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SOCIAL ENVIRONMENT AND SCIENTIFIC CREATIVE POTENTIAL: UNDERSTANDING THE MEDIATING VARIABLES WITHIN

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Abstract
Creativity exists in every field of work and is a part of everyday life. Its contribution to developing an individual, building a society, and developing a nation has made it an interesting field of study for academicians. The social aspect of creativity is now a well-established fact, many social factors work in confluence with personality traits and cognitive skills to develop the creative potential of an individual. This creative potential is often considered as the ability of the individual to generate multiple novel and appropriate ideas, it is called their ideational behavior. The present study was aimed to study the effect of social factors like positive parental behavior and friend group behavior on the ideational behavior of the science learners with three mediating factors namely grit, motivation in science, and legislative thinking style. The study was conducted on science learners from different branches of science. The quantitative analysis of data was done and the results revealed parental behavior doesn't have any direct association with the ideational behavior whereas friend's behavior does affect the ideational behavior of the science learners. The path analysis revealed that both the social factors do affect the mediating variables to influence the ideational behavior of science learners.

Keywords: creative potential; grit; motivation; thinking style; science learners

Introduction

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Creativity is a need of the modern world and needs to be promoted in every classroom, across all the disciplines of study. Social theories of creativity suggest that creativity among the learners is the complex confluence of many different resources, these resources can be categorized into three different groups- cognitive, affective, and environmental (Amabile, 1983; Csikszentmihalyi, 1988; Sternberg & Lubart, 1991). Different resources like intellectual skill, knowledge in concerned fields, motivation, thinking style, personality, and environment confluence in a complex way to give rise to different creative abilities belonging to different domains like art, music, science, literature, technology, and many more (Sternberg, 2006). For many decades researchers are studying all these different resources and how they contribute to developing creative potential among individuals. It was proposed that individual's creativity depends on the environment surrounding them. Along with different skills, personality traits, and intrinsic motivation, the supporting role of the environment cannot be neglected. It determines the creative output of an individual in the form of useful and novel innovation in any organization (Amabile, 1988). This also hints towards the domain-specific nature of creativity as not all resources of creativity have a similar necessity and hence the impact on the creative potential. Creative potential refers to the latent abilities present in the individual to be creative in a specific field.

Science is the field that has seen tremendous growth over the last century and it has become the need of modern society. With science, the industrial sector also evolved and nobody can deny the contribution of both in building the economy of the society. In modern times, creativity has become the center of the economy and it is defining the features of economic life (Florida, 2002). In such a creativity-driven economy, the generation of ideas plays an important role in shaping society. Now as science is an integral part of today's socio-economic growth and development so creativity in the domain of science could not be neglected. Scientific creativity is nothing new and various aspects of it still attract the interest of many researchers. Scientific creativity has been defined in many ways and the most relevant to the present context is as, "a kind of intellectual trait or ability producing or potentially producing a certain product that is original and has social or personal value, designed with a certain purpose in mind, using given information" (Hu & Adey, 2002). Our society thus needs individuals with scientific creative potential that means people having the ability to produce novel and socially useful products.

Educational institutes are the places where individuals get the space and supportive environment to know and enhance their creative potential. So undoubtedly, for promoting the scientific creative potential within the learners the best place is the educational institutes. Many studies were conducted at different levels of educational institutes on the scientific creativity of the learners and factors affecting it. It has been found that at a secondary level of school with growing age the scientific creativity increases and knowledge in science is necessary for scientific creativity (Hu & Adey, 2002), also attitude toward science is strongly correlated to scientific creativity of learners (Usta & Akkanat, 2015). In another study, teenage learners of school were found to have a high positive correlation of attitude in physics, aptitude in physics, and motivation with scientific creativity (Mukhopadhyay, 2011; 2013). The learning process adapted by the learners also plays an important role to foster scientific creativity among them. It is found that learning by critical thinking (Hu et al., 2013), collaborative learning (Sri & Kurnia, 2018), problem-solving methods (Siew, Chong & Lee, 2015) are having a positive impact on learners scientific creative ability. Learning is something that is not restricted to some specific level of education, from schooling to graduating, and thereafter the learning continues and hence the scope of being scientifically creative. In this process, it is certain from social theories of creativity (Amabile, 1983; Csikszentmihalyi, 1988; Sternberg & Lubart, 1991) that some cognitive abilities, personality traits, and affective factors should confluence to facilitate scientific creativity. Some classic studies by Sternberg (1991, 2007a, 2007b) and Amabile (1982, 1983) showed that intrinsic motivation positively affects creativity in general whereas perseverance was unrelated to creativity. Similarly, willingness to grow, individuality, risk-taking, tolerance to ambiguity also correlates to some extent with creativity (Sternberg & Lubart, 1991). Contemporary work by Rojas (2015) tried to show the relationship between the measure of creativity- Runco ideational behavior scale (RIBS) score of which reflect individual's ability of ideation, a measure of perseverance- Grit scale, academic motivation, and achievement. It revealed that creativity is not related to academic achievement but girt may mediate between motivation and achievement. Despite such extensive general studies, there is no major research done on creativity specific to the domain of science to understand the interaction between different factors from the three categories of resources of creativity.

