when ready to write and reflect at home. The acrostics and reflection spaces were presented on A4 paper, with limited reflection space. Although students were told they could write more than a page, they all tried to fit their ideas into the limited space. The reflection notes were not more than 60 words. They were allowed to use various external resources (e.g., online) and were instructed to report these in their process notes. Their performance was not formally assessed. Based on the lack of AI references in the reflection notes and the pre-ChatGPT timing, it can be assumed that students' responses were written without AI assistance. Students were proficient users of English. They were familiar with acrostics and had previously produced acrostics.

I then imitated an AI scenario many teachers nowadays face with the possibility of students asking AI to do unsupervised, out-of-class pedagogic tasks. To see the outcome if AI/ChatGPT were instructed to perform the task, in October 2023, the exact instructions given to students in 2015 were provided to ChatGPT along with the incomplete acrostic. For example, the instruction given to ChatGPT was: "Please



fill in the blank for the following incomplete acrostic (HOPE). Reflect on the process you go through. Here is the Only Possible E... ." ChatGPT returned the completed acrostic but initially did not include reflection notes (see Appendix 2). A second prompt was provided: "Please reflect on the process you go through in coming up with the above." ChatGPT then generated a process note with subheadings, which was rather lengthy. ChatGPT was instructed to limit its response to 60 words in Prompt 3 to match the human-generated reflections, which were constrained in length. For subsequent acrostics, both instructions (to fill in the blank and reflect on the process) were given in one prompt. ChatGPT produced the reflection notes without further prompting, demonstrating its ability to understand and adapt to the task requirements after a few attempts (e.g., Ray, 2023).

The study compares ChatGPT and humans regarding their written products and reflection notes. The comparison addresses: (1) To what extent can ChatGPT mimic human behaviour in producing new, valuable ideas and creative language even without explicit prompts? (2) What processes are reported to be used by humans and AI to generate ideas? A central goal underlying these comparisons is to foresee what aspects of creativity (in particular unprompted creativity and processes involved in creativity) might be affected if AI were to be used in the future.

## 5 Results: Comparing Human and AI Performance

A qualitative content analysis (e.g., Selvi, 2019) was used to analyze the data. A reiterative data-driven analysis led to the formulation of some initial codes and themes, which were later modified and re-interpreted, referring to the creativity literature. Comparisons between and within individual cases (students and ChatGPT) were made to make sense of the data. The following sections report the findings and further discuss the data analysis used.

### 5.1 A comparison between ChatGPT-generated and students-generated texts

Table 1 summarizes the texts generated by students and ChatGPT, completing the missing E lines and the researcher's comments on these texts. The students' responses for each acrostic are also described in token frequency (i.e., the total number of students who produced the response) and type frequency (the total number of varied reactions). The number given after each response in Table 1 refers to the number of students who gave that choice (token frequency). Some acrostics have missing cases.

The comparison examines the texts regarding form-related (e.g., noun, verb, single-word, multi-word units) and semantic-related properties (e.g., abstract or concrete ideas). Based on these properties, confirmation-based and violation-based salience is identified among students' responses for each acrostic. Confirmation-based salience refers to the form and meaning expressed by most students (expected patterns among a specific community). In contrast, violation-based salience refers to the deviant case that differs from the majority and stands out as an unexpected, appropriate form or meaning. Violation-based salience can be viewed as a form of creativity (especially transformational creativity) if creativity is the ability to produce new, unexpected but valuable ideas. Responses that vary but are inappropriate are not counted as violation-based salience. ChatGPT's responses are then categorized as confirmation- or violation-based. This analysis addresses the question: To what extent can ChatGPT mimic human behavior in producing new, valuable ideas and creative language (measured in violation-based salient meaning and form) even when unprompted?

Table 1.

*A Comparison between ChatGPT-generated and Student-generated Texts in Terms of Form and Meaning*

Acrostics	Source and texts produced (tokens and types)	Form-related properties		Semantic-related properties	
		Confirmation-based salience	Violation-based salience	Confirmation-based salience	Violation-based salience
1. <b>Hold One Positive E</b> ..... Here is the <b>Only Possible E</b> .....	<b>Students:</b> (Tokens = 18, Types = 8) emotion (6), expectation (4), energy (2), evaluation (2), emphasis (1), endeavour (1), enthusiasm (1), envelope (1) <b>ChatGPT:</b> emotion	Single-word (noun) (18)	None	Abstract (17) (e.g. 'emotion', 'enthusiasm')	Concrete (1) (‘envelope’)
	<b>Students:</b> (Tokens = 18, Types = 12) entrance (3), exit (3), emotion (2), ending (2), effect (1), effort (1), ember (1), emergence (1), escape (1), establishment (1), earthly answer (1), elegance in life (1) <b>ChatGPT:</b> escape	Single-word (noun) (16)	Multi-word (noun phrase) (2)	Abstract (‘emotion’)	
		Single-word (noun) (16)		Movement-related (e.g. ‘exit’, ‘escape’)	Unusual collocation (1) (‘earthly answer’)
3. <b>Moment Of Truth – Her E</b> ..... Read my heart	<b>Students:</b> (Tokens = 18, Types = 11) eyes (8), expertise (1), empathy (1), emergence (1), elegance (1), eggs (1), eccentricity (1), every word (1), everlasting love (1), entry into my heart and (1), endearing inner soul (1) <b>ChatGPT:</b> eternal	Single-word (noun) (14)	Multi-word (noun phrase) (4)	Movement-related (‘escape’)	
		Single-word (noun) (14)		Reading-related (8) (‘eyes’) Abstract qualities (8) (e.g. ‘empathy’, ‘expertise’)	Concrete (food-related) (1) (‘eggs’)
		Single-word (adjective)		Abstract quality (‘eternal’)	
4. <b>Mother Once Told me Hold on until E</b> ..... <b>Right for you.</b>	<b>Students:</b> (Tokens = 16, Types = 10) everything is (7), everything (1), environment (1), extremely (1), elegance is (1), end of stories (1), every chance is (1), every destiny comes (1), eligible moment which is (1), every pleasure moment (1) <b>ChatGPT:</b> eternity	Multi-word (noun + verb) (10), (noun phrase) (3))	Single-word (noun) (2), adverb (1))	Time-related (13) (e.g. ‘every destiny’, ‘every pleasure moment’)	None
				Time-related (‘eternity’)	

