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Minding the Dreamer Within: An Experimental Study on the Effects of Enhanced Dream Recall on Creative Thinking

ABSTRACT

Several studies have found an association between frequency of dream recall and creativity. We tested the hypothesis that training individuals to increase dream recall by means of a daily dream log would increase scores on the Torrance Test of Creative Thinking (TTCT). One hundred twenty-five participants completed a baseline measure of creativity (TTCT, figural version) as well as of dream recall, dissociation, thinness of psychological boundaries, mindful-attention awareness, and well-being. Participants were randomly allocated to two groups: the experimental group (n = 55) received a daily dream log; while the control group (n = 32) received a similarly phrased log registering memories of a vivid episode from the previous day. After 27 days, all participants completed follow-up measurements identical to those at baseline. A non-randomized non-intervention group (n = 35) was used to test for practice effects on the TTCT. There was significant selective increase for the "creative strengths" component, which was only observed in the experimental group. There were significant correlations between creativity and dissociation as well as between creativity and thinness of psychological boundaries. Enhanced dream recall through daily dream logging fosters aspects of creativity. Associations between creativity, dissociation, and thinness of boundaries, suggest that increased awareness to dreams increases creativity through a "loosening" of stereotyped thinking pattern.

Keywords: dream recall, creativity, depersonalization, dissociation, boundaries, states of consciousness.

It has long been noted that dreams can provide a source of creative solutions to challenging problems. Although such a relationship has been mainly founded on anecdotal accounts, there is some systematic empirical evidence supporting this view. A recent survey of 635 participants suggested that around 8% of all dreams provide creative solutions to a problem (Schredl & Erlacher, 2007). Interestingly, this study identified 3 different pathways through which dreams seemed to afford such creative solutions: 1—dreams that provided an explicit solution to a problem, 2—dreams that provided an impetus to act in an out of character way, and 3—dreams containing emotional insights, such as those allowing an understanding of persistent maladaptive attitudes in life.

In addition to dreams being able to provide solutions to specific problems, a few studies carried out since the early 1960s have found that irrespective of dream content, there is an intriguing association between frequency of dream recall and measures of creativity (Bone & Corlett, 1968; Schechter, Schmeidler, & Staal, 1965). An early study found a significant correlation between dream recall and scores on the Remote Associates Test (a measure of divergent thinking) in a sample of 72 college students (Bone & Corlett, 1968). Another study found that as compared with low dream recallers, high-frequency recallers scored significantly higher on the elaboration and originality dimensions of the Torrance Test of Creative Thinking (TTCT) (Fitch & Armitage, 1989). Similarly, Schredl (1995) found a significant correlation between frequency of dream recall and a measure of verbal creativity in 44 adults. A comparison of dream reports between high and low creative high school students revealed that the former group was characterized by more a "primary process", symbolic thinking style, and a tendency to make unusual combinations of images or ideas (Domino, 1976). Following a more neurophysiological line of

enquiry, Cai, Mednick, Harrison, Kanady, and Mednick (2009) similarly found that as compared with quiet rest and non-REM sleep, REM sleep seems to foster novel ways of integrating information for creative problem solving.

Of further relevance to the association between frequency of dream recall and creativity, is the finding that of all personality dimensions, "openness to experience" shows the most reliable association with creative capacity (Li et al., 2015; McCrae, 1987). This personality dimension refers to a flexible and permeable way of organizing the contents of consciousness irrespective of their type (McCrae, 1994). The idea that people differ in terms of the fluidity and permeability of their conscious experience has been expanded and elaborated upon in the last two decades and the term mental "boundaries" has been proposed as more encompassing, and as a better descriptor than "openness to experience" (Hartmann, 1989; Hartmann, Russ, Oldfield, Sivan, & Cooper, 1987; McCrae, 1994). According to this model, people categorize and organize information by placing conceptual or experiential boundaries between conscious domains that vary in their "thickness" and "permeability" (Hartmann, 2011). In this respect, some studies have found that people with thinner "boundaries" are characterized by high creative capacity and frequent dream recall (Hartmann, 2001, Hartmann, 2011). Such an association is not surprising given that a key feature of creative capacity, namely divergent thinking, entails the ability to generate associations in an original and useful way. Another key dimension that has been found to be associated to creative capacity is "dissociation." This term was introduced into the psychiatric literature during the 19th century to describe a range of anomalous experiences and behaviors affecting self-consciousness, identity and autobiographical memory (Crabtree, 2003). Not surprisingly, the term still carries with it an implicit assumption of abnormal mental functioning. Recently, however, a growing body of research suggests an enlarged view of dissociation, according to which dissociation also encompasses an ability to foster creativity through the experiencing of non-ordinary states of consciousness (Grosso, 1997; de Ruiter, Elzinga, & Phaf, 2006). It has been proposed that non-ordinary states of consciousness might help transcend constraints imposed by habitual, stereotyped ways of thinking and experiencing (Grosso, 1997). Recent studies have indeed found a significant association between measures of dissociation and creative capacity (Perez-Fabello & Campos, 2011a,b; Thomson, Keehn, & Gumpel, 2009; Van Heugten-Van der Kloet et al., 2015) and dissociation and fantasy proneness (Giesbrecht, Merckelbach, & Geraerts, 2007).

In view of the replicated association between dream recall and creativity, this study attempted to test the hypothesis that training participants to increase their frequency of dream recall by means of a standardized dream log would have an augmenting effect on creative thinking. As a secondary goal of the study, we explored associations among boundary thickness, dissociation, and creative thinking. In addition, measures of mindful-awareness and well-being were employed to establish their relationship with our main variables.

