What Shall I Write Next? Subliminal and Supraliminal Priming as Triggers for Creative Writing

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ABSTRACT

Creative writing requires the manipulation of language in demanding ways, as individuals attempt to uniquely express themselves. As a result, during creative writing people often experience the writer's block: a stress reaction that affects their ability to write. Addressing this problem, creativity support tools have been incorporating story prompts to instigate the creative process. However, such strategies distract the user from the writing task and impose cognitive load to get over the block. In this paper, we investigate subliminal priming as a novel technique to support creative writing. We developed a text-editor that provides conscious and unconscious textual hints during a writing task and explored its impact on user's self-experienced creativity. Results showed that participants in the subliminal condition experienced more loss of self-consciousness when compared to the control condition. Self-report data revealed higher loss of self-consciousness in the subliminal condition while the analysis of eye-tracking data and verbal-accounts revealed a stronger influence on people's thoughts during the supraliminal condition. We report our findings and conclude with insights for future research.

CCS CONCEPTS

• **Human-centered computing - User centered design**

KEYWORDS

Creativity Support Index; Creativity Support Tools; Subliminal priming

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1 INTRODUCTION

Creative writing is an essential human activity and a central component to a breath of industries, including filmmaking, advertising, the video game industries and many others [1]. There is evidence suggesting that the regular practice of creative writing induces positive moods, and it also leads to an increased involvement with related tasks, thus having the potential to increase the likelihood of professional success, an important component of human wellbeing [2]. Despite its benefits, creative writing is a cognitively demanding task. As Robinson states, [3] language is primarily a system of communication: first we have our thoughts and then we find the words to convey them. As there are millions of subjects a writer can write about and thousands of ways to express the same idea, writing is more challenging than it initially appears to be. It is a problem-solving activity, a process that requires the generation, planning, reading and reviewing of the writer's thoughts [4]. Deciding what to write about can be tricky and during that process, some writers often have blocks - a temporary inability to write that can last from minutes to weeks. The writer's block is a source of frustration and fatigue for authors [5], and has been acknowledged as a *"creativity killer"* [6]. It comes up when writers become too judgmental and apprehensive about their writing, resulting in a potential loss of productivity and feelings of self-doubt, which aggravate this state. As writers' anxiety levels increase, it becomes more and more difficult to write [7].

Over the years, researchers have been investigating different strategies to make writing a more pleasurable and easy-going experience, able to foster creativity and cope with stress. Successful methods have included the provision of *story prompts*, as modeled-stories or picture-sequences to inspire and initiate the

creative process [8], the design of *distraction-free interfaces* to reduce anxiety levels and help focus on the craft [9,10,11], or *brainstorming and free associations techniques* to stimulate the overall flow of the writing tasks [8]. Yet, current creativity writing support tools still rely on the writers' ability to enhance the creative process and break their mind-set when a block occurs. This might not happen and writers often abandon the activity when faced with this burdensome situation.

Research suggests that writers' block reflects the conflict between the two modes thinking: *the* automatic (unconscious) and the *reflective* (conscious) [12]. The *automatic* formulates thoughts and judgments quickly and unconsciously, guided by intuition and past experience. The *reflective*, in contrast, accounts for conscious reasoning; it is slower, effortful and comes into place only when a decision cannot be made intuitively. The conflict arises when the *reflective mind* is confronted with writer's feelings of self-doubt, causing the mind to overthink and anticipate possible outcomes, inhibiting the *automatic mind* that seeks to create [10].

In this paper, we aim to leverage the automatic mind as an approach to boost creative thinking and enhanced idea generation.

The core contribution of this research is a novel within-subjects study to explore the idea of concept priming and examine its effectiveness by comparing the impact of conscious (supraliminal) and unconscious (subliminal) cues stimulation on a creative writing task. The research described below makes two supporting contributions. First, we triangulate qualitative and quantitative data from different sources to access creativity of users in different writing conditions. In the experiment, we observed that participants did not realize that they were actually being influenced by textual cues. In post-experiment interviews, some considered that textual cues influenced their thoughts and consequently their writing, others considered that the cues were in their implicit memory and used them in later conditions. We contribute with insights gained from this research for the design of creativity support tools. Second, although research on creativity has thus largely occurred within areas such as psychology and neuroscience and HCI, we believe other areas of computer science can also contribute to this domain.

