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The Role of Incubation in Creative Problem Solving: Within a Collectivistic Cultural Context

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Abstract

Creative thinking is essential for the progress in education, industry and life in general. Incubation is a widely studied phenomenon in creativity research, referring to leaving a problem aside for a period, to accrue performance on a creative problem. This study investigated the effect of incubation on creative problem-solving by means of a pretest-posttest quasi-experimental design, and remote associates tasks (RATs) were used as a measure of creative problem-solving. For this purpose, a sample of 60 students (22 males, 38 females) was recruited from the population of a private university. They were assigned to a control condition and two different experimental conditions based on the time of onset of incubation. The data collected was analyzed for a significant effect across all conditions by means of a chi-squared test, and covariates were inferred by means of Spearman's Rho, with significance level set at α<.05. The results did not find an incubation effect in creative problem-solving, and several possible explanations may account for this trend, especially the limited cross-cultural application of measurement tools and theoretical paradigms. The disparity is especially prominent with regards to Pakistan, which is a predominantly collectivistic, and the educational system stymies creative thinking. Future research must take into account the relevance of culture in creative problem-solving, and propose solutions to circumvent the dearth of creative potential in developing nations such as Pakistan.

Keywords: Incubation, Creative Problem-Solving, Creativity, Remote Associate Tasks, Cross-Cultural Psychology.

The phenomenon of creativity is a characteristic feature of human cognition—as ubiquitous across cultures as language, but at the same time, surprisingly rare. Creativity has been the springboard for innovation and discovery from the dawn of time, in fields as diverse as science and arts (Ritter & Dijksterhuis, 2014). Over the years, though, incubation as a contributing factor has gained interest of scientists. Eminent personalities such as Einstein and Newton have attributed their turn-of-the-century discoveries to "leaving the problem aside for a period of time" (Baird et al., 2012), or in other words, incubation. Thus, incubation is defined as "leaving a problem aside for a period of time." Nonetheless, incubation in creative problem-solving has been made amenable to scientific inquiry only in recent years. It has also been noted that enforced silencing and lack of expression adversely impact learning which in turn hampers creativity (Saqib, & Arif, 2017).

Current research supports the positive influence of incubation on creative problem-solving, while parallel research has found strikingly unsupportive results (Dodds, Ward, & Smith, 2004; Patrick, 1986;Sio & Ormerod, 2009). The lack of a consistent pattern in results and inability to replicate previous experiments can be attributed to aberrations in research design and small sample sizes (Christensen & Schunn, 2005). Moreover, since the effect of incubation on creative problem-solving is determined by multiplicity of factors, it has been challenging to develop a unified model of incubation in creative problem-solving. However, recent work by Hélie and Sun (2010) has attempted to circumvent that weakness, though its research application is still largely lacking. Future research may attempt to consolidate various theoretical models of incubation into a comprehensive understanding that is accessible to experimentation and supersedes weaknesses in research design.

Creative problem-solving is construed as the generation of novel and useful solutions to problems (Amabile, Barsade, Mueller, & Staw, 2005; Batey, Chamorro-Premuzic, & Furnham, 2010; Cheng, 2011; Koppel & Storm, 2013), which is embedded in its context—the originality and utility of the solution is determined with regards to the cultural roadmap and may vary from one individual to another (Cheng, 2011; Hélie & Sun, 2010; Ramos & Puccio, 2014).

Wallas (1926) was the first to elaborate the creative process, and incubation is one of the stages in his model. According to Wallas, creative problem-solving occurs in four stages:

preparation, the first conscious interaction of an individual with the problem, in which one may call upon previous knowledge and expertise to solve the problem in a logical manner. If a solution is achieved at this stage, the future stage may not be needed (Hélie &Sun, 2010). It is followed by incubation, which Wallas (1926) defined as a period one terminated conscious problem-solving, and the individual unconsciously worked on the problem, though newer paradigms of creativity may not always subscribe to this definition (Dodds et al., 2004; Gilhooly, Georgiou, Sirota, & Paphiti-Galeano, 2014; Hélie & Sun, 2010). Incubation may be followed by illumination, in which the problem-solver experiences insight, such that he/she may suddenly and unexpectedly become aware of the solution to the problem (Penaloza &Calvillo, 2012 ; Smith & Blankenship, 1991). Upon insight, the last stage is verification¸ in which the insight acquired is put to test, refined and confirmed as a solution to the problem.