METHOD

ETHICAL APPROVAL AND PARTICIPANTS

The research design was approved by a local ethics committee. Participation was entirely voluntary and participants were neither paid nor in receipt of educational credits.

Participants were recruited from the first-year undergraduate student population at the Colegiatura Colombiana University, an institution with an emphasis in creative thinking. Recruitment posters were displayed throughout the university campus, and email advertisement material was also sent out to all the first-year undergraduate population. In total 290 students were invited to participate in the study.

BASELINE MEASUREMENTS

Following written consent to participate, two hundred participants completed the TTCT, figural version (Torrance & Ball, 1984). Participants received either version A or B of the TTCT distributed in an alternate manner; such that one student would be given version A, and then the next student version B. This method was chosen in order to reduce the possibility of plagiarism, since students were seated fairly close together in the university auditorium. After completing the TTCT, all participants supplied demographic information and completed the following self-report questionnaires: the Boundaries Questionnaire (BQ-18; Short Version) (Hartmann, 2011); the Warwick-Edinburgh Mindfullness Well-being Scale (WEMWBS) (López et al., 2013; Tennant et al., 2007); the Dissociative Experiences Scale (DES) (Bernstein Carlson & Putnam, 1986; Icaran, Colom, & Orengo-Garcia,1996); the Mindful Attention Awareness Scale (MAAS) (Brown & Ryan, 2003; Johnson, Wiebe, & Morera, 2014); and the Schredl "Dream Recall Scale" (Schredl, 2004).

Two groups, an experimental group, and a control group, were emailed a short questionnaire each morning for a total of 27 days using the cloud-based Survey Monkey platform (www.surveymonkey.com). For the experimental group, this questionnaire enquired about the quantity of dream recall for the previous night (to be rated on a seven-point scale of 1 to 7, based on how much detail was recalled), as well as the vividness of recall for six sensory modalities (to be rated on a three-point scale of 0 to 2). These two scales were devised and validated by Reed (1976a,b). The control group, in turn, received an equivalent questionnaire of identical item length and scoring, which asked about "moments vividly recalled from the previous day, in which you felt unusually grounded in the here and now." Given that dreams represent non-habitual states of consciousness, the control question emphasized memories of being unusually grounded because such experiences would also qualify as non-habitual states of consciousness for most people. Survey Monkey records the time spent answering surveys by participants and these questionnaires took a mean average of less than 1 minute to complete.

Random number tables were used in order to allocate the 160 "log keeping" participants to either the experimental group or the control group. Using this method, 86 participants were allocated to the experimental group, and 74 to the control group.

Of the 200 participants who completed all baseline measurements, 40 were unable to commit to logging information on a daily basis, but were willing to complete final follow-up measurements at the end of the study (please see Figure 1 for a flowchart of the participation process). These participants constituted a "non-intervention" group, allowing for the testing of TTCT practice effects.

FOLLOW-UP MEASUREMENTS

Only participants completing 70% or more of the daily questionnaires were entered for data analysis. After 27 days, qualifying participants completed a battery of follow-up measures, identical to those at baseline with the exception that they received the complementary TTCT form (A or B) to that completed at baseline. In total, 55 participants allocated to the dream logs (experimental group), and 32 participants allocated to the mindful-episodes recall (control group) completed daily questionnaires above the participation cut-off point mentioned above. The participation retention rates were therefore 64% for the dream group

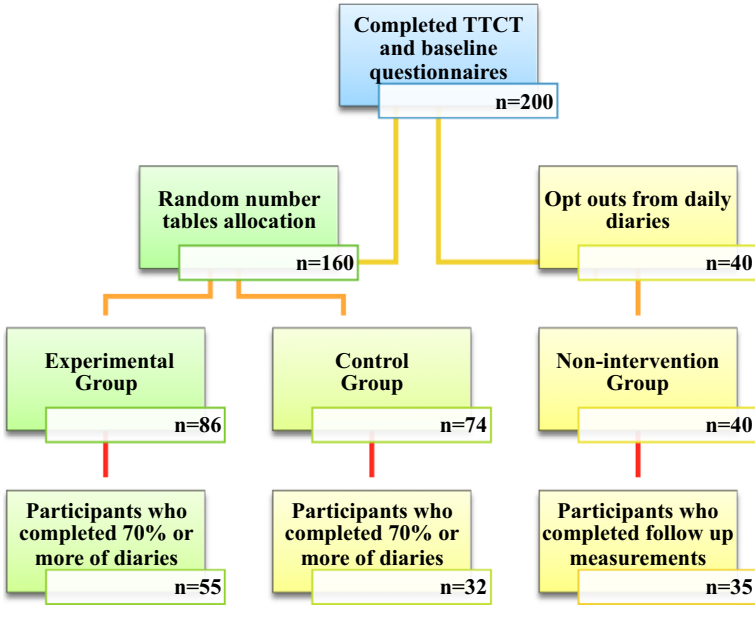

FIGURE 1. Flowchart of group allocation, the participation process, and sample sizes. [Color figure can be viewed at wileyonlinelibrary.com]

and 43% for the control group. Thirty-five out of the 40 participants in the non-intervention group completed all follow-up measures.