Going back to the social theories of creativity, different cognitive skills, abilities, personality traits necessary for scientific creativity are also supposed to

be influenced by environmental factors but in literature, it's very hard to find any model that attempted to explain this interaction of resources. The present study was an attempt to explore the interaction of the environment of science learners and resources of scientific creativity.

The study

Many different kinds of environment may interact with the learner, broadly it can be classified into two types: physical environment and the social environment. Among the social environment, the family of the learner and their friend's group are the most important ones. It was found that creative adolescent learners are very likely to form bonds with peers with similar interests and age groups (Hopp et al., 2019) which hints towards the possible correlation between learners with creative potential and their friend's group. In another study, it was found that parent's behavior, upbringing, and support also affect the learner's creativity in digital science (Pérez-Fuentes et al., 2019). So both, parents and friends may influence the creative potential of the learners.

According to the social theories of creativity, personality traits are also the major resources of creativity (Sternberg & Lubart, 1991; Oldham & Cummings, 1996) so traits like grit and motivation of learners are also under the scope of the present study. The grit of a person is the perseverance of effort and consistency of interest for a long term goal, and for assessing grit a scale was developed consisting of 12 items (Duckworth, Peterson, Matthews, & Kelly, 2007), later it was improved and a shorter version with 8 items was adapted (Duckworth & Quinn, 2009). A study on college learners revealed that grit is correlated to academic success whereas over-parenting and parent's acceptance can predict grit but grit only mediates between over-parenting and academic success (Howard, Nicholson, & Chesnut, 2019). Again creativity does not predict academic achievement but is related to grit and motivation (Rojas, 2015), so there is the possibility of predicting the creative potential of the learner from the parental behavior and learners friend's group taking grit and motivation as mediating variables.

Motivation plays an important role in learning science and hence it is natural to consider that it may also affect creativity in science. There are few factors of motivation in learning science and among those intrinsic motivation and self-efficacy are the important ones (Glynn, Taasoobshirazi, & Brickman, 2009). Self-efficacy refers to individuals' beliefs about their ability to perform in specific situations (Bandura, 1997), so self-efficacy in science is the self-belief and

confidence of the learner about doing well in science (Lawson, Banks, & Logvin, 2007). Self-efficacy was found to be affected by creative activity in science but the opposite relationship is still needed to be explored (Conradty et al., 2020). Now the intrinsic motivation is driven by inner joy, self-satisfaction & wellbeing, unlike extrinsic motivation which is driven by external factors like rewards (Deci, 1971; Deci & Ryan 2008). Many pieces of literature supported the positive correlation of intrinsic motivation with the creativity of individuals (Amabile, 1988, 1996; Oldham & Cummings, 1996; Runco, 2005; Simon, 1985; Zhou, 1998). The same should probably be true for scientific creativity also as motivation is a strong indicator of success in the field of science (Trost & Sieglen, 1992) but some studies like Helene (2001) contradicted it and revealed that there is no significant correlation of intrinsic motivation and creativity of scientists in science. It gave the researcher a reason to examine any possible mediation of motivation in science (SciMotiv) with the creative potential of science learners keeping the environment (parental behaviour and friends group) as the possible predictor variable.

Two more variables, legislative thinking style (LTS) and ideation were also considered for exploration in the present study. These two variables are the part of cognitive resources of creativity. LTS is the ability of individuals to decide for themselves about doing any task (Sternberg, 1988; 1997) whereas ideation is the ability to think differently and to generate multiple ideas (Runco, Plucker, & Lim, 2001). Both these factors are considered to be the indicator of the creative potential of an individual (O'Neal, Paek, & Runco, 2015; Sternberg, 2012). Since LTS is one of the many other thinking style that may influence creative behaviour (Sternberg, 1988; 1997) so it was also explored as the mediator variable in the present study whereas ideation which is considered to be the indicator of creative potential, was taken as the criterion variable.

In this study parental behavior (Pbehavior) and friend's group behavior (Fbehavior) were explored as the predictor of creative potential. The grit (perseverance of effort and consistency of interest), motivation in science (intrinsic motivation and self-efficacy), and LTS were explored as mediating variables whereas ideation which determines the creative potential of the learners was the dependent variable. Parental behavior is comprised of two factors: parental support (PSupport) and parental freedom (PFreedom) whereas friend’s group comprised of three factors: friend’s support in academics (FSacademic), friend’s support in personal life (FSpersonal), and acceptance by friends (Facceptance).

The present study extended the previous works in this line and for that following objectives were set:
(a) To explore the effect of parental behaviour on the ideation of the science learners.
(b) To explore the effect of friend's group behaviour on the ideation of the science learners.
(c) To study how grit, motivation in science, and LTS may mediate between parental behavior and ideation.
(d) To study how grit, motivation in science, and LTS may mediate between friend's group behavior and ideation.
To achieve the objectives of the study a conceptual model was proposed showing the possible relationship between the various variables as shown in Figure 1.