2 BACKGROUND

2.1 Creativity and the Automatic Mind

Creative writing is an essential activity that can be found in a huge variety of areas (e.g. journalism, science fiction, etc.) being express through different forms (e.g. prose, poetry, etc.) [13]. Usually, writers try to take their creativity from anything that they get a hint of, even television or news reports, in such a way that they can imagine new characters and situations that can be included in their writings. Yet, writers still face the lack of ideas, and therefore the lack of words to write – so called *writer's block*. Rose [5] states that *writer's block* is a condition characterized by the inability to come up with original or novel ideas, regardless of the topic being worked on, some of the writing tools that are currently available attempt to initiate the creative process.

To tackle this issue, researchers have explored the design of interfaces to foster inspiration, concentration and immersion on creative writing tasks through different explicit features such as themes with sound and images [14,15,16]. These different stimuli have been found able to increase both the originality and the diversity of ideas while writing and during brainstorming task. Yet, while the importance of conscious processes in creativity has been noted, literature suggest that that our ability to produce creative and inspired insights comes from the unconsciousness rather than from a conscious process [17]. Is the unconscious mind that holds the ability to spontaneously produce new concepts, due to its proficiency to make or generate elements available for associations (e.g. through thoughts and past-experiences [18]). And while the unconscious mind is bonded with novelty generation, the conscious mind is tied with the evaluation of ideas [18]. Ritter et al. [18] posit that writer's block leverages the conflict between our two modes of thinking the *Unconscious* and the *Conscious* mind: when we consciously think about an idea, our creative (unconscious) mind is suppressed with a deliberate weight of how creatively the ideas are perceived (conscious mind). Writers become too judgmental and apprehensive about their writing, resulting in a potential loss of productivity and feelings of self-doubt, leading to this state.

Research has investigated how to leverage the unconscious mind by presenting a stimuli that is not consciously perceived.– *subliminally* (implicit). Subliminal Priming is a technique validated across a number of domains that has the potential to influence individual's thoughts instinctively and trigger action by means of associative inferences. This is accomplished by presenting a stimulus below the threshold of conscious perception [19,20,21]. While previous research posits that creativity is lead by a motivated state [22] subliminal priming has the potential to arouse interest and enjoyment in the writing tasks. Providing implicit hints can uphold the user's flow and inspire creative thinking without user's conscious awareness while the practice is conducted (i.e. prompting topics, associations or random words).

Recent research has investigated the potential of subliminal cues triggering the creative process. For instance, Fitzsimons et al. [23] found that flashing quickly a brand identified as creative (e.g. Apple logo) motivated users to behave creativily and resulted in a higher number of creative responses. Lewis et. al [24] explored how affections influenced creative performance by presenting positive, negative and neutral images during a creative task. They found that the quality of participant's ideas was influenced by the type of stimuli (e.g. a laughing baby had a positive influence). Further, Ritter, S. M et al. [18] provided empirical evidence in support of the role of unconscious processes influencing creative process. They demonstrated that people can better recognize creative ideas unconsciously than through conscious thought [18]. The strengths of different primes enhancing creativity has been recognized, yet, there is no knowledge on how different primes can be integrated in creative writing support tools to enhance idea generation and prevent writer's block. In the remainder of the paper, we described our setup design were evaluated the effectiveness of both primes in a creative writing task.

3 STUDY - PRIMING CREATIVITY

We conducted a within-subject experiment to investigate whether textual cues, subliminal or supraliminal, affect people's creativity during creative writing. We chose a creative writing task a) because it has been reported to be among the most demanding creative tasks [25,26] and b) because in its different forms, writing is part of the everyday routine – a brief e-mail, a composition, a report, an article – and as such, our insights may have broad application to a wider range of cognitively demanding tasks, beyond that of creative writing. As a prerequisite, participants had to have some interest in creative writing and a computer and Internet experience since our questionnaires are all online. All participants went through three conditions: subliminal, supraliminal and control (no cues). To control carry-over effects, the order of the conditions was counterbalanced between participants.

No Priming condition (control): No cue disclosure.