To explain the process and understand incubation two theories have gained appreciation. These theories are the Unconscious thought theory and forgetting fixation hypothesis.

The most common theory of incubation, which derives directly from the Wallas (Wallas, 1926) stages of creativity, is that of unconscious thought theory (UTT) (Dijksterhuis & Meurs, 2006). In this theory, the problem-solver continues to work unconsciously on the problem at hand, which eventually leads to a solution (Gilhooly et al., 2012; Hélie & Sun, 2010; Penaloza & Calvillo, 2012). The theory is compatible with immediate incubation paradigm (Gilhooly et al., 2012), and implies that incubation would occur regardless of the conscious load of the interpolated distracter tasks. However, if the interpolated task is similar in nature to the target task, then interference between unconscious and conscious processes may occur, diminishing the advantage of incubation (Vul & Pashler, 2007).

Another popular theoretical construct that has found ground in recent research is the forgetting-fixation hypothesis. It proposes that during the initial attempts to solve the problem, fixation may occur and one may form inappropriate associations that impede the actual solution (Gilhooly et al., 2014; Hélie & Sun, 2010; Koppel & Storm, 2013; Mc Carthy, Malony, & Morrison, 2013; Penaloza & Calvillo, 2012; Ritter & Dijksterhuis, 2014; Segal, 2004; Vul & Pashler, 2007).

Functional fixedness may also be at play, which is the inability to generate unusual uses for an object, differing from its typical function (Smith & Blankenship, 1991). An incubation period allows the shifting of mental set, and selective forgetting or inhibition of the fixative elements, which may be the personal predispositions of the participant, or external stimuli such as misleading associates in a Remote Association Test (RAT) (Koppel & Storm, 2013; Sio & Ormerod, 2009; Vul & Pashler, 2007). In this way, correct associations are retained, and a solution can be derived.

It has been observed that individuals find it hard and sometimes impossible to let go of a problem and they insist on finding a solution which leads not only to stress but depletion of their energies (Ellwood, Pallier, Snyder, & Gallate, 2009; Hélie & Sun, 2010; Ritter & Dijksterhuis, 2014) which is also associated with job satisfaction and enhances the cognitive fitness of an individual (Rajper, Ghumro, & Mangi, 2020). It has been mentioned before that leaving a problem aside helps in finding a solution. Therefore, it is imperative to study "incubation" in relation to creative problem solving.

Literature Review

Research on incubation as a factor in creative problem-solving has shown that participants with lower ability level are more likely to benefit from incubation during creative problem-solving, contrasted with high ability level participants (Dodds et al., 2004; Patrick, 1986). Similarly, another study emphasized the importance of incubation with regard to improvement in creativity. Dijksterhuis and Meurs (2006) suggested incubation, unconscious thoughts strengthen the association among the previous knowledge and brought together the scattered information. Whereas the conscious thoughts add on to the ideas related to the topic under discussion.

Murray and Denny (1969), hypothesized that it may be that whereas high ability level participants engage in an orderly search process that is highly efficient, those of lower ability adopt inappropriate approaches. An incubation period interrupts these processes, which is harmful for high ability level participants, who waste their resources while it provides low ability participants an opportunity to overcome retroactive inhibition, and shift their mental set (Dodds et al., 2004; Patrick, 1986). There are others who contend that incubation positively impacts the decision-making ability (Jabeen, Shan, Sultana, & Khan, 2020).

Reportedly it had been concluded through experiment that the different factors affect the incubation period. The experimenters contented that if another creative or difficult task is provided to the participants during the time of incubation it may enhance creativity. Furthermore, they hypothesized that the switching among different tasks help to increase creativity but

unexpectedly could not ascertain significant results. However, it was suggested that the intervening activities should be engaging or attention demanding otherwise may play a role of mere distraction (Madjar & Shalley, 2008).