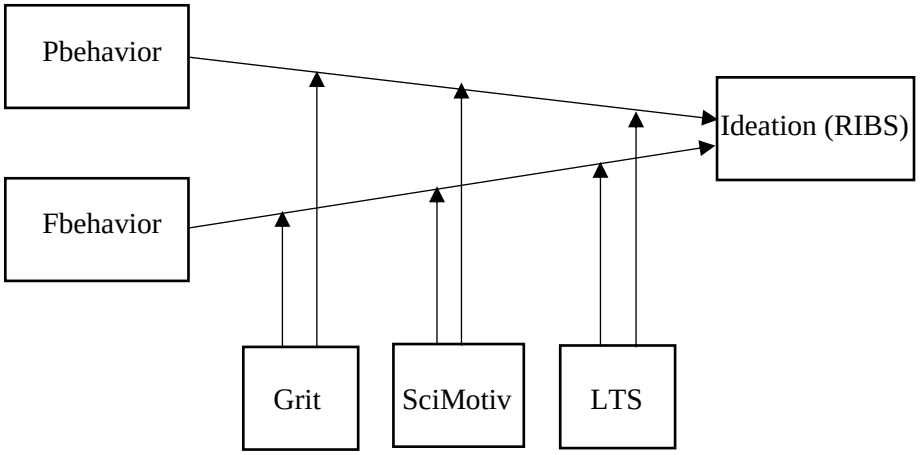

Figure 1. Conceptual model of the study

Based on the objectives and to explore the conceptual model following hypotheses were made:
H1: Parental behavior will relate positively and significantly with RIBS.
H2: Friend's group behavior will relate positively and significantly with RIBS.
H3: Grit, motivation in science, and LTS may mediate the relationship between parental behavior and RIBS.

H4: Grit, motivation in science, and LTS may mediate the relationship between friend's group behavior and RIBS.

Delimitation

An important limitation of the study was the skipping of the stepwise regression, as it would have helped in developing a model with the most significant independent variables. It was skipped due to the presence of enough studies to support the possible involvement of the explored variables with the dependent variable. Also, the study didn't take into consideration the effect of the demographic variables on the dependent variable which was also possible through step-wise regression. Stringent time frame and paucity of money were other limitations. Thus, the study was delimited to the participants mainly from three different countries and in its comparison the sample size was relatively small which affected the strength of the result. Future research could consider all the above mentioned delimitations.

Method

Participants and data collection

The data was collected in an online social platform using Google Forms. The questionnaire consisted of several sections. All necessary information for the respondent was given at the beginning of the questionnaire. A total of 386 participants recorded their responses anonymously and voluntarily. The majority of the participants were from USA, UK, and India. Participants were learners from various major branches of science studying at high school, under graduate, and post graduate courses. The randomly made responses were identified using detector questions and then removed. The data was checked to meet the assumptions of linear regression and outliers were removed. Finally, 302 (85 male, 211 female, 5 non-binary, and 1 preferred not to say) participant's responses qualified for the data analysis. As per the demand of the study here only those participants' responses were kept whose score on ideation from a self-reporting questionnaire (RIBS) was high.

Due to the paucity of resources some further screening of variables was made. The age of the participants was restricted within the range of 15 to 30 years of age. Only two genders of participants were considered, male and female. As a control, the participants only from the major branches of science are considered.

The socio-economic class of the participants was restricted to lower middle class, middle class, and upper middle class, which constitutes the major portion of the population of any nation. Lastly, N=243 participant's responses were used in the study for the analysis of data, demographic information of the participants are given in Table 1. The data were rechecked for the assumption of linear regression and no outliner was found.

Table 1. Demography of the participants

Gender	No.	Age group	No.	Science group	No.	Socio economic Class	No.
Male	67	15-18	21	Pure science	10	Lower middle class	56
Female	176	19-22	98	Bio science	15	Middle class	121
		23-26	97	Computer science	17	Upper middle class	66
		27-30	27	Engineering	15		
				Social Science	114		
				Other major science subject	72		
Total(N)=243							

Tools used and measures

Parental behavior inventory. The parent's behavior toward the learner was measured using a researcher-made self-reporting inventory (see appendix). Parental behavior inventory contains 10 items, 5 items each in two factors- parental control (parental freedom if scored reverse) and parental support. Parental control items were negatively phrased and could represent parental freedom if scored reverse as done in the present study. Responses were on a five-point scale ranging from 1 (strongly disagree) to 5 (strongly agree), a mean score of five items from each factor should give the score for parental freedom and parental support. Their total would give the score for positive parental behavior. The tool was moderately reliable with Cronbach's alpha score of .77. The face and content validity was established by the panel of experts. Construct validity was done through Exploratory factor analysis (EFA) using SPSS (v 21). A satisfactory two-factor solution was obtained with five items in each construct, all items having a coefficient value greater than .66. Kaiser-Meyer-Olkin (KMO) score of sample adequacy was .82 and two factors explained 59.92% variance when subjected to non-orthogonal rotation (promax). Confirmatory factor analysis (CFA) of the inventory was also done using SPSS AMOS v23. It was found that the chi-square value, χ^2 (34, N=243)=63.95, $p<.05$, does not support the model which is not rare for a large sample. Thus the fitness indices were analyzed for construct validation of the tool. It was found that as per the recommendation of Kline (2005) and Byrne

(2001) some of the popular fitting indices for the model were satisfactory like the goodness of fit (GFI)=.95, normed fit index (NFI)=.94, comparative fit index (CFI)=.97 and root mean square error of approximation (RMSEA)=.06, representing a good model.