Subliminal Priming (implicit): Participants were exposed to a new subliminal cue every three seconds. The cues were displayed in the middle of the screen (highest visual acuity – foveal), flashing with duration of 60 milliseconds (*ms*), 60pt font size, font Helvetica, and color black. Grounded on research we tested the value of these attributes in a pilot experiment with three participants. Cues were found easy to read (size), capable of being noticed (position), unable to induce emotional responses (neutral color) and presented outside of conscious awareness [27].

Supraliminal Priming (explicit) (Fig. 1): In order to be more noticeable, the cues were initially displayed in the center of the screen and gradually displaced to one of the corners of the interface. Each animation lasted 3 seconds. ***Cues***: Participants were exposed to a total of 60 randomly selected cues during the 5-minute task. We selected a total of 250 words randomly extracted from a dataset.[†]

Task. We used a simple creative writing technique [28]. We selected three fridge magnets (Fig. 2) and told participants to treat the object as a trigger for bringing their senses into the writing task. The time was limited to 5 minutes. Due to the use of a within-subject design, we defined three different writing tasks of a similar degree of complexity that participants were equally familiar with.

[†] https://myvocabulary.com/word-list/travel-and-leisure-vocabulary/

Figure 1: Example of Supraliminal Priming. The dataset embraced different topics (e.g. actions, emotions, objects, etc.)

Figure 2: Magnetic fridge used as a creative writing prompt to initiate the writing for it users.

Participants. This study involved 14 participants, 6 males and 8 females (M=28.4; SD=5.6) recruited through a university-wide mailing list. All selected participants reported having a normal or corrected visual acuity, and enjoyed writing. Eight participants (57.1%) reported writing at least 1 hour per day, and six (42.9%) at least 2 or more. Most of the users consider themselves to be creative (71.4% of participants rated higher than 5). The experiment was conducted within a single week.

Measure. Before the experiment, participants were asked to fill a very short survey to collect some demographic data and rank their own creativity ("Do you consider yourself a creative person?") in a Likert Scale (0-10 values) [29,30]. We applied the Creative Behavior Inventory (CBI) [31,32] to categorize how creative the participants were, and a questionnaire inquiring a. how often they write and b. how familiar they were with priming techniques. We used 30 items from the original CBI [31,32], particularly the specific examples of creative activities such as: literature, miscellaneous, arts, science and music [29].

After finishing the writing task, they were asked to fill a Likert scale survey about how that experience made them feel using the Flow Theory dimensions [33] and the survey about Creativity Support Index [34]. Also participants were asked to rank their self-perception of creativity [30] in a Likert Scale (0-10 values).

The Flow Theory survey was based on the following dimensions: (i) intense and focused concentration on the present moment, (ii) sense of personal control or agency over the situation or activity, (iii) loss of reflective self-consciousness, and (iv) distortion of temporal experience. Participants ranked a 10-point Likert scale based on questions such as: "*I felt very concentrated*

during this condition" and *"I lost track of time during this condition"*.

To access the participants' mental well-being, we asked them to select up to three adjectives from the following list: Surprised, Delighted, Laid back, Depressed, Passive, Happy, Tired, Bored, Sad, Satisfied, Frustrated, Angry, Serious, Animated, Distressed, Creative and Frightened.

Finally, we interviewed them based on their experience using the tool *("Did you see the cue?" Did you use it? etc.*), and they were asked to rank their creativity in each condition (*"How do you rate your creativity in this condition?"*) in a Likert Scale (0-10 values) [29].

Procedure. Participants were brought individually to a control room, previously prepared for the experiment. For the examination, we used one Mac with Retina LED 13.3'', display resolution 1440x900 pixels and one screen–based eye tracker (Tobii Pro X2-30) [35] to capture gaze data. A preliminary evaluation was conducted with 3 participants to examine the feasibility and accuracy of the eye tracking calibration and assesses the perception of the cues in a short trial. While nobody noticed the subliminal cues, eye tracker data revealed that all participants scanned them. Moreover, since participants reported not being interrupted by the explicit cues during the task.

Participants were then asked to sit about 70 cm away from the screen and to report any kind of visual impairment before starting the calibration procedure of the eye tracker. They were informed that their eye tracking behavior would be recorded. We tracked gaze-aware region, active region (click), panable region (scroll), gaze point, eye positions and fixations. Our aim was to identify and analyze patterns of visual attention during the writing task.