Acrostics	Source and texts produced (tokens and types)	Form-related properties	Semantic-related properties
5. <b>M</b> aybe sometimes you don't agree with her <b>O</b> r you find That woman is annoying and you <b>H</b> ave a quarrel with her but <b>E</b> ..... <b>R</b> ealise that she's the one who loves you most in the world.	<b>Students:</b> (Tokens = 18, Types = 8) eventually, you will (6), eventually, you (1), eventually (5), every time (2), every single day she makes you (1), equally in the end (1), end with gratefulness and deep understanding (1), emotional (1) <b>ChatGPT:</b> eventually, you	Multi-word (12)  Multi-word	Realisation of a mother's love (18) (e.g. 'eventually, you will')  Realisation of a mother's love ( 'eventually, you' )
6. <b>M</b> ost of the love stories <b>O</b> f life will not be like <b>T</b> itanic <b>H</b> owever <b>E</b> ..... <b>R</b> ose	<b>Students:</b> (Tokens = 17, Types = 16) each mother is like (1), each one deserves a handful of (1), every mother deserves a (1), each will remind you of a little red (1), everyone can find something like her (1), even a mother needs a (1), even Jack did not save (1), ensure she is given a (1), emblem (1), end with (1), ending (1), ensure his given (1), envy of (1), except (2), expectations (after watching) (1), everlasting Jack and (1) <b>ChatGPT:</b> every mother is a	Multi-word (subject + complement) (8)  Multi-word (subject + complement)	None  Mother deserving/is like 'rose' (flower) (8), or 'Rose' (the character from Titanic movie) (3)  Mother is compared to 'rose' (flower) ( 'every mother is a' )

The comparison (Table 1) shows that ChatGPT's choices imitate most students' choices in form and meaning. For example, in Acrostic 4, the most frequent meaning for both students and ChatGPT is related to the notion of time ("moment," "everything," "end of," "destiny," "chance," "eternity"). This choice seems to be primed by the preceding word "until," usually followed by an idea related to time. Similarly, in Acrostic 1, all 18 students and ChatGPT fill the slot with one word (noun), the most expected confirmation-based salient form to fill the slot.

Some human responses appropriately deviate from the majority's preferred choices, making them stand out as violation-based salient responses. This behavior resembles transformational creativity (Boden, 2001), a higher form of creativity that transforms the commonly shared conceptual space. Instances of this transformational creativity are found in Acrostics 1, 2, and 3, all created by the same student, Nick (pseudonym). First, in Acrostic 1, words selected by almost all students and ChatGPT are abstract nouns (e.g., "emotion," "expectation," "enthusiasm") while Nick's selection ("envelope") is a concrete noun, thus standing out as violation-based salient meaning (unusual but still appropriate). Hope is depicted as holding an envelope hoping it contains a positive message. Similarly, in Acrostic 2, while most students and ChatGPT are attracted to filling the slot with one word (noun) related to movement (e.g., "entrance," "exit," "escape"), "earthly answer" selected by Nick seems the most violation-based salient choice due to its unusual but appropriate collocation and meaning. For Acrostic 3, the word "eggs" chosen by Nick appears to be the most semantically deviant, while the majority are attracted to selecting abstract qualities of mothers (e.g., "empathy," "elegance") or "eyes" (a word highly associated with the surrounding text "reading"). The selection of "eggs" (a food-related item) stands out as an amusing and appropriate depiction of the mother, not as a person of abstract qualities but as a food source.

Although ChatGPT's responses could mimic students' responses in terms of exploratory creativity to some extent (i.e. exploring ideas within the given conceptual space, such as generating words that begin with E), the ability to demonstrate unprompted transformational creativity is observed only in human responses.

## 5.2 A comparison between ChatGPT-generated and students-generated reflection notes

This section compares the reflection notes written by students and ChatGPT in response to the prompt "Reflect on the process you go through." It identifies various strategies used and resources referenced. The comparison addresses the question: What processes are reported to be used by humans and AI to generate ideas? The analysis includes both between-group and within-group comparisons. The between-group comparison explores the similarities and differences between the reflection notes of students and ChatGPT. The within-group comparison examines the differences and similarities within the approaches of three selected students (pre-AI) and the AI/ChatGPT in solving all six acrostic tasks. The analysis investigates whether students' behaviors are similar to or different from those of ChatGPT at the individual and group levels.