Friend's group behavior inventory. This researcher-made inventory consisted of 12 items, with 4 items in each of the three factors: friend's support in academics, friend's support in personal life, and rejection by friends (see appendix). The items in rejection by friends were reverse scored to represent acceptance by friends. Responses were on a five-point scale ranging from 1 (strongly disagree) to 5 (strongly agree). The mean score of items for each factor represents the score for that factor and the mean of the sum of the score from all factors will give the score representing the degree of positive friend's group behavior. Cronbach's alpha score of reliability turned out to be .72. Face and content validity was established by the experts. Construct validity was established through EFA and CFA, three factors loaded very well with high correlation coefficient when subjected to oblique promax rotation. The KMO score of sample adequacy was .76 and three factors explained a 49.60% variance of the sample. CFA revealed χ^2 (53, N=243)=102.01, p<.05 where fitness indices had the value GFI=.93, CFI=.90 and RMSEA=0.06. Thus the model had acceptable fitness and construct validity.

Grit Scale. Original grit scale (Duckworth, Peterson, Matthews & Kelly, 2007) of 12 items was used in the pilot test for this study. It's a two-factor scale: consistency of interest (GritCI) and perseverance of effort (GritPer), with 6 items in each factor. Factor analysis with oblique promax rotation did not load all items as expected from the original grit scale version. So four items with improper loadings were removed and in the final study, only 8 items grit scale with 4 items in each factor was retained. All the items under consistency of interest are to be scored reverse. EFA result of the final study showed Cronbach's alpha score of reliability as .71, KMO score of sample adequacy was .71 and two factors explained 52.3% variance of the sample. CFA of the scale was done which revealed moderate model fit for the two latent variables. Fitness indices for 8 items grit scale was χ^2 (19, N=243)=37.36, p<.05, GFI=.96, NFI=.91, CFI=.95 and RMSEA=.06. GFI, CFI, and NFI scores represent an acceptable model but RMSEA value was a little higher than the recommended value of .50 (Kline, 2005; Byrne, 2001). Responses were on a five-point scale same as the original scale but response options were modified and range from 1 (strongly disagree) to 5 (strongly

agree). The mean score of items for each factor represents the score for that factor and the mean of scores from two factors would give the score for grit.

Science motivation questionnaire (SMQ). SMQ was developed by Glynn, Taasoobshirazi, and Brickman (2009) to explore the six factors of motivation that may affect self-regulatory learning in science. Among the six factors for the current study, items from two factors: intrinsic motivation in science (SMIM) and self-efficacy (SMSE) in science was adapted. So the adapted questionnaire for the present study contained 10 items in total, with 5 items in each of the two factors. Responses were on a 5 point scale ranging from 1 (strongly disagree) to 5 (strongly agree) unlike the original 5 point scale ranging from 0 (never) to 4 (always). The mean score of items for each factor represents the score for that factor. The Cronbach's alpha reliability score of the questionnaire turned out to be .93. On doing EFA, the two factor extraction with promax rotation showed properly loaded items in the two factors with a high correlation coefficient. The KMO score of sample adequacy was .93 and two factors explained the 72.20% variance of the sample. The CFA results further establish its construct validity. CFA results showed good fitness of model with $\chi^2(34, N=243)=94.63$, $p<.05$, GFI=.93, NFI=.95 and CFI=.96 but the value of RMSEA with .09 was not very satisfactory.

Legislative thinking style (LTS). The original thinking style inventory was developed by Sternberg and Wagner (1991) based on the theory of mental self-governance (MSG) (Sternberg, 1988). This inventory consisted of 107 items measuring 13 different constructs. For the current study, only legislative thinking style was selected which consisted of 8 items. The data analysis of the pilot test resulted in the removal of 3 items and the final form of the legislative thinking style scale consisted of 5 items. The Cronbach's alpha reliability score turned out to be .69. EFA showed one factor solution as expected with KMO score of sample adequacy of .72. The scoring is modified to 5 point scale ranging from 1 (strongly disagree) to 5 (strongly agree) instead of 7 point scale of the original inventory. The mean score of five items will give the total score of legislative thinking style.

Runco ideational behavior score (RIBS). The RIBS is a two factor scale that consists of 23 items (Runco et al., 2001). For the present study, a single factor scale was used by taking only one factor from the original RIBS. The pilot study eliminated few items and for the final study, a 7 items scale was adapted. Responses are on a 5 point scale ranging from 1 (strongly disagree) to 5 (strongly agree). The reliability score of the scale was .75. EFA showed a single factor

solution with all items having a high correlation coefficient and the KMO score of sample adequacy was .80.