After filling the inventory, the writing task was explained. When they finished the writing task, they were asked to fill the survey based on Flow Theory dimensions, the adjectives from the list we gave, and the survey about Creativity Support Index. Lastly, we interviewed them. The total time per user took over thirty minutes, it included a pre-questionnaire, instructions, experiment and post-experimental semi-structured interviews. Participants were allowed to take breaks between each condition.

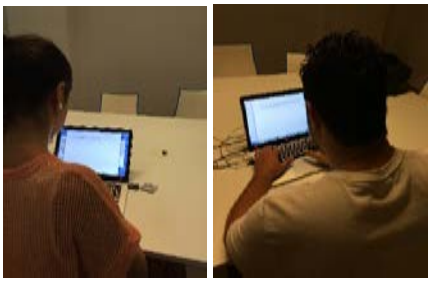

Figure 3: User performing the study in the research laboratory.

4 RESULTS

To inquire into the impact of subliminal and supraliminal priming on users' apparent and experienced creativity we triangulated different data sources: eye tracking data, behavioral data, users' verbal accounts during task execution, self-reports using psychometric scales of creativity, and data from our exit interviews.

The CBI inventory was found to be highly reliable (30 items; α= .88). Regardless of the self-report scale in the 30-item CBI that could capture a creative accomplishments and activities in past behaviors, our results suggest that our sample was likely "homogenous" in terms of past creative actions. 64.3% (nine out of fourteen) of participants had a more than 30 points on the CBI and 35.7% (five out of fourteen) participants had less than 30 point on the CBI.

Did priming lead to increased experience of creativity?

We found no significant difference between pre (*Mpre*=6.07; *SDpre*=2.33) and post measures of experienced creativity in either of the three conditions: No priming (*Mpost*=6.04; *SD*=2.31); Subliminal (*Mpost*=5.28; *SD*=1.97); Supraliminal (*Mpost*=6.00; *SD*=2.11). Moreover, no statistically significant difference was found in post measures between the three conditions. From the results most of the users consider themselves creative persons (64.4% of participants ranked themselves with values higher than 5). In the conditions No Priming (*M*=6.4; *SD*=2.3), and Supraliminal Priming (*M*=6.0; *SD*=2.1), they reported having experienced more creative moments than during Subliminal Priming (*M*=5.3; *SD*=2.0).

Using Friedman's ANOVA, this difference was not found to be statistically significant (Fr (2) =2.94, p>.05). When we compare the self-perception of creativity before (Mpre=6.07; SDpre=2.33) and after each condition (Figure 5) the difference was not considered to be statistical significant (Fr (3) =2.85, p>.05). Yet, qualitative data revealed that the experience and appraisal of the three conditions varied among participants. Initially, most participants seemed to prefer the supraliminal condition as a strong creativity trigger: *"I liked this condition because the words came fast and this was good to get ideas"* [P10]; *"The words are good to get an idea and start writing"* [P7]; *"I was concentrated in writing the story, I did not use any cue, but they gave me ideas"* [P12]; *"I was writing and I had a block (…) I was waiting for another word to appear. Sometimes, the word did not fit, but gave me ideas (…) in the last condition [no priming] I missed the cues. I was checking to see when they would appear"* [P8]; *"I was waiting for another word to inspire me"* [P4].

This preference, however, seemed to fade away during the course of the tasks, as some words were not directly relevant to the topic: **"***It became frustrating as none helped"* [P8], *"After a while the words became annoying, they were not related"* [P7]. *Some participants felt overwhelmed: "The words started being intrusive. I felt forced to use them"* [P14]; and others felt distracted during the tasks "*It was annoying. The words distracted and broke the flow of my writing. I was frustrated"* [P1]*; "Since I*

had the story already set in my mind, I found them annoying. I wanted to write 100% original" [P5].

Did priming boosted output?

Participants wrote an average of 125.3 words in the *Subliminal* condition (*SD*=57.50), an average of 118.4 words in the control condition (*SD*=39.1), an average of 124.9 words in the *Supraliminal* condition, (*SD*=32.6). A Friedman's ANOVA revealed no statistically significant difference among the three conditions (*Fr* (2)=2.81, *p*>.05).

Some participants showed mixed feelings about the supraliminal cues: *"The words helped me getting the first idea, yet after a while I overlooked them because I wanted to focus on my idea" [P9]; "I did not use the words, but they helped to remember others. Some words made me stop writing to think. Later they were always in my memory, but did not know how to use them to make sense of the text that was being writing"* [P6].