### 5.2.1 Use of socio-cultural, metaphorical, and personal experiences

First, while human reflection notes include rich socio-cultural details, ChatGPT's reflection notes (see Table 2) are general and devoid of such information. For example, in Acrostic 6, Eddy chooses "each one deserves a handful of (Rose)" and makes references to "Mother's Day" (a specific cultural context), where people give flowers to their mothers ("Mother's Day is full of flowers, although roses are less popular. They still represent a kind of love."). However, in Acrostic 6, ChatGPT, which chooses "every mother is a", compares a mother with a rose in general terms, and the reasons given are rather general ("every mother is unique and beautiful in her way, just like a rose").

Table 2

*ChatGPT's Process Notes and Choices*

<b>Words selected for acrostics</b>	<b>ChatGPT's reflection notes</b>	<b>Analysis/ Comments</b>
1. Emotion	The process for this acrostic involved thinking of a word that starts with "E" and complements the theme of positivity and hope. "Emotion" was selected as it encapsulates the essence of holding positive feelings and underscores the importance of maintaining a hopeful outlook. The acrostic seeks to encourage a focus on positive emotions during challenging times.	General rules of acrostics: formal rule (begin with E), semantic rule (about the key word -HOPE).
2. Escape	I systematically brainstormed "E" words that align with the theme of "hope." "Escape" was chosen for its relevance to finding hope and freedom. I ensured the word's flow within the acrostic, making it both linguistically sound and emotionally resonant. The result creates a meaningful message within the constraints of the acrostic.	General rules of acrostics: formal rule (begin with E), semantic rule (about the key word -HOPE).
3. Eternal	The process involved considering words that start with "E" and are relevant to the theme of motherhood. "Eternal" was chosen to emphasise the enduring, timeless love and connection between a mother and her child, evoking a deep emotional sentiment. The acrostic aims to celebrate and acknowledge the everlasting bond between a mother and her child.	General rules of acrostics: formal rule (begin with E), semantic rule (about the key word - MOTHER).
4. Eternity	The process involved considering words that start with "E" and fit the context of the acrostic. "Eternity" was chosen to convey the idea of enduring love and advice from a mother, emphasising that her guidance lasts indefinitely. The acrostic serves as a tribute to a mother's timeless wisdom and support.	General rules of acrostics: formal rule (begin with E), semantic rule (about the key word - MOTHER).
5. Eventually, you	The process involved understanding the acrostic's sentiment, which is appreciating a mother's love despite occasional disagreements. The word "Eventually" was chosen to highlight the gradual realisation of a mother's unwavering love over time, even in moments of conflict. This acrostic reflects the evolving understanding of a mother's love.	General rules of acrostics: formal rule (begin with E), semantic rule (about the key word - MOTHER).
6. Every mother is a	The process involved identifying a word starting with "E" that complements the theme of love and mothers in the context of the acrostic. "Every mother is a Rose" emphasises the idea that every mother is unique and beautiful in her way, just like a rose. This acrostic celebrates the individuality and beauty of maternal love.	General rules of acrostics: formal rule (begin with E), semantic rule (about the key word - MOTHER).

Second, human thinking is more metaphorical than ChatGPT. For Acrostic 6, the response selected by Melanie ("each mother is like") is similar to ChatGPT's choice ("every mother is a"). However, the



reasons given are different. While ChatGPT uses the word “Rose” in a literal sense, comparing a mother to a flower, Melanie uses “Rose” in a metaphorical sense, referring to a character featured in the movie “Titanic” (“I followed the simile pattern of the second line and associate the character ‘Rose’ in the movie with a figure of mother.”).

Despite being similar in their choices (products), students’ processes (how they arrive at the same product) are unique and different as they vary in their personal experiences. For example, in Acrostic 4, most students (7) choose “everything is.” The reasons given vary (see Table 3).

Table 3

*Same Products but Different Processes in Human Language Use*

Students	Words selected for Acrostic 4	Reflection notes	Analysis/ Comments
Kate	Everything is	‘right for you’ always goes after ‘everything.’	Using collocation
Ben	Everything turns/is	Looking for words which go together with ‘right for you.’ Arrive at ‘everything,’ find the missing verb ‘turns’ or ‘is’.	Using collocation
Irene	Everything is	In China, there is an old saying: ‘Success cannot occur without the conjunction of timing, location and human relationships’. That’s when everything is prepared well, we are likely to succeed, so before making achievement, we have to keep on working hard.	Socio-cultural experience
Tara	Everything is	My mum says, when you are young, you go overseas, you make friends, you go adventures, or do whatever you want to try in your life. Because this is the right time for you to experience more. And she says if there is no right boy for you, you make a better life then he will come into your life.	Personal experience
Nick	Everything’s	Mother’s advice about the right girlfriend – Always, she finds fault – <u>everything’s</u> not right with my girlfriend – wait until <u>everything is right</u>	Personal experience
Sue	Everything is	When writing this poem, I just read it as it was and instead of trying to write something overly creative I just wanted to sort of use words that would fill in the gaps & make it so it was sort of like a smooth flowing sentence rather than a poem.	Meta-task
Tina	Everything is	Same as the one above – I tried to think of something else that kind of made sense in that gap, but I couldn’t – words like extra, Edward + each one came to mind but I rejected them.	Meta-task

As seen in Table 3, Kate and Ben give a similar reason (“everything is” collocates with “right for you”). Irene talks about a cultural context (an old saying in China). Tara and Nick give extra personal details that prompt and justify their choices, though not reflected in their final products. On the other hand, Sue and Tina engage in meta-task commentary, commenting on the task, their behavior, or their difficulty.