Moreover, it had been experimented that Rapid Eye Movement (REM) improves creativity by activating associative network related to the task that was in process before sleep. Also, REM strengths the association among the previous or the knowledge from the past. Therefore, REM induces priming and integration of the previous learning which helps in bringing up of creative ideas. Furthermore, the influence of REM is attributed to the fact that REM facilitates neocortical structures to carry out reorganization of the associative network. This task is made possible by reinterpreting information from hippocampus which is in accordance with the previously gained knowledge based on facts and learning (Cai, Mednick, Harrison, Kanady, & Mednick, 2009).

However, the scarcity of these results limits the extent to which these would be determining factors in the creative problem-solving, therefore an in-depth exploration of this variable needs to be carried out. In the current study, CGPA was used a measure of creative ability and intelligence, which has precedence in research and it has been seen to be a good predictor (Bolandifar & Noordin, 2013). Moreover, intelligence testing suffers from various weaknesses and has been criticized as a tool for measuring the construct in literature (Vergauwe & Cowan, 2014).

Cultural Aspect

Cross-cultural psychology has recently gained interest as cognitive and social psychologists have begun to appreciate the significance of culture in learning (Glăveanu, 2010). However, developments in this area are relatively staggered, best exemplified by the fact that no universal and valid cross-cultural test of creativity has been designed up till now (Zha et al., 2006). Moreover, differential performance across cultural groups in different kinds of creativity tests has been observed, especially in verbal tasks, suggesting a significance of lingual barriers to creative thinking (Zha et al., 2006).

A robust trend that cross-cultural research has shown up till now is that participants from collectivistic cultures tend to score lower on creative problem-solving tasks than participants from individualistic cultures (Gluaveanu, 2010; Goncalo & Staw, 2006; Ng, 2003; Niu & Sternberg, 2003). Anwar, Shamim-Ur-Rasool and Haq (2012) conducted research on Pakistani students who regardless of ability show uniform performance and incubation was not studied directly in this study. According to another study conducted in Pakistan, the creative decision making occurs because of intellectual processes of the individual (Saqib, Ullah, Hyder, & Malik, 2019).

Lastly, creative problem-solving and its product is embedded in a cultural context therefore, emic approach should be used to study creativity (Glăveanu, 2010; Hélie & Sun, 2010). Csikszentmihalyi, proposed a three-prong model of creativity, where he suggested that it was comprised of a *domain*, a *field,* and the *individual*. The domain and field describe the features of the environment, and in terms of a systems theory it can then be postulated that a product which would be considered creative in a certain environment, might not be attached the same value in a different environment, or culture (Glăveanu, 2010; Niu & Sternberg, 2003; Zha et al., 2006).

By far, creative problem-solving has shown much potential as tool for improvement in school, organizational and health settings, and its future potential may be explored as creativity research gain more empirical ground. According to Sriraman (2017), creativity is not an ingrained ability rather it can be learned by proposing activities that can foster creativity. Moreover, the teachers can be trained to improve creativity among students, and this can be helpful with regard to mathematics. Furthermore, there was another experiment conducted which aimed to ascertain the effect of incubation and artistic inclination on creativity. The experimenters found the insignificant results of incubation on the creativity which might be attributed to the difficult task assigned during incubation period. Moreover, it was reported that those participants who have artistic inclination were found more creative. Therefore, it was concluded that mere incubation period cannot turn out to creativity rather it is needed to make students indulge in tasks that could brighten their artistic inclination (Haraldsdottir, 2016).

Another study shed light on the variable creativity and suggested that it had been more found among the students of arts and information technology as compare to other majors. Similarly, cognitive institutes also enhance innovation in technology (Nouman, Younis, & Mufti, 2019). Reportedly, the assignments and the tasks assigned at university are less likely reported to enhance creativity. However, if the students possess intrinsic motivation that they learn to understand concepts at dept and enjoy learning more about it which may promote creativity among them (Rogaten & Moneta, 2016).

Understanding the mechanisms operating in creative problem-solving, including incubation would prove indispensable into elucidating the still elusive science of creativity. In a

similar vein, the experimenters found the participants as better at creative problem solving who were given more incubation period than the ones who were given less time as incubation. Moreover, it had been proposed that the incubation time bring in the association of the past knowledge which may be unrelated to the task at hand therefore help in creative problem solving (Nam and Lee, 2015).