For other participants, the supraliminal condition had no effect, e.g., *"I continued writing, I was concentrated and I ignored words" [P2]*.

In the *Control* condition, 64.29% of users chose the adjective **Relaxed** in contrast to 42.86% of users in the *Subliminal Priming* condition and 57.14% in the *Supraliminal Priming* condition. 57.14% of users in *Subliminal* and *Supraliminal Priming* conditions selected **Creative** compared to the 71.43% selected in the *No priming condition*. **Satisfied** was chosen 42.86% in the *Supraliminal Priming* condition, 50.0% in the *Subliminal Priming* condition and 57.14% in the *No Priming* condition. The most relevant observation is simply the confirmation that most of the chosen adjectives indicate a positive mental well-being.

Did priming boosted flow?

Some statistical results are shown in Table 1, to test differences between each condition based on the Flow Theory dimensions [36].

Table 1: Average (SD) for Flow Theory dimensions in each environment.

	No Priming	Subliminal Priming	Supraliminal Priming
(i) Concentration	7.86(1.92)	6.43(2.44)	7.29(2.55)
(ii) Sense of Control	7.64(2.10)	6.36(2.06)	7.36(2.34)
(iii) Loss of self-consciousness	3.50(3.80)	6.00(3.16)	6.43(3.50)
(iv) Lost Track of Time	3.14(2.66)	4.57(2.93)	4.64(3.79)

By looking at the Table 1, one can see that the *Loss of Self-consciousness* has higher average levels for Subliminal Priming (*M*=6.00; *SD*= 3.16) and Supraliminal (*M*=6.43; *SD*= 3.50) in contrast to the No Priming condition (*M*=3.50; *SD*= 3.80). Using an ANOVA with repeated measures with a Greenhouse-Geisser correction, the mean score for *Loss of Self Consciousness* of participants in Subliminal Priming when compared with No Priming condition was statistically significantly different (*F*(1.000, 13.000)=5.759, p<0.05).

The *Lost Track of Time* dimension was not considered by participants for any of the conditions we evaluated (No Priming *M*=3.14; *SD*=2.66); Subliminal (*M*=4.57; *SD*=2.93); Supraliminal (*M*=4.64; *SD*=3.79)). The *Concentration* dimension (No Priming *M*=7.86; *SD*=1.92); Subliminal (*M*=6.43; *SD*=2.44); Supraliminal (*M*=7.29; *SD*=2.55)) results were most consistent and similar in all conditions also in the *Sense of Control* (No Priming *M*=7.64; *SD*=2.10); Subliminal (*M*=6.36; *SD*=2.06); Supraliminal (*M*=7.36; *SD*=2.34)). However, using Friedman's ANOVA, this difference was not found to be statistically significant (*Fr* (2) =1.13, *p*>.05).

Can priming support creativity support tools?

We used the CSI [34] as a way of evaluating how well each condition (no priming, priming subliminal and priming supraliminal) supported the creativity of the participants.

14 participants generated an average overall CSI score as shown in Table 2 for a creative writing challenge in each condition. Tables 3,4,5 show the average factor counts, average factor score, and average weighted factor score for each of the six factors on the CSI in each environment session.

The most important factors for the task were "Enjoyment" and "Immersion", as shown on Tables 3,4 and 5, although we did not find any significant difference through statistical analysis, there is a tendency of higher scores with Subliminal Priming and Supraliminal. Experiments among all the conditions revealed themselves as being quite diverse amongst all the participants.

Table 2: Overall CSI Score in each environment.

	No Priming	Subliminal Priming	Supraliminal Priming
Overall CSI Score	*M*=56.81; *SD*= 18.54;	*M*=50.98; *SD*= 23.16;	*M*=54.64; *SD*= 23.03;

The Subliminal condition, however, provided surprising results. The cues were perceived consciously by 21% of our participants (3 out of 14), total of 69. Every cue was only perceived once, the same was verified in the Supraliminal condition. Thus, when asked about their preferences and experiences with the subliminal cues influencing their ideas, participants reported similar thoughts to the *Supraliminal* condition, e.g. *"I saw them, but I did not use them, because I had my clear-cut ideas"* [P3]; *"I notice but I did not use them, […] the words came and went too fast"* [P4]; *"The words bothered me, because they disappeared too quickly and influenced my writing. It was stressful"* [P7]*; "I did not use the words, but I can still remember some of them"* [P12]. Despite reporting being unaware of the cue, some participants used them across their stories – *"I thought it was a problem with the program or the screen* [P5]*"; "I did not see them, I was focused writing"* [P7].