As human thinking is personal and specific, the key word seems to affect their process. HOPE, an abstract topic, seems to generate less personal experience. In contrast, MOTHER, a personal topic to which all students could relate, evokes more personal experiences when finding words to fill the slot. For example, Eddy talks about personal experiences in MOTHER acrostics (Acrostics 3, 4, 5), while no personal experiences are mentioned in HOPE acrostics (Acrostics 1, 2) (see Table 4).

Table 4

*Eddy's Process Notes and Choices Made (The Effect of Topics on the Process)*

Topics	Words selected for acrostics	Eddy's reflection notes
HOPE	1. Enthusiasm	1. Hope reminds me of optimistic/positive/exciting/energetic sides. 2. Enthusiasm is the first word popped out.
HOPE	2. Ending	The final step is usually is the last one you can take.
MOTHER	3. Every word	My mum knows me very well and she gives me suggestions when I cannot decide on big moves.
MOTHER	4. Every chance is	My mum always encourages me to stay positive and wait for the dreamed opportunity to come.
MOTHER	5. Every time	This is just what I am still experiencing at the moment
MOTHER	6. Each one deserves a handful of	Mother's Day is full of flowers, although roses are less popular. They still represent a kind of love.

In contrast, ChatGPT's reflection notes, as seen in Table 2, remain the same regardless of the type of topic.

### 5.2.2 Use of heuristics: General and creative heuristics

Common strategies reported by ChatGPT and students include using the key word and the linguistic context to generate ideas. Besides these strategies sanctioned by task constraints, humans report using other heuristics or cognitive shortcuts to complete the task. Unlike AI, human has a limited capacity to explore all the possibilities, and this leads to the use of various general or creative cognitive shortcuts and strategies such as expansion, reverting the situation or thinking about the opposite scenario, using the immediate physical, social and emotional context, using the take-the-first heuristic (i.e., selecting the first word that comes to their mind) and so on.

One common heuristic is expansion: adding a word to their original choice to meet the requirement of the acrostic task (the need to start the line with E). For example, Melanie, who chooses "every destiny comes" for Acrostic 4, explains how "every" is added to "destiny" to meet the requirement of the acrostic task as follows:

This one is the hardest as I did it last. I ran out of ideas. I needed a subject and a verb, and directly decided 'comes' as the verb since it suits the following line. Then, I found 'destiny' matching, so I just added 'every' to deal with the 'e'! (Melanie, Acrostic 4)

Reverting the situation (or "doing the opposite") is another strategy students use to complete the task. For example, Tom devises "exit" for Acrostic 2 by considering the opposite scenario (what happens when we lose hope?). He then uses that opposite case to talk about hope:

These words have created some constraints to look for the word. Probably a noun. ‘only’ is the key word. So I tried to find a noun that is related to hope and it must be something unique. Then I thought when we lose hope, we can’t find the direction to the future. Conversely, if we have hope, we can find the way out. That’s an exit. (Tom, Acrostic 2)

The immediate physical, social, and emotional context in which humans do the task also affects their thinking. Humans’ self-reflection is “inward-expressive,” expressing “something about the creator” (Giannuzzo, 2023, p. 58). Kate’s first choice in Acrostic 1 is “envelope,” and this is influenced by the task where the instruction is given on an A4 paper in a sealed envelope (i.e. the immediate physical context). Her final choice (“energy”) is driven by her immediate social and emotional context (feeling stressed about the assignment). Her reflection expresses something about her immediate physical and emotional context:

Firstly I thought of ‘envelop’ because of the task 😊 Then, I feel recent days I’m very stressful about the assignment, I really need some emotion. When I’m writing, I suddenly think of ‘positive energy’ is a perfect match. (Kate, Acrostic 1).

Another strategy students use is the take-the-first heuristic (i.e., selecting the first word that comes to their mind). Unlike ChatGPT, humans could not consistently articulate how they get ideas for the missing E line. Some words just come up probably due to the confirmation-based salient effect (i.e., those words appear frequently in daily usage). This could be found in Tania’s reflection notes for Acrostic 1:

Hmm what starts with E? Emotion! Done! Why did I think emotion? Not sure. Maybe because I wrote something similar in the last forum? Just checked, actually I didn’t but maybe was thinking it. Hope can be an emotion! (Tania, Acrostic 1)

### 5.2.3 Use of cognitive fixation tendency

When faced with a new problem, individuals often rely on familiar routines to find a solution (e.g., solving all six acrostics in a similar way) – a phenomenon known as cognitive fixation tendency (e.g., see Tin, 2011). This section analyses the behaviours of ChatGPT and three students (Ben, Tina, and Nick) to assess whether they exhibit cognitive fixation tendencies by consistently using similar thinking styles for all six acrostics.