ADMINISTERED MEASURES

The Torrance Tests of Creative Thinking (TTCT) Figural Version (Torrance & Ball, 1984)

This is a widely used instrument in creativity research, and performance on it has been found to predict creative achievement (Kim, 2006). The test comprises three tasks: Task 1 consists in a "picture construction" activity, in which the participant is provided with an ambiguous curvy shape. The participant is then required to produce a drawing that incorporates this provided shape. Task 2 consists in a "picture completion" activity, in which the participant is provided with ten incomplete figures. The participant is invited to make additions to each of them, in order to transform them into meaningful drawings. Task 3 consists of either thirty sets of parallel lines (TTCT Version A) or thirty circles (TTCT Version B). The participant is asked to create different drawings from either the lines or circles they are provided with, and to create a title for each response they provide. In addition, they are specifically asked to offer responses that are unique as possible. Each task is timed to last for 10 minutes.

The TTCT yields two different types of scores: a "Raw Score" and a "Creative Strengths Score" (Torrance, 2008). The "Raw Score" dimension encompasses the following sub-domains: (1) *Fluency*: the number of relevant ideas; (2) *Originality*: the number of unique, statistically infrequent ideas; (3) *Elaboration*: the number of non-essential details added; (4) *Abstractness of Titles*: the degree to which titles generated deviate from being a literal labeling of contents; and (5) *Resistance to Premature Closure*: the degree to which a participant withstands sealing the provided open figures with a single line and instead generates a different solution in a less predictable way. The "Creative Strengths Score" dimension encompasses the following subdomains: (1) *Emotional expressiveness*: the number of instances where produced pictures and titles communicate feelings and emotions; (2) *Storytelling*: the number of instances where there is allusion to a narrative context surrounding the central image of a drawing; (3) *Movement or Action*: the number of instances where a participant suggests movement or an ongoing activity in their drawing; (4) *Expressiveness of Titles*: the degree to which the titles given to drawings go beyond concrete descriptions and convey emotion and feeling; (5) *Synthesis of Incomplete Figures*: the number of occasions where a participant combines two or more figures to generate a larger composite picture (task two of the test); (6) *Synthesis of lines or circles*: the number of occasions where a participants combines two or more circles or sets of parallel lines (task three of the test); (7) *Unusual Visualization*: the number of instances where drawn images depict an unusual visual perspective upon the figure provided, for example, an object perhaps being drawn as seen from above or underneath; (8) *Internal visualization*: the number of instances where a participant's drawing depicts contents pertaining to an interior, for example, where sweets are shown inside a jar, or where an embryo is visible inside a pregnant woman; (9) *Extending or Breaking Boundaries*: the number of instances where a participant's drawings extend beyond the boundaries of the circles or pairs of parallel lines (task three of the TTCT); (10) *Humor*: instances where a picture is perceived as funny by the scorer; (11) *Richness of imagery*: the number of pictures generated perceived as vastly striking by the scorer; (12) *Colorfulness of imagery*: the number of pictures that reference one or more of the five senses; (13) *Fantasy*: the number of pictures that include fantastical images, evoke mythical creatures, reference the imaginary, depict fairy tales, or that are suggestive of science fiction.

Scoring of the TTCT was carried out by two of the researchers (MSS & E-LJ) who were blind to group allocation of the tests. Given that the effect of our intervention was our focus and not group-norms, we opted to count every instance where we observed an expression of a particular dimension. This enabled us to explore the data in greater depth.

The Boundary Questionnaire (BQ-18) (Hartmann, 2011)

The original Boundaries Questionnaire (BQ) comprises 138 items and has proven high internal consistency ($r = .925$) (Harrison, Hartmann, & Bevis, 2005). This version is considered to be prohibitively long for many experimental study designs (Harrison & Singer, 2013), and other researchers have developed shorter versions. The BQ-18 is an eighteen-item version used in many studies (e.g., Hartmann & Kunsendorf, 2005). The 18 items were selected based on their face validity and high correlation with the BQ total score. The BQ-18 is calculated by the addition of all the items.

The Warwick-Edinburgh Mental Well-being Scale (WEMWBS) (Tennant et al., 2007)

This instrument comprises 14 items, and assesses mental well-being across both psychological functioning (eudaimonic) and affective (hedonic) dimensions. Positively worded questions are scored on a Likert scale ranging from 1 to 5, therefore total scores can range from 14 to 70. A higher score indicates a higher level of mental well-being. The scale has been found valid for use in both general and student populations (Tennant et al., 2007), has a good psychometric profile (Lloyd & Devine, 2012), and is sensitive to change (Maheswaran, Weich, Powell, & Stewart-Brown, 2012). The WEMWBS has been translated into the Spanish language and validated in a Spanish student population sample (López et al., 2013).

The Dissociative Experiences Scale (DES II) (Bernstein Carlson & Putnam, 1986) is a 28-item self-report questionnaire proved sensitive for the detection of dissociative disorders at a cut-off point of 30 (the global score is calculated as the mean of all items). It has been validated and translated into the Spanish language (Icaran et al., 1996). It has three subscales; "depersonalization-derealization" (the experience of a sense of unreality of and distance from one's sense of self), "amnesia" (difficulties with intentional recollection of stored information), and "absorption" (the experience of being immersed in thoughts and imagery to the exclusion of being aware of one's surroundings) (Carlson et al. 1991).

The Mindful Attention Awareness Scale (MAAS) (Brown & Ryan, 2003) is a 15-item six-point self-rating scale, whose global score is calculated as the addition of all the items. The scale measures trait mindfulness, that is, the disposition to give attention to what is taking place in the present moment. This scale has been validated in healthy and clinical populations and possesses a very good psychometric profile. It has been translated into Spanish and validated in clinical samples (Johnson et al., 2014).