Table 3: CSI Avg. Factor Counts (SD): Sum of Results of Two Questions by Factor.

	No Priming	Subliminal Priming	Supraliminal Priming
Results Worth Effort	11.83 (4.45)	9.85 (4.85)	12.08 (5.14)
Exploration	10.75 (3.91)	9.08 (5.38)	10.00 (5.10)
Collaboration	7.75 (5.24)	6.00 (4.53)	6.25 (4.99)
Enjoyment	10.83(4.39)	**8.67 (5.33)**	11.25 (5.56)
Expressiveness	11.67 (4.85)	10.00 (5.15)	11.08 (4.93)
Immersion	13.50 (5.32)	**9.50 (5.40)**	11.92 (6.08)

Table 4: Avg. Factor Score (SD).

	No Priming	Subliminal Priming	Supraliminal Priming
Results Worth Effort	3.00 (1.60)	2.58 (1.56)	2.58 (1.31)
Exploration	3.08 (1.31)	3.42 (1.08)	3.17 (1.27)
Collaboration	0.42 (1.00)	0.33 (0.89)	0.42 (0.79)
Enjoyment	1.08 (1.44)	**1.33 (1.56)**	**1.33 (1.44)**
Expressiveness	3.33 (1.44)	3.33 (1.44)	3.67 (1.23)
Immersion	2.67 (0.98)	2.67 (0.89)	2.50 (1.09)

Table 5: Avg. Weighted (SD).

	No Priming	Subliminal Priming	Supraliminal Priming
Results Worth Effort	37.17 (23.82)	26.17 (21.42)	33.42 (23.66)
Exploration	32.58 (21.88)	32.17 (23.59)	29.58 (20.20)
Collaboration	3.17 (7.41)	1.17 (2.76)	3.67 (7.76)
Enjoyment	14.25 (22.25)	**14.83 (21.46)**	**19.17 (24.15)**
Expressiveness	39.92 (27.20)	29.33 (17.29)	38.50 (21.03)
Immersion	37.00 (21.81)	**26.92 (19.35)**	31.58 (25.63)

Priming and "writer's block"

The analysis of the participant's gaze with the eye tracker data revealed that only 36% participants saw the cues enough time for them to be perceived (either consciously or unconsciously). While 21% (3 of 14 participants) looked down at the keyboard the entire time after start writing, the remaining 43% were looking at the fridge magnets at the time the cues were displayed.

We observed that participants searched for a cue when facing a block during the Supraliminal condition (see Table 7). A block was denoted when we noticed a longer interruption during the writing, a distant look or an anxious movement [5], which were confirmed at the end of the experiment e.g., *"(...) when I had a block, I waited to see the cue."*[P9-Supraliminal]. We expected that providing participants with random cues during the writing activity would lead to lower overall number of blocks, when compared to the control condition. However, this was not verified (No Priming = 13, Subliminal = 19 and Supraliminal = 13). Yet, when we consider only the participants that glanced across the subliminal cues, results showed lower blocks in the Subliminal condition (n=9) (see Table 6).

Table 6: Number of writer's blocks across the conditions. Participants in the *Subliminal* condition that noticed the cues are identified with *.

User	1	2	3	4	5	6	7	8	9	10	11	12	13	14
No Priming	0	1	1	0	3	1	2	1	2	0	1	0	1	0
Subliminal Priming	1*	2*	3*	2	3	2	0	1*	0	0	0	2	2*	1
Supraliminal Priming	0	5	1	2	1	3	0	0	0	0	1	0	0	0

Table 7: Comparison between the number of words seen and used in the supraliminal and subliminal conditions

