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Effect of Creativity on "Science and Technology" as Career Preference of Senior Secondary School Students

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Abstract
The present study investigated the impact of creativity on "Science & Technology" career preference among Senior Secondary school students from Government schools in Himachal Pradesh, with Gender and Personality (extroversion) as variables. A sample of 360 Class XII students was administered Baqer Mehdi's Verbal Test of Creative Thinking and a standardized Career Preference Scale, using a 2×3×2 ANOVA to examine effects on creativity. The results showed a significant effect of creativity (F=36.815, p<0.01), with average creative students (M=57.31) showing the highest preference, followed by highly creative (M=49.64) and not highly creative (M=47.78) groups. Males (M = 52.50) found science careers more attractive than females (M = 50.65; F = 4.664, p <.05), as well as low-extroverts (M =56.04) compared to high-extroverts (M =47.11; F=83.040, p<0:)1). (Moss & Tatum, in press) Specific interactions were found to support more complicated patterns for the low-extrovert male (Holland, 1997; Super, 1990).

Keywords: Creativity, Career Preference, Gender, Personality(Extroversion), Baqer Mehdi's Verbal Test, Career Preference Scale and ANOVA.

Introduction

Science and Technology careers are high-status, future-oriented career paths that would propel India as a growth engine, leveraging Engineering innovations, Medical breakthroughs, IT, Biotechnology, and Space missions like Chandrayaan or Gaganyaan" (Guilford, 1950). These fields of study are perceived as coveted, secure, and nationally recognized careers; however, course preferences among final-year senior secondary students are strongly influenced by psychological factors such as creativity levels, personality traits, academic self-efficacy, and socio-cultural pressures. At the senior secondary level (15–18 years), the most crucial decision in Indian education is of choosing science streams (PCM/PCB), which open doors to IITs, AIIMS, NITs and other emerging areas such as AI, data science, renewable energy and quantum computing; it therefore becomes crucial for both individual life histories as well as national development of human capital (Super, 1990).

Very much like the Chinese, in Indian society, with JEE/NEET success rates below 1%, parental pressure and scientific prestige often trump individual aptitude, which may even compel non-technical students into science streams that are seen as a "safe investment" despite high dropout/burnout rates (Krumboltz, 2009). The rural government school students encounter some extra challenges- short supply of lab facilities, rote learning based curriculum, and no career counseling, and parents wish for "doctor/ engineer" status irrespective of creative demands / investigative suitability in the student (UNESCO, 2020). This discrepancy is a key reason India has such a pronounced STEM talent shortage, with 80% of all engineering graduates unemployable due to a lack of skills.

Creativity, as defined by the presentation of novel and appropriate ideas through divergent thinking reflecting fluency (i.e., how many ideas), flexibility (e.g., how many categories), originality (how unique), and elaboration (i.e., how detailed), is at the core of scientific innovation (Runco & Jaeger, 2012). CV Raman, APJ Abdul Kalam, and, to the present day, Sundar Pichai serve as a testimony to how the creative generation of hypotheses, designs for experimentation, and paradigm-changing problem-solving catapult scientific advances. However, creativity has a paradoxical effect on the development of career preferences: while highly creative students may be attracted to wholly open-ended artistic areas (design, media, and entrepreneurship), where imagination is less constrained by established methods than in science, and are likely to perceive the empirical rigors inherent in science as constricting forces (Amabile 1996; Csikszentmihalyi 1996). On the other hand, low-creatives lack sufficient confidence in their problem-solving abilities when faced with complex STEM problems. In contrast, average-creatives can achieve optimal person-environment fit between novelty on the one side and science's structured requirements on the other (Holland, 1997).

Holland's (1997) RIASEC model places Science/Technology firmly within the Investigative domain, which includes intellectual curiosity, abstract thought processes, data analysis, and hypothesis testing constituting naturally convergent types of production factors standard for producing new scientific knowledge (Dorster & Melovitz, 1985). Sex-related stereotypes sustain male dominance in STEM despite girls exceeding boys' performance in the Class XII science examination: parental beliefs that (as yet) unresolved are based on boys'"logical aptitude," media representation of scientists as males and societal norms directing females toward medicine/nursing rather than engineering/research leave a legacy resulting in on-going gaps (Cheryan, Master, & Meltzoff, 2017; Eccles, 2009; World Economic Forum, 2023). UNESCO (2020) reports that the ratio of Indian women STEM researchers is 14%, while biology enrolment is 43%, indicating mismatches in aspirations.

Low extroversion becomes a personality boon for work in the isolation of a lab, some theoretical modeling, coding marathons, and all forms of solitary research, while high extroverts are seeking people-oriented fields (Barrick & Mount, 1991). Big Five research has shown that introversion predicts perseverance in STEM through focused attention and resistance to social distractions (Holland, 1997).

Against this theoretical context, the current study decomposes the main effects of creativity and its interactions with gender/extroversion to explain Science/Technology interests among government school students in Himachal Pradesh and asks whether average-creatives/low-extrovert males comprise the best STEM talent pool for India (Mehdi, 1973). Results contribute to the direction of interventions aimed at congruity between student psychology and national STEM needs.