However, the complexity of creative problem-solving, and its subset incubation, makes it necessary to target specific variables, so that it is readily replicable and applicable. This study aims to investigate the influence of incubation on creative problem solving, whilst studying the influence of a prominent mediator, the time of onset of incubation period performed during the incubation period. Much research could not be retrieved indigenously that's why preset study was initiated.

In the current study influence of incubation on creative problem-solving was studied. Incubation was defined as a time period in which an individual did not consciously study the problem at hand, and due to unconscious processes or restructuration of mental elements, it facilitated insight, while creative-problem solving was the formation of novel associations between ideas, facilitating in problem-solving.

Thus, the primary independent variable under investigation was incubation. It was further studied by means of the independent variable: the time of onset of incubation. The time of onset of incubation was immediate, whereby the onset of incubation was 30 seconds after presentation of the problem, or delayed, whereby the onset of incubation was 60 seconds after the presentation of the problem. The effect of these two sets of independent variables was studied on the single dependent variable, creative problem-solving.

Research Questions

- Does incubation increase creative problem-solving?
- How does the time of onset of incubation influence the creative problem-solving performance?
- Which theory—the unconscious thought theory (UTT) or forgetting-fixation hypothesis—is a most likely theoretical explanation of incubation effects in creative problem-solving?

Hypotheses

H1: The score on the RAT would be higher for the experimental group (incubation) than the control group (no incubation).

H2: According to the unconscious thought theory, the score on the RAT would be higher in case of immediate incubation condition, rather than the delayed incubation condition.

H3: According to the forgetting-fixation theory, the score on the RAT would be higher in case of delayed incubation condition, rather than immediate incubation condition.

Method

The study employed nonrandomized control group pretest-posttest, with no random assignment. The design was characterized by nonprobability (convenience) sampling and participants were drawn from the population as per the convenience of the experimenter.

Participants and Sampling

The population was the Baccalaureate student body of a private university in Lahore city. The participants were selected based on an inclusion criterion, restricting them to an age bracket of 18 to 24 years and CGPA ranging from 3.00 to 4.00. To ensure a certain level of English Language proficiency, only students having a grade equivalent to or greater than B in the basic English course (Basic Writing Skills) were selected. The sample size was 60 students.

Variables and Measures

In order to measure creative problem-solving, a remote associates task (RAT) was administered (Bowden & Jung-Beeman, 2003) utilizing an online module designed on LimeSurvey®. RATs have been shown to have very high reliability and validity in creativity testing (Bowden & Jung-Beeman, 2003; Vul & Pashler, 2007), with a high test-retest reliability, up to r=0.7 (Jung-Beeman, personal communication, December 12, 2014).

A free recall task was developed from a word list (Miller, 2010). A total of 15 randomly selected words or numbers appeared on the screen, for 4 seconds each, and at the end of the list, the participant had to recall and enter the words or numbers in a text-box within another 30 seconds.

Procedure

The participants were approached either directly by the experimenter, or indirectly through social media and word of mouth. Participants were seated in computer lab with minimal interference, and each participant was tested on a separate computer. The same room was used each time. The onscreen modules were opened in a Chrome® window—no other windows were open, and the first page with the informed consent were presented to the participants. Informed consent was obtained from the participants, who were assured that their confidentiality will be maintained, their participation in the study is voluntary and they could leave at any time. Moreover, participants were asked to provide demographical information prior to the testing.

The participants were shown instructions onscreen, with an example question and its answers. Thereafter, the participants were given two practice RAT problems, which were timed (two minutes). That is, for both pretest and posttest, the participants attempted problems in a trial basis, solving one RAT problem at a time. This was expected to minimize interference effects of one RAT problem on the other.

In the pretest, all the participants were given three RAT problems to solve. The webpage automatically proceeded to the next RAT problem, and so on. At the culmination of the pretest, the participants were divided into control and experimental conditions. In the **control** condition, the participants attempted three more RAT problems in the same manner as in the pretest. In the **experimental** conditions, the participants attempted three RAT problems, but with an incubation period. They differed in terms of the time of onset of incubation.