User	# seen Supraliminal	# used Supraliminal	# seen Subliminal	# used Subliminal
1	**14**	**0**	**20**	**0**
2	**25**	**5**	**13**	**0**
3	**5**	**0**	**15**	**0**
4	**13**	**5**	**0**	**0**
5	**2**	**0**	**0**	**0**
6	**3**	**0**	**0**	**0**
7	**14**	**5**	**0**	**2**
8	**15**	**0**	**1**	**0**
9	**13**	**0**	**0**	**0**
10	**11**	**0**	**0**	**0**
11	**13**	**1**	**0**	**5**
12	**11**	**0**	**0**	**0**
13	**12**	**1**	**20**	**5**
14	**15**	**15**	**0**	**0**

5 DISCUSSION

As suggested by Carroll et al. [37] and Silvia et al. [29], we used different ways to measure creativity in each condition to obtain more consistent results. Silvia et al. [29] argue that self-assessments about individual creativity is not standardized and can lead us to different results every time we try to measure it. Boden [38] states that creativity is a puzzle, a paradox, and in some ways a mystery.

As it can either be encouraged or discouraged [39], we used a simple creative writing technique such as showing the fridge magnet [28] to trigger the creativity in users performing the writing tasks. This was important to make users harness and embrace their creativity through the use of our creative support tool. Creativity support tools promote or accelerate or facilitate creativity [40] but in this case, from the results, we could notice that implicit cues – Subliminal Priming – were not considered by the users as a good tool to boost creativity.

CSI results suggest that the Immersion factor had one of the lowest scores. Also, according to the results we could see that users rank their self-perception of creativity with lower values rather than with Supraliminal Priming or without any priming. Using triangulation methods [37] with semi-structured interviews, results and observations, we could acquire that our sample was usually engaged with creative activities, with an emphasis in literature, miscellaneous, performing arts, science and music actions, as reported by the CBI. Results indicate that the study was not biased by highly critical self-assessments.

As stated by Csikszentmihalyi [41], flow is the state in which people are so involved in a given activity that nothing else seems to matter. Giving our creative task, we could observe that some participants were concentrated in the writing task that they did not even see the implicit cues (subliminal priming). Also, most of the adjectives chosen by participants were positive, indicating a good mental well-being. Results from the Flow dimension Loss of Self-consciousness were a significant issue in the Subliminal priming condition. Moreover, results from Concentration and Sense of Control dimensions were most consistent and similar in all conditions.

Cherry et al. [34] presented a study from a collaborative writing experiment using Google Docs (with no stimuli) where their results were higher when compared with our results. The top two factors in their study where Expressiveness and Collaboration, whereas in our study the top two where Enjoyment and Immersion.

When comparing each condition with CSI results and qualitative data it is suggested that participants were really thoughtful and engaged in the writing activity. They put less amount of effort in producing a similar outcome among other conditions (see Table 5 "Results worth effort"). Moreover, while the subliminal condition was reported as the less enjoyed condition, participants previously self-reported that they felt more animated during the subliminal task (see Table 5 "Enjoyment"). On the other hand, and while the No Priming condition revealed higher values of Immersion (see Table 5), minimizing the speed with which cues (subliminal or supraliminal) were presented, may help reduce the number of disruptions of participant's workflow. Although the results are not statistically significant, they are important as part of the process.

6 CONCLUSION

In this paper we presented a novel approach that addresses for the first time the study of priming (subliminal and supraliminal) in a creative task such as creative writing.

In the within-subject study, we highlight the value of interaction with implicit or explicit cues as an alternative to boost the creative process more effectively. Many techniques are sometimes used to boost the creativity while writing – our experiment used the fridge magnets as creative writing prompts.

Reflecting upon the state of the research, we see there are many aspects of this study that remain open for future investigation, such as our results about creativity and its metrics combined with priming. When using creative writing tools, it is important to measure creativity because metrics can lead us to the different impacts that these tools can have on diverse people. These types of features such as subliminal and supraliminal cues may be present within these tools as a way to trigger the writing process and also to intensify the creativity of writers. Also, writing prompts are sometimes used to stimulate the creative process, when writing. In this research, we highlight the value of priming as a powerful mean to encourage that same process.

It is important to increase the research efforts on designing user interfaces that support creative writing and to develop novel tools that can be used by numerous users.

Finally, acknowledging the limitation of not considering the long-term usage of each condition, the present study found empirical support for using subliminal or supraliminal priming in creativity support tools. Also, our study can be replicated in different fields, combining several approaches that have the common objective of supporting human creativity.

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