Result

The data obtained from the study was analyzed through path analysis, a special case of structural equation model (SEM) where only observed variables are considered, using AMOS v23 software. Path analysis was used as it was suitable to identify the significantly regressed paths between the variables and also to analyze the significant indirect effect of mediating variables. Since SEM is based on linear regression thus the assumptions of linear regression were checked. The P-P plot of regression standardized residual was a linear graph that showed residuals are normally distributed. The data displayed satisfactory multivariate normality when the chi-square Q-Q plot of Mahalanobis distance was plotted which gave almost a linear graph with no significant outliner. The variance inflation factors (VIF) for all the variables was within 2.0 which was low enough to support the absence of multicollinearity (Hair et al., 1995) same could be asserted from the correlation matrix of the variables (*see* Table 2) where none of the correlation was above the recommended value of .80 (Berry & Feldman, 1985).

Table 2. Descriptive statistics and correlation among the variables

	M	SD	1	2	3	4	5	6
Pbehavior	3.68	.69	1					
Fbehavior	3.80	.48	.06	1				
Grit	3.36	.57	.22**	.09	1			
SciMotiv	3.78	.82	-.02	.18**	.32**	1		
LTS	3.94	.52	.05	.17**	.08	.21**	1	
RIBS	3.86	.52	.00	.21**	.03	.28**	.69**	1

Note: N = 243, **p < .01

In the sample, there was no problem with missing data. Path analysis was done based on the conceptual model, it is worth mentioning that due to the exploratory nature of the study the path analysis done was moreover exploratory in nature to find out the possible relationship among variables. The path analysis model is presented in Figure 2. Pbehavior and Fbehavior are the independent variables. The girt, SciMotiv, and LTS are acting as the mediator between independent variables and RIBS. The regression paths are shown with single-headed arrows along with the regression coefficient. The model was recursive with

chi-square value $\chi^2(4, N=243)=14.76$, $p<.005$, the p value was less than 0.05 so the model was not satisfactory. Such outcome is not rare as SEM is based on maximum likelihood estimation methods so chi-square value depends heavily on sample size (Byrne, 2001). In such a case, the importance of various fitness indices becomes relevant to decide about the acceptance of the model. The value of fitness indices like GFI=.98, NFI=.94, and CFI=.95 indicates an acceptable model though RMSEA = .107 was higher than the recommended value of .05.

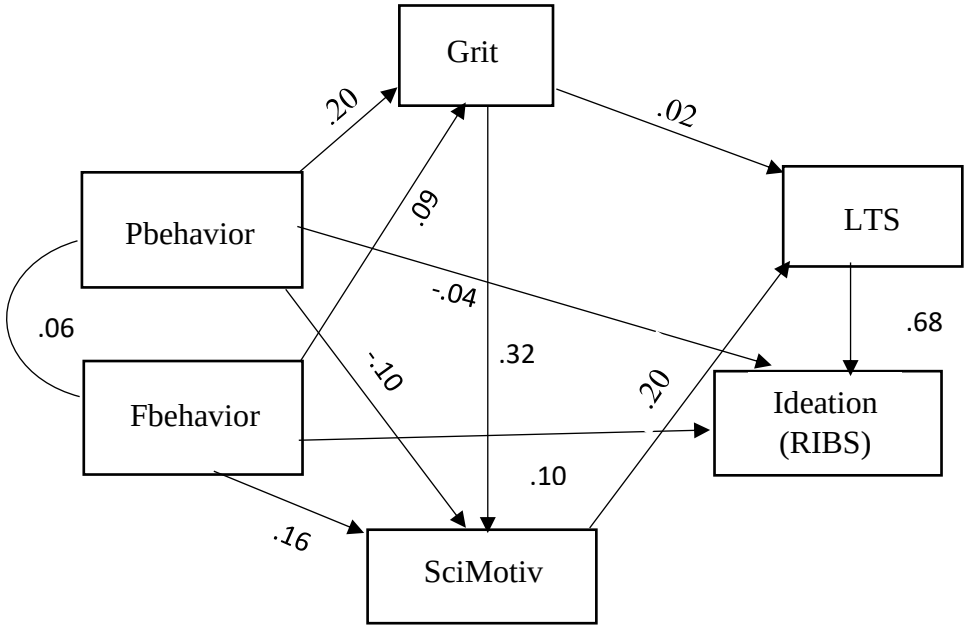

Figure 2. Path analysis model of the study

In table 3, the regression weight of various paths between different variables is shown. The standardized regression coefficient (β) for the Parental behavior on ideation (β =-.04, p>.05) was not significant thus rejecting the hypothesis H1. Interestingly, the friend's group behavior (β =.11, p<.03) predicts positively and significantly the ideation thus the second hypothesis H2 was accepted, though both are not significantly correlated (r=.06, p >.01), *see* Table 2.