In a typical condition, the participants were presented the RAT problem on the screen for a period of time, after which incubation would initiate—it could be immediate ((30sec) or it could be delayed (60sec). Once the time had elapsed, the webpage proceeded to the interpolated distracter task for the incubation period (2min). At the end of the incubation period, the participants were redirected to the textbox to type in their answers, which was timed (90 sec/ 60 sec).

For the purpose of clarity, the experimental conditions were labeled as follows:

- **Experimental 1**, in which the participants studied a RAT problem for 30 seconds (immediate)
- **Experimental 2**, in which the participants studied a RAT problem for 60 seconds (delayed)

Results

Demographical Information of the Participants

A total of 60 participants (22 males, 38 females) were recruited from a private university for the experimental study. The descriptive statistics were analyzed both in total and across gender.

Table 1: *Frequencies and Percentages of the demographic variables (N=100).*

Demographic	**Males** ***f*(%)**	**Females** ***f*(%)**	**Total** ***f(%)***
Gender	37	63	100
Year of Study			
Freshman	14	3	7
Sophomore	32	21	25
Junior	36	42	40
Senior	18	34	28
English Language Grade			
Exemption	14	26	22
A	23	50	40
A-	14	5	8

B+	32	13	20
B	18	5	10

Testing of Hypotheses

To investigate the overall difference between the pretest and the posttest, Pearson's chi-square test was used. There was no statistically significant difference between the pretest and posttest in general and chi-squared test for each of the groups yielded the same result

Table 2

Mean and Standard Deviation for Experimental and Control Groups (N=60)

Condition	Pretest		Posttest	
	M	***S.D.***	***M***	***S.D.***
Experimental 1	0.15	0.489	0.05	0.224
Experimental 2	0.10	0.308	0.35	0.745
Control	0.25	0.639	0.25	0.716

Table 3: *Chi-Squared Test for Experimental and Control Groups*

Condition	χ^2	*P*	*Phi*		*Cramer's V*	
			Value	***Sig.***	***Value***	***Sig.***
Experimental 1	0.117	0.943*	0.076	0.943	0.076	0.943
Experimental 2	0.741	0.690*	0.192	0.690	0.192	0.690
Control	0.623	0.960**	0.176	0.960	0.125	0.960
Total	1.398	0.844***	0.153	0.844	0.108	0.844

*df=(2,20); **df=(4,20); ***df=(4,60)

Testing for *H1*

H_o: The score on the RAT would show no difference for the experimental group (incubation) than the control group (no incubation).

Since no significant difference was found between the scores of the experimental and control groups (p<0.05), the experimental study failed to contradict the null hypothesis.

Testing for *H2*

H_o: According to Unconscious Thought Theory (UTT), an incubation effect would not be observed in case of immediate incubation.

Since no significant effect was observed in case of experimental group 1 (immediate incubation), the experimental study failed to contradict the null hypothesis.

Testing for *H3*

H_o: According to Forgetting-Fixation Hypothesis, an incubation effect would not be observed in case of delayed incubation.

Since no significant effect was observed in case of experimental group 2 (delayed incubation).

The Relationship between Scores on RAT and Covariates

As an auxiliary measure, two covariates were considered for their possible influence on the participants' performance on RAT. The first variable was the total time spent on the remote associate tasks (pretest and posttest) inclusive of the incubation period, whilst the second variable was the score obtained on the interpolated distracter tasks (verbal recall). Spearman's *Rho*was calculated and the results show that no statistically significant difference was found with regards to both variables, suggesting that time spent on the RATs or the score on the distracter tasks, was not a mediating variable in the performance of the participants on the tasks (p>0.05*)*.

Table 4: *Mean and Standard Deviation for Total Time Spent on the Remote Associate Tasks (Pretest and Posttest)*

Condition	Trial	Control		Experimental 1		Experimental 2	
		M	***S.D.***	***M***	***S.D.***	***M***	***S.D.***
Pretest	1	46.542	30.2129	38.231	32.3975	46.598	31.9724

Pretest	2	43.217	38.9643	34.784	24.6587	49.055	26.0190
Pretest	3	34.266	26.6847	24.349	17.4937	51.670	41.2371
Posttest	1	35.474	28.7071	71.296	30.0184	89.230	18.0771
Posttest	2	36.542	29.2607	72.240	34.0243	85.716	17.8486
Posttest	3	33.115	27.7585	65.325	28.7352	81.310	17.4511