The "Schredl" Dream Recall Scale (Schredl, 2004) is a single item, seven-point self-rating scale used to measure dream recall frequency over the last month. Participants answering the scale are asked: "Thinking about the last month, with what frequency have you usually remembered your dreams?" Their response is selected from the following: 0 = never, 1 = less than once a month, 2 = approximately once a month, 3 = two or three times a month, 4 = approximately once a week, 5 = several times a week and 6 = almost every morning. This scale has an established high test-retest reliability (r = .83; n = 39; tested over 70 days) (Schredl, 2004).

STATISTICAL ANALYSIS

Statistical analyses were conducted using SPSS (IBM Corporation, Armonk, New York) for Windows, version 22.0. Parametric statistics were used throughout.

Analysis of variance, as well as lineal Pearson correlations and multiple linear regressions were used. An $\alpha \leq .05$ was considered statistically significant, and all significance tests were 2-tailed. For the purposes of hypothesis testing comparison of TTCT scores (both "raw" and "creative strengths") before and after intervention across groups constituted the primary outcome variables. All other analyses were regarded as exploratory.

RESULTS

A total of 122 participants were included in the analysis. The mean age was 20.0 years (*SD* 4.8); 147 (63%) were female. Mean scores were as follows: TTCT-global 96.1 (*SD* 38.0); TTCT-"raw"; 61.2 (*SD* 21.1); TTCT-"creative strengths" 33.6 (*SD* 19.1); BQ-18 39.2 (*SD* 9.3); DES 23.9 (*SD* 15.6); WEMWBS 54.0 (*SD* 9.4); MAAS 63.6 (*SD* 12.5); "Schredl" dream recall scale 4.9 (*SD* 1.6). Table 1 shows the demographics and scale results for each of the three groups. A histogram was performed in order to provide a global index of how creative capacity was distributed among the sample. As can be seen in Figure 2 global scores on the TTCT showed a normal distribution, suggesting that there was no ceiling effect although the sample comes from an institution which emphasizes creative thinking.

As can be seen in Table 1 there were no significant differences across groups on most variables with the exception of age (individuals in the control group were slightly older than the other two groups) and well-being scores (which were significantly higher in the non-intervention group).

PROOF OF CONCEPT ANALYSIS

Firstly, given that our hypothesis of being able to increase creativity through trained increased dream recall was dependent on our training method being successful, a proof of concept analysis was carried out to ascertain dream logging's ability to enhance dream recall (Figure 3). However, as has been shown by previous research, there can be a ceiling effect caused by those participants reporting high dream

TABLE 1. Means, Standard Deviations, and Group Differences on All Self-Report Scales and on the TTCT at Baseline

	[1] Experimental group (n = 55)	[2] Control group (n = 32)	[3] Non-intervention group (n = 35)	One-way ANOVA	Significance	Tukey's Test
Age	19.4 (3.1)	21.5 (6.3)	18.3 (2.9)	$F(2,18) = 6.38$	$p = .002$**	2>1,3
Gender (Female)	66.7%	56.8%	68.6%	$F(2,18) = 0.74$	$p = .475$	NS
BQ-18	39.8 (8.8)	39.0 (9.5)	38.5 (8.2)	$F(2,15) = 0.21$	$p = .811$	NS
DES	23.0 (14.4)	25.3 (14.9)	22.4 (20.5)	$F(2,15) = 0.47$	$p = .627$	NS
WEMWBS	53.4 (8.5)	53.0 (7.9)	60.5 (16.6)	$F(2,15) = 4.28$	$p = .015$**	3>1,2
MAAS	64.3 (1.3)	62.4 (2.3)	62.8 (7.2)	$F(2,15) = 0.40$	$p = .668$	NS
Schredl	5.06 (1.49)	4.5 (1.71)	5.06 (1.8)	$F(2,16) = 2.03$	$p = .134$	NS
TTCT "Global"	97.5 (39.1)	94.3 (34.6)	90.5 (34.4)	$F(2,103) = 0.21$	$p = .812$	NS
TTCT "Raw"	63.4 (23.4)	60.4 (21.2)	59.8 (19.8)	$F(2,103) = 0.08$	$p = .920$	NS
TTCT "Creative Strengths"	37.2 (22.3)	34.5 (18.0)	32.9 (18.6)	$F(2,103) = 0.56$	$p = .573$	NS

BQ-18 = Boundaries Questionnaire (short version); DES = Dissociative Experiences Scale; WEMWBS = Warwick-Edinburgh Mental Well-being Scale; MAAS = Mindful Attention Awareness Scale; Schredl = Dream Recall Scale.