Table 3. Regression weights

			Estimate	β	S.E.	C.R.	p
Grit	←	Pbehavior	.16	.20	.049	3.24	***
Grit	←	Fbehavior	.10	.09	.070	1.47	.14
SciMotiv	←	Pbehavior	-.11	-.09	.073	-1.61	.11
SciMotiv	←	Fbehavior	.27	.16	.103	2.59	.01*
SciMotiv	←	Grit	.49	.32	.094	5.27	***
LTS	←	SciMotiv	.13	.20	.042	3.02	***
LTS	←	Grit	.02	.02	.065	.29	.77
RIBS	←	Pbehavior	-.03	-.04	.035	-.85	.39
RIBS	←	Fbehavior	.11	.10	.050	2.17	.03*
RIBS	←	LTS	.67	.68	.046	14.56	***

Note: N=243, *** $p < .05$, * $p < .05$

Mediating variables, like motivation in science could be predicted with friend's behavior ($\beta = .16$, $p < .01$) and grit could be predicted with parental behavior ($\beta = .20$, $p < .05$). Motivation in science in turn regressed significantly with legislative thinking style ($\beta = .20$, $p < .05$) whereas legislative thinking style significantly regressed to ideation ($\beta = .68$, $p < .05$). The direct path between parental behavior to ideation was not significant but the direct path between friend's group behavior to ideation was found to be significant ($\beta = .10$, $p < .05$). Moreover, a significant causal relationship between the other mediating variables and ideation raised the possibility of the significant indirect effect of parental behavior and friend's behavior on the ideation. This made the researcher to conduct the indirect path analysis of certain pre-defined paths. To achieve it in AMOS, the data was bootstrapped to 1000 samples at a 95% bias-corrected confidence level as it helped to generate the significant value for indirect effects. In Table 4 indirect effects of variables through user-defined paths are shown.

Table 4. User defined paths: Indirect effect of variables

Variable paths	Estimate	p
IE1: Pbehavior→Grit→LTS→RIBS	.00	.83
IE2: Pbehavior→Grit→SciMotiv→LTS→RIBS	.01	.00*
IE3: Pbehavior→SciMotiv→LTS→RIBS	-.01	.07
IE4: Fbehavior→Grit→LTS→RIBS	.00	.59
IE5: Fbehavior→Grit→SciMotiv→LTS→RIBS	.00	.11
IE6: Fbehavior→SciMotiv→LTS→RIBS	.02	.01*

Note: N = 243, * $p < .05$

The analysis revealed that the paths IE2 (β=.01, p<.05) and IE6 (β=.02, p<.05) were having significant indirect effects between the predictor and the dependent variables through the mediating variables. Path IF2 showed that parental behavior could affect the ideational behavior of the learners through the help of mediating variables like grit, motivation in science, and legislative thinking which made the researcher accept the third hypothesis H3. Similarly, IE6 revealed that the friend's behavior not only has a direct causal effect on ideational behavior but also through the mediator variables like motivation in science and legislative thinking it could affect the ideational behavior of the learners, so the fourth hypothesis H4 was also accepted.

Conclusion

Creativity is an essential part of the modern economy, novelty and originality in life form the basis of creativity (Amabile, 1983) so the individuals with creative potential should be identified and must be promoted so that they can contribute to the progressive society. The present study contributes further to the existing studies on the social theories of creativity (Amabile, 1983; Csikszentmihalyi, 1988; Sternberg & Lubart, 1991). Among the main findings, the current study did not find any empirical evidence of a direct relationship between the positive parental behavior toward the science learner with their ideational behavior. It is contradictory to the study done on parenting and digital creativity where it was found that democratic parenting or positive parenting promotes the everyday creativity of learners in digital science (Pérez-Fuentes et al., 2019). This could be due to the fact as proposed by Sternberg and Lubart (1991) that creativity is a result of the confluence of different factors, not just one particular factor so though positive parenting is essential for learners to be creative but it does not work alone. Some other factors do play an important role in between. Surprisingly, the same was not true for friend's group behavior of learners, the study revealed that positive friend's behavior (personal support of friends, academic supports of friends, and their acceptance) was directly related to the ideational behavior of the science learners and many other factors may play a mediating role. This also explains the tendency of creative teenagers and adults to be in a friend circle of creative people just like them (Hopp et al., 2019).

Finally, the indirect effects from path analysis empirically established that personality trait like grit, motivation in science, and cognitive ability like legislative

thinking style not only mediates in between parental behavior and ideation but also between friend's group behavior and ideation. This study is empirical proof showing the confluence of factors from a different domain to affect the ideational behavior which is the indicator of creative potential (O'Neal, Paek, & Runco, 2015; Sternberg, 2012) of the learner in science. It could be asserted that the social environment interacts with the personality of the learners to shape their traits like grit (perseverance and consistent effort) and motivation in science (intrinsic motivation and self-efficacy) to develop their legislative thinking style that finally works together to build their ability of ideation which gets reflected as their creative potential in science. It should be noted that the effects obtained in this empirical study are not very strong but they are significant enough to reflect the importance of social environment on the scientific creative potential of learners and further validates the social theories of creativity. Future research with more restricted and controlled variables may reveal much stronger effects of the social environment on the creative potential of the science learners.

Reference

Amabile, T. M. (1982). A Consensual Technique for Creativity Assessment. *The Social Psychology of Creativity*, 37-63. doi: 10.1007/978-1-4612-5533-8_3

Amabile, T. M. (1983). *The social psychology of creativity.* New York: Springer.