ChatGPT’s cognitive fixation is evident in its reflection notes (see Table 2). Its approach is consistent across all acrostics, indicating a formulaic algorithm. ChatGPT reports using logical, ordered thinking, following an identical procedure for each acrostic. ChatGPT reports brainstorming words that start with ‘E’, align with the acrostic theme, and fit the context. This strategy, dictated by the explicit rules of acrostics, shows that ChatGPT’s reflection notes adhere strictly to these rules without breaking or transforming them. Its approach is straightforward, linear, and “public-oriented,” responding “in the best possible way” to what is explicitly required by the task (Giannuzzo, 2023, p. 58).

The reflection notes from Nick, Ben, and Tina (see Table 5) show that, like ChatGPT, they exhibit cognitive fixation tendencies by using similar thinking styles for all six acrostics. Ben mainly draws on linguistic contexts and collocations, while Tina is fixated on task nature and idea quality. Nick’s prominent processes involve drawing on socio-cultural and personal experiences.

Table 5

*Reflection Notes and Choices of Three Selected Students*

Student	Words selected for acrostics	Students' reflection notes	Analysis/ Comments
Ben	1. Emotion	Hope is emotional, positive collocates with 'emotion'.	The key word (HOPE). The linguistic context (collocation).
	2. Escape	The word 'only' implies something negative, the last chance (hope/ to avoid it) is to run away, 'escape'.	The linguistic context (collocation).
	3. Everlasting love	Think of mother, her feelings towards children, the word 'love' didn't fit, expand with an adjective, make a collation.	The key word (MOTHER). The linguistic context (collocation). Cognitive shortcut (adding an adjective to 'love').
	4. Everything turns/is	Looking for words which go together with 'right for you'. Arrive at 'everything', find the missing verb 'turns' or 'is'.	The linguistic context (collocation).
	5. Eventually you will	The part before 'but' is negative, so something positive would follow, a summarising word and phrase, like 'in the long 'un' etc.	The linguistic context (collocation).
	6. Each will remind you of a little red	Main theme – 'love', with the word 'Rose' given, the most common match is 'red.' Parallel constructions in the future: 'will not be' (-), 'will remind you' (+)	The linguistic context ('rose' collocates with 'red', parallel construction in the given acrostic 'Most of the love stories of life will not be like'). Cognitive shortcut (reverting negative to positive)
Tina	1. Emotion	Thinking about the first word that comes to mind – emotion came to mind straight away because hope is an emotion and not that many words start with E.	Meta-task
	2. Exit	I wasn't expecting the next one to be HOPE as well. When I think of hope, these days, I think of the refugee crisis and I thought of exit = way out = way out of a terrible situation → if you had a way out, you would have hope.	Meta-task & Personal experience.
	3. Eyes	This one seemed kind of obvious and	Meta-task

		when I had thought of it, I couldn't 'unthink' it.	
	4. Everything is	Same as the one above – I tried to think of something else that kind of made sense in that gap, but I couldn't – words like extra, Edward + each one came to mind but I rejected them.	Meta-task
	5. Eventually, [you will]	'Every time' came to mind first, but it's not quite right grammatically – sounded like something a student would say.	Meta-task
	6. Everlasting Jack and	This was the hardest one as I couldn't really think of an 'E' that made good sense here. I first wrote 'everlasting' then added the rest to give it more meaning.	Meta-task
Nick	1. Envelope	What can be <b>positive</b> ? Positive news = a positive message. Where would I find a message? → In an envelope.	Specific words in the given acrostic.
	2. Earthly answer	<b>Only possible</b> answer? What starts with 'E' that is similar? Solutions? Universal answers? Earth? → Earthly answer	Specific words in the given acrostic. Cognitive shortcut (expanding 'answer' by adding an adjective, replacing 'universal' with 'earthly').
	3. Eggs	Mother's love is priceless? heart. A way to a man's heart is through his stomach → eggs.	Socio-cultural experience ('mother's love', 'a way to a man's heart'). Specific words in the given acrostic ('heart').
	4. Everything's	Mother's advice about the right girlfriend – Always, she finds fault – <b>everything's</b> not right with my girlfriend – wait until <b>everything</b> is right	Personal experience ('my girlfriend'). Cognitive shortcut (reverting negative to positive).
	5. Every time	Misunderstandings are common between us. Always arguing about pointless things. Sometimes feel unloved – <b>every time</b> I should feel loved.	Personal experience ('between us'). Cognitive shortcut (reverting negative to positive).
	6. Even a mother needs a	Titanic – a sinking ship helpless to do anything. Roses make up for trouble with a girlfriend or <b>even</b> , a mother sometimes.	Socio-cultural experiences (Titanic and roses).

Although both students and ChatGPT exhibit cognitive fixation at the individual level, students collectively demonstrate diverse thinking styles or collective diversity. Unlike ChatGPT, students'



process notes are not dictated by the explicit rules inherent in the acrostic task. Ben's preferred style draws on linguistic contexts and collocations, Tina focuses on task nature and idea quality, and Nick manipulates personal and socio-cultural experiences. This collective diversity, or "collective novelty" (Doshi & Hauser, 2023, p. 1), highlights the unique approaches of human thinkers.