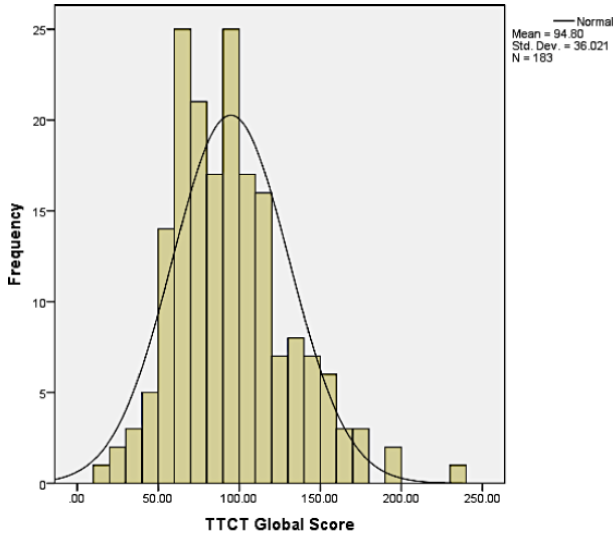

FIGURE 2. Histogram of "global" TTCT scores for the whole sample. [Color figure can be viewed at wileyonlinelibrary.com]

recall at baseline (Beaulieu-Prévost & Zadra, 2007). In order to control for these ceiling effects, we restrained our proof of concept analysis to those participants with low dream recall at baseline (lower third of each group). It is important to clarify that such curtailing of the sample was only restricted to this "proof-of-concept" analysis.

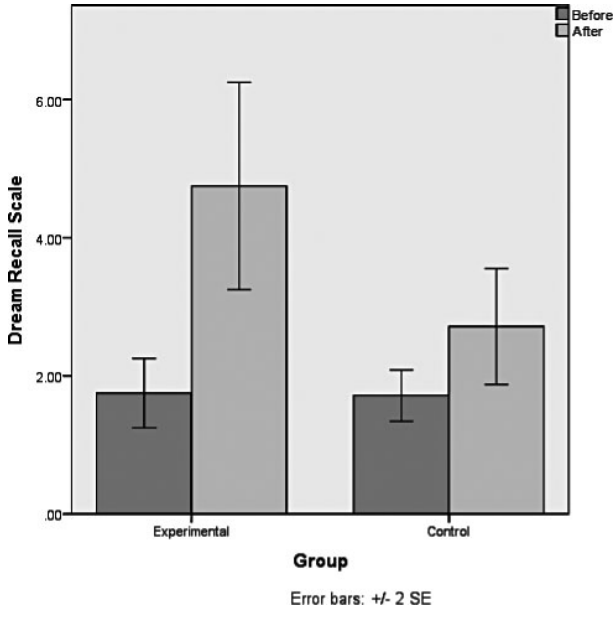

FIGURE 3. Scores on the "Schredl" Dream Recall Scale, for both the experimental and control groups.

A one-way between subjects ANOVA was conducted to compare dream recall change for the experimental and control groups. There was a significant effect of percentage of dream recall increase at the $p < .05$ level for the two conditions [$F(2,11) = 7.83$, $p = .008$]. The mean percentage of increase in dream recall for the experimental group ($M = 60$, $SD = 23.9$) was significantly higher than the control group ($M = 20$, $SD = 16.32$).

Paired-samples *t*-tests were conducted to compare frequency of dream recall before and after the intervention for each of the two groups. In the experimental group there was a significant difference in the "Schredl" dream recall scores before ($M = 1.7$, $SD = 0.5$) and after the intervention ($M = 4.1$ $SD = 1.5$), $t(9) = -5.19$, $p = .014$. There was also a significant difference for the control group, before ($M = 1.71$, $SD = .48$) and after ($M = 2.71$, $SD = 1.11$) the intervention ($t(12) = -3.24$, $p = .018$).

ANALYSES OF THE EFFECTS OF THE INTERVENTION ON CREATIVITY

Having ascertained proof of concept, the following analysis incorporates all participants in the experimental and control groups. A one-way between subjects ANOVA revealed no differences at baseline for both the "raw" [$F(1,129) = 0.001$; $p = .969$] as well as the "creative strengths" [$F(1,129) = .889$; $p = .348$] components of the TTCT among the experimental and control groups. Comparison of post-intervention "raw scores" by means of one-way ANOVA revealed a significant effect of type of intervention [$F(1,89) = 4.834$; $p = .030$]. Pairwise comparisons for "raw" TTCT scores before and after the 27-day interval for the experimental group were: "before" ($M = 63.4$ $SD = 23.3$) and "after" ($M = 85.4$, $SD = 24.5$); $t(53) = -6.0$, $p < .000$; while for the control group they were: "before" ($M = 60.3$, $SD = 21.2$) and "after" ($M = 75.5$, $SD = 18.9$); $t(30) = -3.9$, $p < .000$. In short, although there was a larger effect size for the experimental group, the two groups showed a significant increase in their "raw scores" on the TTCT after the intervention, suggestive of a practice effect.

A comparison of "creative strength" scores on the TTCT after the 27-day period by means of a one-way ANOVA across groups revealed a significant effect [$F(1,89) = 6.624$; $p < .012$].

Pairwise tests comparing "before" and "after" "creative strengths" scores for the experimental group were: "before" ($M = 37.4$, $SD = 22.3$) and "after" ($M = 49.0$, $SD = 27.8$); $t(55) = -3.8$, $p < .000$); while for the control group they were: "before" ($M = 34.5$, $SD = 18.5$) and "after" ($M = 35.4$, $SD = 17.4$; *t*

(30) = −.23, p = .817). In short, these results suggest, that the intervention resulted in an increase on the "creative strengths" score of the TTCT, and this effect was only observed in the experimental group.