Table 5: *Spearman's Correlation of Score on RAT and Time*

Condition	Trial	Spearman's Correlation	Time					
			Pretest			Posttest		
			1	2	3	1	2	3
Pretest	**1**	**Statistic**	-.086	-.159	-.045	-.186	-.163	-.146
		Sig. (2-tailed)	**.517**	.230	.733	.159	.217	.273
	2	**Statistic**	-.007	-.014	.129	-.247	-.204	-.215
		Sig. (2-tailed)	.957	**.914**	.331	.060	.122	.106
	3	**Statistic**	.209	.198	.192	.082	.055	-.090
		Sig. (2-tailed)	.112	.133	**.144**	.534	.679	.500
Posttest	**1**	**Statistic**	.089	.014	.093	-.011	-.036	-.020
		Sig. (2-tailed)	.501	.914	.484	**.936**	.788	.880
	2	**Statistic**	.142	.066	-.046	.148	.086	.014
		Sig. (2-tailed)	.285	.620	.729	.263	**.519**	.920
	3	**Statistic**	.198	.225	.132	.132	.082	-.023
		Sig. (2-tailed)	.133	.086	.319	.319	.534	**.866**

Table 6: *Mean and Standard Deviation for Score on Interpolated Distracter Tasks*

Trial	Experimental 1		Experimental 2	
	M	***S.D.***	***M***	***S.D.***
1	4.55	.407	6.05	0.373
2	6.15	.612	6.00	0.528
3	5.10	.624	5.60	0.483

Table 7: *Spearman's Correlation of Score on RAT and (Posttest) and Score on Interpolated Distracter Tasks*

Trial (Posttest)	Spearman Correlation	Interpolated Distracter Task		
		1	2	3
1	**Statistic**	.189	-.355	-.042
	Sig. (2-tailed)	**.242**	.025*	.798
2	**Statistic**	.380	-.169	.173
	Sig. (2-tailed)	.015*	**.298**	.286
3	**Statistic**	.185	-.211	.078
	Sig. (2-tailed)	.254	.190	**.634**

*p<0.05

Discussion

The results suggest no significant relationship between an incubation period, regardless of its length, and its effect on the score on the remote associate task (RAT). Thus, no rapport was found for both the UTT and Forgetting-Fixation Hypothesis, and in general, there was no significant difference between the control and experimental groups in terms of their performance on the RAT. Although the results do not support the literature review, previous studies have also not found any rapport for the incubation effect, in one capacity or another (Dodds et al., 2004; Sio & Ormerod, 2009). This can be attributed to either the inherent weakness of the theoretical paradigms that were being investigated, or the inability of the research design to eliminate or control for certain weaknesses and limitations.

However, no statistically significant correlation was found between the score on any of the interpolated distracter tasks and the subsequent score on the respective RATs. Nonetheless, this measure is not mutually exclusive, and it is possible that interference was not amenable to the measurement employed for this study. In spite of two, two possibly spurious relationships were seen—the score on distracter task trial 2 was negatively correlated with the score on the posttest trial 1, suggesting that posttest trial 1 interfered with performance on the subsequent memory task. Secondly, the score on distracter task trial 1 and subsequent posttest trial 2 were positively correlated, so performance was seemingly enhanced in this case. These results can be explained in terms of mental fixation, whereby the nature of words present in one task may have influenced subsequent performance on the next tasks. Moreover, other factors such as motivation and emotion may have influenced the participants performance **(**Sternberg, 2011)**.**

Taking into perspective the Forgetting-Fixation Hypothesis, it has been challenging to find experimental support for self-induced fixation, which was the target of this experimental study (Vul & Pashler, 2007); it has been easier to demonstrate in the context of artificial fixation (Penaloza & Calvillo, 2012). In this study, no artificial fixation was provided and instead the delayed incubation paradigm (Gilhooly et al., 2012) was tested by presenting the participants with the RAT for 60s followed by a verbal interpolated distracter task, as in experimental group

Although RATs were presented on a trial basis to reduce proactive and retroactive interference (Sternberg, 2011),nonetheless it is quite possible that the performance of participants on the RATs was influenced by fixation on the stimulus words, because of which shifting of mental sets was hampered and interference was produced.