To summarize, the comparison of reflection notes shows that while ChatGPT's explanation of how it generates ideas is general, human thinking is more specific and detailed. It consists of manipulating personal, socio-cultural, and emotional experiences and various cognitive shortcuts to perform the task. In other words, ChatGPT's reflection notes are "public-oriented," responding "in the best possible way to what humans ask of them"; humans' self-reflection is "inward-expressive," expressing "something about the creator" (Giannuzzo, 2023, p. 58). While ChatGPT's reflection notes follow the explicit rules inherent in the acrostic task, students' reflection expresses their varied personal and socio-cultural experiences and diverse thinking styles. Although both ChatGPT and students show evidence of cognitive fixation tendency at the individual level (i.e., each individual being attracted to a similar thinking style to solve all different acrostic tasks), collectively, humans demonstrate cognitive variation in their preferred styles of thinking they are fixated on.

## 6 Discussion

To foresee what aspects of creativity may be affected by the increasing use of AI in the future, the study revisited pre-ChatGPT humans' responses to a language processing task (filling in a missing line in acrostics and reflecting on the process involved) and compared human responses with ChatGPT's responses. The findings show that ChatGPT's responses (products) are similar to most students' responses regarding construction types and meaning selected to fill the various slots. However, deviation or unexpected but appropriate performances are observed only among students' data. One student (Nick) produces texts appropriately, deviating from the choices made by the majority. Humans can demonstrate unprompted playful use of language (or transformational creativity) even in a mundane, ordinary task such as filling in a blank, while ChatGPT tends to perform straight (i.e., completing the task as it is told). It is currently difficult for AI to achieve unprompted creativity, "the richness of human associative memory" (Boden, 1998, p. 349), and "human-level transformational H-creativity" (Lamers, 2023, p. 333). The increasing use of AI in the future can reduce opportunities for transformational creativity and unsanctioned playfulness – i.e., playfulness in tasks not framed as fun or playful (Pomerantz & Bell, 2007).

Although the products generated by ChatGPT and most students share similarities, the reflection notes vary. Although there is a tendency for both humans and ChatGPT to report the use of a similar style of thinking for all acrostics, there are differences. In addition to apparent strategies prompted by explicit task rules, humans use various strategies and cognitive shortcuts to perform the task. Although similar products are produced, students' processes are different, along with varying personal experiences and emotional depth. There is collective diversity and heterogeneity in human thinking. Although not always reflected in their finished products, humans' individuality, life experiences, and emotions are embedded in the process that triggers and inspires their responses.

## 7 Conclusion

What we see in the finished product of humans is merely the tip of the iceberg. What lies hidden underneath a relatively simple text is complex. Even though the product may look uncreative, the process that inspires or triggers it may be profoundly exciting and creative. The increasing use of AI, such as ChatGPT, can affect these processes in producing texts and can make them become redundant.

With the swift advancement in AI, many scholars have proposed the co-creativity model or augmented creativity, where both humans and AI collaborate to create new, valuable ideas or texts of various kinds (e.g., O'Toole & Horvát, 2024; Su et al., 2023). Before abandoning *organic* creativity, where traditional human creativity is maintained without AI (Vinchon et al., 2023), we need to clearly understand what aspects of human creativity we risk losing by adopting AI as a co-creator.

Concern has been raised about the effect of AI, such as ChatGPT, on future knowledge production and creativity. Zhou and Lee (2024, p. 5) note that “If humans increasingly rely on generative AI for sourcing knowledge without creating new knowledge through public discourse, then knowledge production and diffusion may stagnate (....) an over-dependence on AI may constrain future creative explorations.” Similarly, Doshi and Hauser (2023) claim that using AI to co-create texts increases individual creativity but risks the loss of collective novelty. Moreover, in practical terms, assessments in higher education (the society from which the study data comes) and many language learning activities often rely on or encourage students’ out-of-class production of texts, and it is not easy to monitor or supervise how students use AI. Despite the recommendation to use AI-human collaboration, some students may still use ChatGPT or AI as a substitute (the plagiarized or pseudo-creativity model) rather than a tool or a co-creator.

The central concern that motivates me to do this study is: What is the future of language use and creativity in the AI era? What aspects of creativity might be affected in this AI era? The findings show that the pseudo-creativity scenario (i.e. the increasing use of AI/ChatGPT to produce texts and pretending them to be one’s own) can impoverish our human life, depriving us of a fundamental process of who we are and what we do, resulting in homogeneous cognitive landscapes and collective novelty decay. Misuse of ChatGPT can rob us of cognitive opportunities to reflect on, retrieve, and manipulate our personal, socio-cultural, and emotional experiences using general and creative heuristics and various transformational strategies that help us jump to new conceptual spaces. When left unused, these processes and our collective cognitive diversity can become extinct and stagnant, changing how we function. This, I believe, is a potential future effect of AI/ChatGPT on creativity, not so much in terms of productivity but in terms of processing.