Although we did not include the "non-intervention" group in the above analysis in view that it was a non-randomized sample, the data obtained from this group were used to test for practice effects on the TTCT. A paired-samples t-test comparing "raw scores" and "creative strength scores" at baseline and follow-up yielded the following results: there was a significant difference in the "raw scores" at baseline (M = 59.81, SD = 19.8) and follow-up (M = 68.09, SD = 18.64); $t(32)$ = −2.076, p = .046; however, there

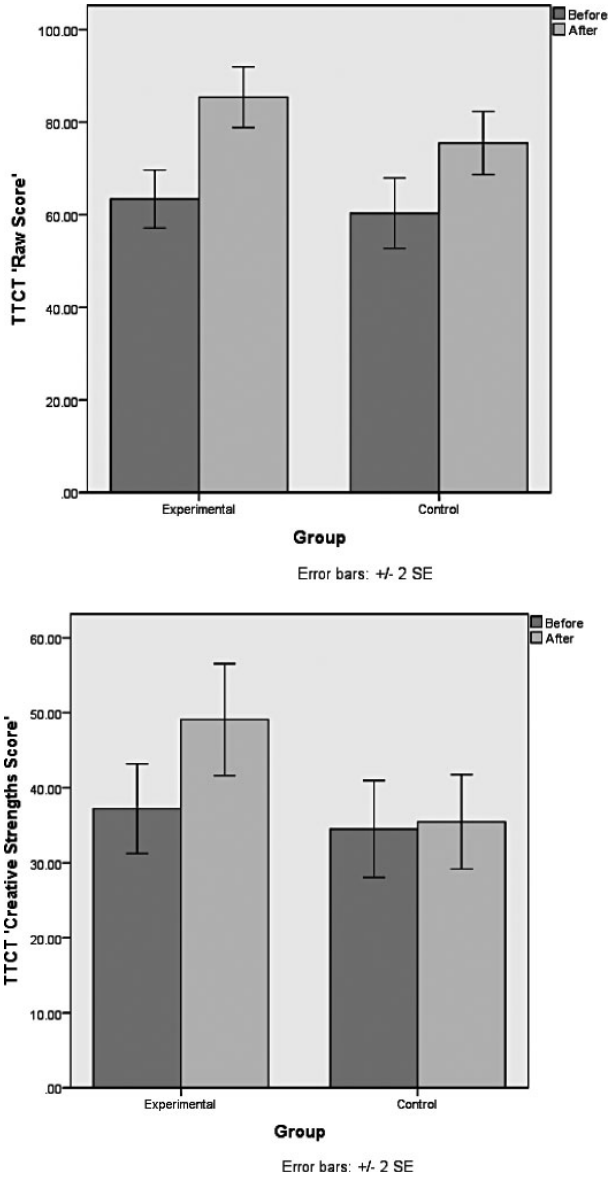

FIGURE 4. TTCT "raw" and "creative strengths" scores at baseline (before) and follow-up (after) across all three groups.

TABLE 2. Spearman Correlations between Creativity Scores of the TTCT ("Raw" and "Creative Strengths" Scores) and the Main Scales Administered

	TTCT "raw" score	TTCT "creative strengths" score	TTCT "global" score
BQ-18	$r = .28$, $p = .01$**	$r = .21$, $p = .04$*	$r = .27$, $p = .01$**
DES	$r = .39$, $p < .00$**	$r = .34$, $p < .00$**	$r = .41$, $p < .00$**
DES-dep	$r = .46$, $p < .00$**	$r = .53$, $p < .00$**	$r = .53$, $p < .00$**
DES-amn	$r = .33$, $p = .01$**	$r = .23$, $p = .98$	$r = .31$, $p = .03$*
DES-abs	$r = .28$, $p = .04$*	$r = .17$, $p = .21$	$r = .25$, $p = .08$
WEMWBS	$r = -.19$, $p = .07$	$r = -.18$, $p = .09$	$r = -.20$, $p = .06$
MAAS	$r = -.26$, $p = .02$*	$r = -.19$, $p = .08$	$r = -.24$, $p = .03$*
Schredl	$r = .07$, $p = .40$	$r = .07$, $p = .36$	$r = .08$, $p = .32$

Notes. *$p < 0.05$; **$p < 0.01$. BQ-18 = Boundaries Questionnaire (short version); DES = Dissociative Experiences Scale; DES-dep = Dissociative Experiences Scale—depersonalization subscale; DES-amn = Dissociative Experiences Scale—amnesia subscale; DES-abs = Dissociative Experiences Scale—absorption subscale; WEMWBS = Warwick-Edinburgh Mental Well-being Scale; MAAS = Mindful Attention Awareness Scale. Schredl = Dream recall scale.

TABLE 3. Spearman Correlations between Creativity Scores on the TTCT ("Raw" and "Creative Strengths" Scores) and Scores of the "Schredl" Dream Recall Scale Across Groups, at Baseline and at Follow-Up

	Experimental group	Control group	Non-intervention group
Schredl (at baseline)			
TTCT "raw" score	$r = .16$, $p = .261$	$r = .04$, $p = .821$	$r = .26$, $p = .234$
TTCT "creative strengths" score	$r = .14$, $p = .303$	$r = .87$, $p = .668$	$r = .22$, $p = .319$
Schredl (at follow-up)			
TTCT "raw" score	$r = .07$, $p = .617$	$r = -.20$, $p = .300$	$r = .25$, $p = .238$
TTCT "creative strengths" score	$r = .310$, $p = .027$*	$r = -.15$, $p = .443$	$r = .12$, $p = .587$

Notes. *$p < 0.05$; **$p < 0.01$.