Amabile, T. M. (1988) A Model of Creativity and Innovation in Organizations. *Research in Organizational Behavior*, *10*, 123-167.

Bandura, A. (1997). *Self-efficacy: The exercise of control*. New York, NY: Freeman.

Berry, W., & Feldman, S. (1985). *Multiple Regression in Practice (Quantitative Applications in the Social Sciences)*. SAGE Publications.

Byrne, B. M. (2001). Structural equation modeling with AMOS: Basic concepts, applications, and programming. Mahwah, NJ: Lawrence Erlbaum Associates.

Conradty, C., Sotiriou, S., & Bogner, F. (2020). How Creativity in STEAM Modules Intervenes with Self-Efficacy and Motivation. *Education Sciences*, *10*(3), 70. https://doi.org/10.3390/educsci10030070

Csikszentmihalyi, M. (1988). Society, culture, and person: A systems view of creativity. In R. J. Sternberg (Ed.), *The nature of creativity* (pp. 325-339). New York: Cambridge University Press.

Deci, E. L. (1971). Effects of externally mediated rewards on intrinsic motivation. *Journal of Personality and Social Psychology*, *18*, 105-115.

Deci, E. L., & Ryan, R. M. (2008). Self-determination theory: A macro theory on human motivation, development, and health. *Canadian Psychology*, *49*, 182-185.

Duckworth, A., Peterson, C., Matthews, M., & Kelly, D. (2007). Grit: Perseverance and passion for long-term goals. *Journal of Personality and Social Psychology*, *92*(6), 1087-1101. doi: 10.1037/0022-3514.92.6.1087

Duckworth, A., & Quinn, P. (2009). Development and Validation of the Short Grit Scale (Grit-S). *Journal Of Personality Assessment*, *91*(2), 166-174. doi: 10.1080/00223890802634290

Florida, R. (2002). *The rise of the creative class and how it's transforming work, life, community and everyday life*. New York: BasicBooks.

Glynn, S. M., Taasoobshirazi, G., & Brickman, P. (2009). Science Motivation Questionnaire: Construct validation with nonscience majors. *Journal of Research in Science Teaching*, *46*(2), 127-146. doi: 10.1002/tea.20267

Hair, J. F., Anderson, R. E., Tatham, R. L., & Black, W. C. (1995). *Multivariate data analysis*. Englewood Cliffs, NJ: Prentice-Hall.

Helene, S. K. (2001). The relationship of intrinsic motivation, cognitive style, and tolerance of ambiguity, and creativity in scientists. Unpublished doctoral dissertation, Seton Hall University, New Jersey.

Hopp, M., Zhang, Z., Hinch, L., O'Reilly, C., & Ziegler, A. (2019). Creative, Thus Connected: The Power of Sociometric Creativity on Friendship Formation in Gifted Adolescents-A Longitudinal Network Analysis of Gifted Students. *New Directions for Child and Adolescent Development*, *2019*(168), 47-73. doi: 10.1002/cad.20324

Howard, J., Nicholson, B., & Chesnut, S. (2019). Relationships Between Positive Parenting, Overparenting, Grit, and Academic Success. *Journal Of College Student Development*, *60*(2), 189-202. doi: 10.1353/csd.2019.0018

Hu, W., & Adey, P. (2002). A scientific creativity test for secondary school students. *International Journal of Science Education*, *24*(4), 389-403. doi: 10.1080/09500690110098912

Hu, W., Wu, B., Jia, X., Yi, X., Duan, C., Meyer, W., & Kaufman, J. (2013). Increasing Students' Scientific Creativity: The "Learn to Think" Intervention Program. *The Journal of Creative Behavior*, *47*(1), 3-21. doi: 10.1002/jocb.20

Kline, R. B. (2005). *Principles and practice of structural equation modeling*. New York: Guilford.

Lawson, A. E., Banks, D. L., & Logvin, M. (2007). Self-efficacy, reasoning ability, and achievement in college biology. *Journal of Research in Science Teaching, 44*, 706-724.

Mukhopadhyay, R. (2011). *Scientific creativity-its relationship with study approaches, aptitude in physics, and scientific attitude* (Ph.D.). University of Calcutta.

Mukhopadhyay, R. (2013). Measurement of Creativity in Physics - A Brief Review on Related Tools. *IOSR Journal of Humanities and Social Science*, *6*(5), 45-50. doi: 10.9790/0837-0654550

Oldham, G. R., & Cummings, A. (1996). Employee creativity: Personal and contextual factors at work. Academy of Management Journal, 39, 607-634.

O'Neal, I., Paek, S., & Runco, M. (2015). Comparison of Competing Theories about Ideation and Creativity. *Creativity. Theories - Research - Applications*, *2*(2), 145-164. doi: 10.1515/ctra-2015-0018

Pérez-Fuentes, M., Molero Jurado, M., Oropesa Ruiz, N., Simón Márquez, M., & Gázquez Linares, J. (2019). Relationship Between Digital Creativity, Parenting Style, and Adolescent Performance. *Frontiers in Psychology*, *10*.