I do, however, hope that this somewhat depressing prediction about the future of creativity will be proven wrong, like any type of prediction, for the best of mankind. To prevent this depressing future, several actions need to be taken. Given the rapid pace of AI development, new forms of AI-assisted product and process creativity are bound to emerge. New advanced versions of AI have been rapidly developing since the ChatGPT data I produced for this article. Simultaneously, humans are constantly learning new ways of using AI (for example, as one reviewer of this article notes, with a different temperature setting, ChatGPT would produce vastly different outputs to the results reported here). Some of us will learn and master how best to use AI as a collaborator and how and when not to use AI. Some revolutionary activists will restrain themselves from using AI to maintain organic human creativity while others may be enslaved by AI and misuse it. When setting up language processing tasks, educators can create space for diverse situations such as legitimising the use of AI and restricting its use. Students can be invited to compare the product and process creativity reflected in AI and non-AI situations. Opportunities to reflect on the processes involved in producing creative products should be created for both AI vs non-AI use. Emphasis should be given not just to product features but also to processes when evaluating students’ work. Studies should also investigate diverse ways of using and avoiding AI by various individuals and language users to discover the creative uses and misuses of AI and how best to promote creativity with and without AI.

## Appendices

### Appendix 1: Acrostic tasks used in the study

Please fill in the blanks for the following incomplete acrostics (HOPE & MOTHER). Reflect on the process you go through for each of the poems. You can write more than a page.

No.	Acrostics	Think aloud as you write
1.	<b>H</b> old <b>O</b> ne <b>P</b> ositive <b>E</b> .....	
2.	<b>H</b> ere is the <b>O</b> nly <b>P</b> ossible <b>E</b> .....	
3.	<b>M</b> oment <b>O</b> f <b>T</b> ruth – <b>H</b> er <b>E</b> ..... <b>R</b> ead my heart	
4.	<b>M</b> other <b>O</b> nce <b>T</b> old me <b>H</b> old on until <b>E</b> ..... <b>R</b> ight for you.	
5.	<b>M</b> aybe sometimes you don't agree with her <b>O</b> r you find <b>T</b> hat woman is annoying and you <b>H</b> ave a quarrel with her but <b>E</b> ..... <b>R</b> ealise that she's the one who loves you most in the world.	
6.	<b>M</b> ost of the love stories <b>O</b> f life will not be like <b>T</b> itanic <b>H</b> owever <b>E</b> ..... <b>R</b> ose	

## Appendix 2: Examples of prompts given to ChatGPT

### Prompt 1 (for Acrostic 2):

Please fill in the blank for the following incomplete acrostic (HOPE). Reflect on the process you go through. Here is the Only Possible E .....

### ChatGPT:

Here is the missing word for your acrostic: Here is the Only Possible Escape

### Prompt 2:

Please reflect on the process you go through in coming up with the above.

### ChatGPT:

Certainly! The process of coming up with the missing word "Escape" for the acrostic "HOPE" involved several creative thinking steps:

1. **Understanding the Acrostic:** First, I carefully read the given acrostic, "HOPE," to understand the context. Acrostics are typically formed by words or phrases where each letter corresponds to a word that starts with that letter.
  2. **Brainstorming:** The letter "E" was missing from the acrostic, and I began to brainstorm words that start with "E" that could fit within the context of "HOPE."
  3. **Relevance and Emotional Connection:** To make the acrostic meaningful and emotionally resonant, I considered words that would relate to the theme of "hope." In this case, "Escape" was chosen because it often implies a sense of relief, liberation, and a hopeful departure from a challenging or confining situation.
  4. **Word Selection:** I selected the word "Escape" because it fulfilled the requirement of starting with "E" and also added depth to the overall message, as escaping can be seen as a way of finding hope and a brighter future.
  5. **Language Flow:** I ensured that the word "Escape" flows well within the context of the acrostic, making it sound natural and coherent.
  6. **Final Check:** Finally, I reviewed the entire acrostic to make sure it made sense and conveyed a meaningful message. In this case, "Here is the Only Possible Escape" forms a phrase that implies a message of finding hope in the midst of challenges or difficulties.
- This process involves a combination of creativity, contextual understanding, and linguistic fluency to generate a word that fits the given criteria while also delivering a meaningful and relevant message.

### Prompt 3:

Reflect on the process you go through in coming up with the above. Write not more than 60 words.

### ChatGPT:

I systematically brainstormed "E" words that align with the theme of "hope." "Escape" was chosen for its relevance to finding hope and freedom. I ensured the word's flow within the acrostic, making it both linguistically sound and emotionally resonant. The result creates a meaningful message within the constraints of the acrostic.

## References

- Begus, N. (2023). Experimental narratives: A comparison of human crowdsourced storytelling and AI storytelling. arXiv preprint arXiv:2310.12902.
- Boden, M. A. (1998). Creativity and artificial intelligence. *Artificial Intelligence*, 103(1-2), 347–356.