Previous research has suggested that participants with higher ability level are less likely to exhibit the incubation effect during creative problem-solving because it can waste their cognitive resources (Dodds et al., 2004; Patrick, 1986). Since the study sampled from relative high ability level participants, it is possible that this may have influenced the results however, no strong conclusion can be drawn. Moreover, creativity research that has been conducted previously on Pakistani students does not support these results (Anwar et al., 2012), who have shown uniform performance in creative-writing tasks regardless of ability, though incubation was not directly tested in the experimental study.

Additionally, the study of creative problem-solving is complicated further by the sociocultural context of its investigation. The remote associates task (RAT) is a widely used tool for measure of creative problem-solving, with high reliability and validity (Bowden & Jung-Beeman, 2003; Vul & Pashler, 2007). While the tasks selected were adjusted for difficulty and counterbalanced so that the overall difficulty of the pretest and posttest was in agreement, they may very well have had differential difficulty for the test population.

In spite of the tasks that were used for measurement of creative problem-solving as a construct, culture still plays a mediating role in creative problem-solving. With a few solid exceptions, it has been consistently shown that participants that belong to a collectivistic culture tend to score lower on tests of creativity than participants from an individualistic culture (Gluaveanu, 2010; Goncalo & Staw, 2006; Ng, 2003; Niu & Sternberg, 2003) even when other factors such as intelligence and language proficiency were controlled for..

As a concluding point from the cross-cultural perspective of psychology, it is essential to impress upon the conception of creative problem-solving across cultures; creative problem-solving cannot be considered in isolation from its context (Glăveanu, 2010). Csikszentmihalyi's model of creativity suggests that the value of a creative product is tied to its context (Glăveanu, 2010; Niu & Sternberg, 2003; Zha et al., 2006). Thus, creativity is embedded in a cultural context which cannot be ignored in creativity testing (Cheng, 2011; Hélie & Sun, 2010; Ramos & Puccio, 2014). Research generally rejects the superiority of one culture over the other in terms of its creative potential, Western culture tends to gravitate towards the product of creativity, while Eastern culture has traditionally has construed creativity as a process of enlightenment and self-revelation (Glăveanu, 2010; Kaufman & Sternberg, 2006). To date, creativity research has failed to provide a quality *emic* approach to creative problem-solving (Glăveanu, 2010)due to which findings of western culture cannot be generalized to Eastern cultures.

Conclusion

The results did not find support for the occurrence of incubation during creative problem-solving, as measured by the RAT. While the sample was normally distributed with regards to major demographics, the distribution for the dependent variable (score on RAT) was found to be not normal and so, a chi-squared test was used as a measure of statistical significance, and correlational tests were used to investigate the interplay of covariates with score on RAT. The statistical tests showed that the results did not reach significance, except in two cases with regards to the score on interpolated distracter task and score on RAT.

Implications Especially in the Field of Education

In context of Pakistan, the implications of previous findings and current research are especially relevant. As indicated by the results the absence of incubation effect is responsible for less creative potential among participants. In Pakistan there is more emphasis on memorization and wrote learning which leaves less room for creative problem-solving skills (Rehmani, 2003). Therefore, there is a need to revolutionize the educational system and teachers should encourage exploratory activities in classroom (Anwar, Aness, et al., 2012; Khan, 2012). This study provides psychologist, educators, and policymakers, a new perspective with regards to the interdisciplinary interest in creative problem-solving is essential to foster growth and progress on a national level.

Further Research

The current study, in light of previous literature, attempted to find a significant relationship between the phenomenon of incubation and creative problem-solving, however it is limited in its implication and future research may improve upon the research design to account for any confounding. For instance, the use of convenient sampling meant that the sample was not truly representative of the sample, and though pretest-posttest design was used to circumvent this weakness and increase the internal validity of the issue. Additionally, an inclusion criterion was also set to augment the homogeneity of the ability level of students. It should also be noted that most research that has been conducted to study incubation, has incentivized prospective participants, meaning that there may still exist a non-response bias in the recruited participants (Martin, Abreu, & Winters, 2001; Singer & Bossarte, 2006).

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