Rojas, J. (2015). *The Relationships Among Creativity, Grit, Academic Motivation, and Academic Success in College Students* (PhD). University of Kentucky. from https://uknowledge.uky.edu/edp_etds/39/

Runco, M. A., Plucker, J. A., & Lim, W. (2001). Development and psychometric integrity of a measure of ideational behavior. *Creativity Research Journal*, *13*(3-4), 393-400 .

Runco, M. A. (2005). *Motivation, Competence, and Creativity.* In A. J. Elliot & C. S. Dweck (Eds.), *Handbook of competence and motivation* (pp. 609-623). Guilford Publications.

Simon, H. A. (1985). What we know about the creative process. In R. L. Kuhn (Ed.), *Frontiers in creative and innovative management* (pp. 3-20). Cambridge, MA: Ballinger.

Siew, N., Chong, C., & Lee, B. (2015). Fostering Fifth Graders' Scientific Creativity Through Problem-based Learn. *Journal Of Baltic Science Education*, *14*(5), 655-669.

Sri, A., & Kurnia, B. (2018). The Practicality and Effectiveness of Collaborative Creativity Learning (CCL) Model by Using PhET Simulation to Increase

Students' Scientific Creativity. *International Journal of Instruction, 11*(4), 409-424. doi: 10.12973/iji.2018.11426a

Sternberg, R. J., & Lubart, T. I. (1991). *An investment theory of creativity and its development. Human Development*, *34*(1), 1-31.

Sternberg, R., & Wagner, R. (1991). *MSG thinking style inventory* (p. 140). Star mountain project.

Sternberg, R. (1988). Mental Self-Government: A Theory of Intellectual Styles and Their Development. *Human Development*, *31*(4), 197-224. doi: 10.1159/000275810

Sternberg, R. J. (1997). *Thinking styles*. New York: Cambridge University Press.

Sternberg, R. J. (2006). The nature of creativity. *Creativity Research Journal, 18*(1), 87-98.

Sternberg, R. J. (2007a). Finding students who are wise, practical, and creative. *The Chronicle of Higher Education, 53*(44), B11.

Sternberg, R. J. (2007b). The Kaleidoscope Project. *SPIM Newsletter*, Summer Issue.

Sternberg, R. J. (2012). The Assessment of Creativity: An Investment-Based Approach. *Creativity Research Journal*, *24*(1), 3-12. doi: 10.1080/10400419.2012.652925

Trost, G., & Sieglen, J. (1992). Biographische Friihindikatoren herausragender beruflicher Leistungen. In E. A. Hany & H. Nickel (Eds.), *Begabung und Hochbegabung* (pp. 95-104). Bern: Huber.

Usta, E., & Akkanat, Ç. (2015). Investigating Scientific Creativity Level of Seventh Grade Students. *Procedia - Social and Behavioral Sciences*, *191*, 1408-1415. doi: 10.1016/j.sbspro.2015.04.643

Zhou, J. (1998). Feedback valence, feedback style, task autonomy, and achievement orientation: Interactive effects on creative performance. *Journal of Applied Psychology*, 83, 261-276.

APPENDIX

List of researcher made tools:

1) Barai and Saha Parental Behavior Inventory

Sl. No.	Items	Strongly agree 5	Agree 4	Neither agree nor disagree 3	Disagree 2	Strongly disagree 1
Freedom by parents						
1	My parents' permission is necessary for me to travel alone in distant places. (r)					
4	I need to take permission from my parents before spending a whole day at my friend's home. (r)					
5	I need approval from my parents before going to my college/institutional excursion. (r)					
6	I have to take my parents' consent before taking up new projects as a part of my hobbies. (r)					
7	My parents do not allow me to stay outside of the home for a long time without permission. (r)					
Parental support						
2	Whenever I talk about some interesting topic from my studies to my parents they listen to me very carefully.					
3	My parents always motivated me to achieve my academic goals.					
8	My parents regularly discuss with me about my future academic plans.					
9	My parents always encourage me to continue my education.					
10	My parents always supported me even during my failures.					

2) Barai and Saha Friend's Group Behavior Inventory

Sl. No.	Items	Strongly agree 5	Agree 4	Neither agree nor disagree 3	Disagree 2	Strongly disagree 1
Friend's personal support						
12	My friends and I always support each other when anyone among us is in depression.					
15	My friends and I share any kind of problems that we have with our parents.					
16	My friend's group listens and supports even the most 'unusual ideas' of me.					
22	My friends and I like to share our emotional problems.					
Friend's academic support						
11	My friends and I learn in a group.					
17	My friends and I help each other in evaluating our academic works.					
19	In my friends group, we always keep sharing lots of information related to work and academics.					
20	My friends and I share our study notes.					
Acceptance						
13	When I score low in the exam my friends do not give me importance (r)					
14	I am not very popular among my friends. (r)					
18	My friends don't like it when they see that my parents care and support me very much. (r)					
21	Whenever I work together with my friends on some projects, my contribution is never appreciated. (r)					

Note:
(a) *r : items should be codded reversely.
(b) 'Sl. No.' represent the order in which the items should be arranged in inventory.