- Boden, M. A. (2001). Creativity and knowledge. In A. Craft, B. Jeffrey, & M. Leibling (Eds.), *Creativity in education* (pp. 95–102). Continuum.
- Carter, R. (2004). *Language and creativity: The art of common talk*. Routledge.
- Carvalho, M., & Ribeiro, D. C. (2023). Aesthetics after the ontological turn: An ecological approach to artificial creativity. *Critical Humanities*, 2(1), 5.
- Chen, L., Sun, L., & Han, J. (2023). A comparison study of human and machine-generated creativity. *Journal of Computing and Information Science in Engineering*, 23(5), 051012.
- Cropley, D. H., Medeiros, K. E., & Damadzic, A. (2022). The intersection of human and artificial creativity. In D. Henriksen, & P. Mishra (Eds.), *Creative provocations: Speculations on the future of creativity, technology & learning* (pp. 19–34). Springer.
- Doshi, A. R., & Hauser, O. (2023). Generative artificial intelligence enhances creativity. Available at SSRN. <https://ssrn.com/abstract=4535536>
- Farina, M., Lavazza, A., Sartori, G., & Pedrycz, W. (2024). Machine learning in human creativity: Status and perspectives. *AI & Society*, 1–13. <https://doi.org/10.1007/s00146-023-01836-5>
- Giannuzzo, A. (2023). Creativity, intentions, and self-narratives: Can AI really be creative?. In N. Moniz, Z. Vale, J. Cascalho, C. Silva, & R. Sebastião (Eds.), *Progress in artificial intelligence. EPIA 2023. Lecture notes in computer science, vol 14116*. Cham: Springer. [https://doi.org/10.1007/978-3-031-49011-8\\_5](https://doi.org/10.1007/978-3-031-49011-8_5)
- Gigerenzer, G., & Gaissmaier, W. (2011). Heuristic decision making. *Annual Review of Psychology*, 62, 451–482.
- Gilhooly, K. (2024). AI vs humans in the AUT: Simulations to LLMs. *Journal of Creativity*, 34(1), 100071.
- Hutson, J., & Schnellmann, A. (2023). The poetry of prompts: The collaborative role of generative artificial intelligence in the creation of poetry and the anxiety of machine influence. *Global Journal of Computer Science and Technology*, 23, 1–14.
- Koivisto, M., & Grassini, S. (2023). Best humans still outperform artificial intelligence in a creative divergent thinking task. *Scientific Reports*, 13(1), 13601.
- Lamers, M. H. (2023). A computer scientist's view on machine learning and creativity. In C. Anutariya, & M. M. Bonsangue (Eds.), *Data science and artificial intelligence. DSAI 2023. Communications in computer and information science, vol 1942*. Springer. [https://doi.org/10.1007/978-981-99-7969-1\\_24](https://doi.org/10.1007/978-981-99-7969-1_24)
- O'Toole, K., & Horvát, E. Á. (2024). Extending human creativity with AI. *Journal of Creativity*, 34(2), 100080.
- Pomerantz, A., & Bell, N. D. (2007). Learning to play, playing to learn: FL learners as multicompetent language users. *Applied Linguistics*, 28(4), 556–578.
- Ray, P. P. (2023). 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.
- Runco, M. A. (2023). AI can only produce artificial creativity. *Journal of Creativity*, 33(3), 100063.
- Schmid, H. J., & Günther, F. (2016). Toward a unified socio-cognitive framework for salience in language. *Frontiers in Psychology*, 7, 1110.
- Selvi, A. F. (2019). Qualitative content analysis. In J. McKinley, & H. Rose (Eds.), *The Routledge handbook of research methods in applied linguistics* (pp. 440–452). Routledge.
- Su, Y., Lin, Y., & Lai, C. (2023). Collaborating with ChatGPT in argumentative writing classrooms. *Assessing Writing*, 57, 100752.
- Tin, T. B. (2011). Language creativity and co-emergence of form and meaning in creative writing tasks. *Applied Linguistics*, 32(2), 215–235.



- Tin, T. B. (2022). *Unpacking creativity for language teaching*. Routledge.
- Tin, T. B. (2024). Finding constraints to foster creativity in language learning tasks: An autoethnographic approach. *TESOL Journal*, 00, e792. <https://doi.org/10.1002/tesj.792>
- Tromp, C. (2022). Creativity from constraint exploration and exploitation. *Psychological Reports*. <https://doi.org/10.1177/00332941221114421>
- Vinchon, F., Lubart, T., Bartolotta, S., Gironnay, V., Botella, M., Bourgeois-Bougrine, S., ... & Gaggioli, A. (2023). Artificial intelligence & creativity: A manifesto for collaboration. *The Journal of Creative Behavior*, 57(4), 472–484.
- Yilmaz, S., Seifert, C. M., & Gonzalez, R. (2010). Cognitive heuristics in design: Instructional strategies to increase creativity in idea generation. *Artificial Intelligence for Engineering Design, Analysis and Manufacturing*, 24(3), 335–355.
- Zhou, E., & Lee, D. (2024). Generative artificial intelligence, human creativity, and art. *PNAS Nexus*, 3(3). pgae052. <https://doi.org/10.1093/pnasnexus/pgae052>

**Tan Bee Tin** is a Professor in Applied Linguistics and Language Teaching at the School of Cultures, Languages and Linguistics (the University of Auckland, New Zealand). She has published in the areas of language creativity and language learning, the role of interest in language learning, and teaching English in peripheral contexts. She is the author of *Unpacking Creativity for Language Teaching* (Routledge 2022) and *Stimulating Student Interest in Language Learning: Theory, Research and Practice* (Palgrave MacMillan 2016).