TABLE 4. Multiple Regression Analysis for Predicting Global Creativity Scores on the TTCT

SCALES	Beta	*T*	Significance
BQ-18	0.081	0.478	$p = .635$
DES-dep	0.528	2.630	$p = .012$**
DES-amn	−0.095	−0.465	$p = .645$
DES-abs	−0.045	−0.222	$p = .825$
MAAS	−0.046	−0.250	$p = .804$
WEMWBS	−0.075	−0.500	$p = .620$
Schredl	0.050	0.349	$p = .729$

Notes. *$p < 0.05$; **$p < 0.01$. BQ-18 = Boundaries Questionnaire (short version); DES = Dissociative Experiences Scale; DES-dep = Dissociative Experiences Scale—depersonalization subscale; DES-amn = Dissociative Experiences Scale—amnesia subscale; DES-abs = Dissociative Experiences Scale—absorption subscale dream; WEMWBS = Warwick-Edinburgh Mental Wellbeing Scale; MAAS = Mindful Attention Awareness Scale. Schredl = Dream recall scale.

was no significant difference for the "creative strengths" at baseline ($M = 32.90$, $SD = 18.55$) compared with follow-up ($M = 30.24$, $SD = 16.81$); $t(32) = .951$, $p = .34$. Such results suggest a practice effect for the "raw score" component of the TTCT but not for the "creative strengths" component of the TTCT (Figure 4).

As can be seen in Table 2, both the BQ-18 and DES showed significant correlations with the "raw" and "creative strengths" components of the TTCT. In addition, there was a negative correlation between the "raw" and "global" scores of the TTCT and the MAAS.

Correlational analysis between the "Schredl" dream recall scale and the TTCT (see Table 3) revealed no significant correlations for any of the groups at baseline. However, at follow-up the experimental group showed a significant correlation with the "creative strengths" score of the TTCT.

REGRESSION ANALYSIS

A multiple linear regression analysis was conducted to predict creativity scores (dependent variable) on the TTCT based on scores on all administered scales (independent variables). Rather than using the global scores of the DES, and in order to explore more in depth the effects of dissociation, we used the three subscales of the DES, namely "amnesia" (DESamn), "absorpsion" (DESabs), and depersonalization (DESdep).

A significant regression equation was obtained [$F(7,41) = 2.662$, $p < .023$] with an R of 0.195. Participants' predicted creativity was equal to 98.674-0.285(DESamn)-0.088(DESabs)-0.157(MAAS)-0.379 (WEM)+1.327(DESdep)+0.382(BQ)+1.327(Schredl). Only DESdp was found to be a significant predictor of creativity scores ($p < .012$) with a mean creativity increase of 1.327 for every incremental point on the DESdp (see Table 4).

DISCUSSION

The findings of this study replicate previous evidence of an association between dream recall frequency and creative thinking (Bone & Corlett, 1968; Brand et al., 2011; Schredl, 2011). The present study found that bringing increased attention to dream recall by means of daily dream logging resulted in enhanced dream recall, particularly for those individuals with poor or moderate recall at baseline. An unexpected finding was the increase in dream recall frequency found in the control group, which although was much smaller than that found in the experimental group, still reached statistical significance. It might be speculated that the task of focusing on vivid episodic memories on a daily basis had an unexpected, indirect enhancing effect on dream recall; indeed, there is evidence suggesting that visual memory is a mediating variable for dream recall (Schredl et al., 1995).

To our knowledge, this is the first study to report that an intervention aimed at increasing dream recall resulted in a significant increase of specific aspects of creative thinking (an effect that was not shown by either the control or the non-intervention groups). While there were no differential increases in the "raw score" of the TTCT across groups, only the experimental group showed a significant increment on the "creative strengths" component of TTCT. The fact that all groups showed a significant increase in the "raw score" of the TTCT suggests that this component is more liable to practice effects than the "creative strengths" component (Lissitz & Willhoft, 1985). The "creative strengths" component of the TTCT aims to assess produced drawings along distinct dimensions such as emotional expression, storytelling, movement, unusual visual perspective, humor, richness of imagination, and fantasy, among others (Kim, 2006); that is, features usually found in dreams (Hartmann, 2010; Schredl, 2010).

It might be proposed that an increased awareness of dream mentation brought about by enhanced dream recall, might allow a cross-fertilization between "ordinary" and "dream" modes of consciousness. This might have the effect of "loosening" stereotyped and predictable associative patterns of thinking characteristic of one's ordinary state of consciousness. In an experiment to test the effects of "dreaming" states on cognitive flexibility, Walker, Liston, Hobson, and Stickgold (2002) compared the performance of 16 participants' ability to solve anagram word puzzles immediately following REM and NREM awakenings, with their performance during daytime waking state. As predicted, REM awakenings provided a significant 32% advantage in the number of anagrams solved compared with NREM awakenings. The fact that most dreams are known to occur during REM sleep, makes it plausible that the increased gain in divergent thinking required to solve the puzzles was reflective of a creative influence of dream mentation on ordinary consciousness. That nonhabitual states of consciousness can contribute toward enhancing cognitive flexibility and divergent thinking, has been demonstrated in studies looking at the effects of alcohol intoxication (Jarosz, Colflesh, & Wiley, 2012), hallucinogenic substances (Sessa, 2008); hypnosis (Lynn & Rhue,1986); Council, Bromley, Zabelina, & Waters, 2007) imaginative involvement (Zabelina & Robinson, 2010) and meditation (Colzato, Ozturk, & Hommel, 2012; Ding, Tang, Tang, & Posner, 2014). The fact that creative people have been found to be characterized by "thinner boundaries" in their categories of experiencing, as well as by increased fantasy proneness and imagination (Watson, 2003), would seem to argue in the same direction.

One of the most significant findings of this study was a significant correlation between dissociation and both the "raw" and the "creative strengths" scores on the TTCT. A few recent studies have found significant associations between dissociative proneness and measures of creative capacity. For example, Perez-Fabello and Campos (2011a,b) reported significant correlations between a measure of creative imagination and the DES in a sample of 129 art students. Another recent experimental study invited 72 participants to take part in a photo contest, for which they were requested to take one photograph each day for five consecutive days, following specific daily theme requests (Van Heugten-Van der Kloet et al., 2015). Photographs were subsequently scored and ranked by a panel on specific creativity dimensions. In addition to baseline trait dissociation measures, subjects were asked to complete daily measures of state dissociation; it was found that measures of state (rather than trait) dissociation predicted higher creativity scores. In another study, an international sample of 130 artists were assessed on measures of dissociation and fantasy proneness (Thomson et al., 2009). As hypothesized, participants were found to score within the moderately high range of both measures. In fact, 27% of participants obtained scores suggestive of psychopathology in spite of being deemed "high functioning artists maintaining careers in the performing arts." These and similar studies add weight to the concept that dissociation has a much wider semantic field beyond that implied by the clinical literature (where dissociation is mainly conceptualized in terms of mental dysfunction stemming from severe psychological trauma). Our findings, and those of others, suggest that the traditional views of dissociation are too narrow and potentially misleading.

The emerging literature on dissociation and creativity highlights dimensions of dissociation, such as absorption, dream proneness and in general an ability to experience non-ordinary states of consciousness. Taken together, these dimensions of dissociation may afford new problem-solving perspectives on a problem. In keeping with previous research, we found a significant correlation between the BQ-18 (Hartmann, 2011) and the DES (Bernstein Carlson & Putnam, 1986), namely, that the thinner the boundaries the more proneness toward dissociative experiences. Such a correlation seems counterintuitive, given that the current concept of dissociation emphasizes psychological fragmentation and compartmentalization, whereas that of boundary thinness alludes to merging of experiential and cognitive categories. It would seem, however, that both measures tap onto an undefined capacity to experience non-ordinary states of consciousness.

It is important to draw attention to the fact that, rather than being a homogenous phenomenon, dissociation is currently conceptualized as having several distinct dimensions: depersonalization, absorption and amnesia. It has been previously suggested that dissociation encompasses two fundamentally different types of phenomena. According to this view, while depersonalization refers to an ability to detach from experiencing, amnesia and absorption allude to a capacity to compartmentalize information (Brown, 2006; Holmes et al., 2005). We found that depersonalization was not only more strongly correlated with creativity than absorption or amnesia, but our regression analysis revealed it to be the only predictor of creative performance, among all administered scales. In contrast to our findings, Wolfradt and Pretz (2001) failed to find a predicted association between proneness to depersonalization experiences and a measure of creativity (the creative personality scale) in a population of college students. Although to our knowledge no other study has looked closely at the depersonalization-creativity relationship, studies in samples of patients suffering with chronic and disabling depersonalization (i.e., depersonalization disorder) have found patients to score high on fantasy proneness (Levin, Sirof, Simeon, & Guralnick, 2004) and to be characterized by thinner boundaries on the "BQ" than controls (Simeon, Riggio-Rosen, Guralnik, Knutelska, & Nelson, 2003). In fact, in this study, the authors reported a significant correlation of $r = .5$ between the DES and the "BQ".

We found significant negative correlations between mindful attention and creativity. This finding is in keeping with recent research, which found that moments of "zoning out" and accompanying mind-wandering significantly enhanced performance at a creative task, as compared to focused activities (Baird et al., 2012; Mrazek et al., 2012; Zedelius & Schooler, 2015). A recent meta-analysis using studies published between 1977 and 2015 found a significant albeit weak correlation ($r = .22$) between mindfulness and creativity (Lebuda, Zabelina, & Karwowski, 2016). It would seem that this correlation was mostly driven by tasks involving "open-monitoring" rather than focused "awareness" activities, supporting the idea that a mind not driven by goal-focused strategy is conductive to creative output.

This study has some limitations to consider. Firstly, given that participants from the experimental and control groups were likely to meet socially and discuss their participation, it is possible that participants in the control group subsequently gave undue attention to their own dreams. This may have introduced a non-systematic source of error that was difficult to prevent. Secondly, judging from the higher retention rate

in the experimental group, it would seem the experimental condition generated more enthusiasm among participants. Although we are aware that the differential drop-out rate in the experimental versus control groups is tantamount to a self-selection process, if anything, one can argue that the remaining participants were equally motivated (unlike the drop-outs), which makes the found differences less likely to be contaminated by participation-apathy. Thirdly, females were slightly overrepresented, as per the gender distribution of the university; this may have introduced a systematic bias, given that dream recall can be affected by gender (Schredl & Reinhard, 2008). Lastly, allocation to the third non-intervention group was "post-hoc", and not randomized. However, given that the main purpose for this third group was to control for practice effects on the TTCT, this limitation is likely to be negligible.

Taken as a whole, the findings of this study add to the growing body of literature, supporting the view that increased allocation of attention to non-habitual states of consciousness (dreaming, mind-wandering, hypnopompic, meditative states, among others) affords conditions that foster more creative ways of thinking. It is clear that more research is needed in this area, not only with a view toward acquiring practical methods to boost our creative capacity, but to further our understanding of the role that "fringe" mental states might have in the way we construe self and surroundings.

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