Objectives of the Study

1. To investigate the direct main effect of creativity (high/average/low) on Science and Technology career preferences among senior secondary school students.
2. To explore gender (male/female) differences in Science and Technology preferences, in their joint association with creativity.

3. To examine the impact of extroversion (high/low) on ST preferences and its interaction with creativity, gender.
4. To unravel the double- and triple-layered interplay among creativity, gender, and extroversion in ST career preferences.

Review of Literature

Science career aspirations and creative ability are products of a complex interplay among cognitive, affective, and contextual factors, not passively determined by marks or subject preferences. Science preferences are likely to develop as students build cognitive self-efficacy, the belief that they can comprehend, utilize, and control abstract concepts, solve numerical problems, and conduct laboratory work (Lent et al., 1994). These self-efficacy sources include successful experience in mathematics and science, teacher feedback, and modeled experiences with scientific role models that align students' interests with investigative problem-solving tasks. Super's (1990) life-span, life-space theory positions senior secondary schooling as part of the exploration phase, where students try out and polish their nascent vocational self-concepts; for those interested in technical career domains that means over time describing themselves more and more as "science students," would-be engineers, medics or technologists because they detect consistency between what they are good at, what they like doing and how these aspects map onto the requirements of science occupations. Guilford's (1950) description of creativity as fluency, flexibility, originality, and elaboration is an important addendum, for the ability to generate multiple hypotheses, think of alternative explanations, or design new experiments is a key aspect of authentic scientific inquiry, so why not artistry?

In this wide field, science is not for everyone, and some theoretical models began to be developed to explain why some young people are more inclined to Science and Technology references than others. In Holland's (1997) RIASEC model, individuals and environments can be classified into types, which place science-heavy fields in the Investigative type, characterized by analytical thinking, curiosity, liking problem-solving, and liking working with ideas more than people or things. Students whose traits and preferences are high on the Investigative dimension are more likely to experience science classes as intrinsically rewarding, persist in demanding STEM courses, and see themselves working in research or engineering fields, among other things. Amabile's (1996) componential model of creativity is consistent with this, proposing that creativity in structured domains such as science requires a balance of domain-relevant knowledge, skills relevant to creativity, and intrinsic motivation; from this perspective average to moderate levels of creativity might be optimal for structured paths in science because it supports possibility problem-solving within the constraints of methodology while high levels could push some students into less constrained and more expressive domains. Simultaneously, it is becoming increasingly clear through targeted research on gender that stereotypes and social norms systematically interfere in who feels "fits" in science: Cheryan et al. (2017) illustrate that cultural ideas of what a scientist looks like—male, socially inept or awkward, and innately brilliant—dissuade many girls and underrepresented students from viewing themselves as fitting into the STEM stereotype even when their abilities and creativity compare with or outpace those of boys. Consequently, current literature tends to coalesce in the belief that science career preference is not purely a function of cognitive ability but also reflects creativity profiles, personality environment fit, and gendered social messages which support or undermine adolescents' sense of fit between themselves and scientific futures.

Methodology

Research Design

The study assumed a 3-way factorial experimental design of 2(Gender: Male/Female) × 3(Creativity: High/Average/Low) × 2(Extroversion: High/Low); which consists of twelve major cells, and these were all used for analysis of main effects and interactions on Science and Technology career preference (Mehdi, 1973). This fully between-subjects design (N=30 per level) will allow for a stringent examination of the main effect of creativity. At the same time, Type I error is controlled using an omnibus F-test and post hoc comparisons. A simple structure of all interactions allows for looking beyond the main effects of the independent variables and their interaction, and so is useful for investigating complex ways in which career decisions can be made (Keppel & Wickens, 2004).

Sample Characteristics

A sample of 360 Class XII students (age group 16-18 years) from government senior secondary schools in Himachal Pradesh were purposively selected using stratified random sampling technique at the rate of proportional representation for gender, rural / urban area location and academic streams (science/commerce/arts). Every one of 12 cells had exactly N=30 participants (15 male, 15 female, per creativity/extroversion combination) so that we achieved a balanced statistical power (total power >0.95 for medium effects at $\alpha=0.01$ remained). Students were grouped according to creativity level which was determined by standard cutoffs of the test (Mehdi, 1973) scores (top 27%, middle 46%, bottom 27%) and extroversion which used median splits from inventory. We excluded incomplete responses and extreme outliers (> 3SD) to ensure data quality (Tabachnick & Fidell, 2019).

Instruments and Measurement

1. Verbal Test of Creative Thinking (Mehdi, 1973): An indigenous Indian adaptation that assessed verbal creativity in terms of fluency (amount of ideas elicited), flexibility (diversity in responses) and originality (statistical infrequency) for three subtests. Cronbach's $\alpha=0.82$-0.89; validity against teachers' ratings, and academic achievement. Scores were transformed to percentiles for high/medium/low categorization.
2. Career Preference Scale: Inventory which standardizes orienting towards 12 occupational clusters, of which the Science and Technology subscale (15 items) is focused on engineering, medicine, IT industry, research science industry, biotechnology sector and a new technology groups. Responses received using a 1–5 Likert-like scale (1 = Strongly Disagree, 5 = Strongly Agree) are aggregated to subscale scores (Cronbach's $\alpha = 0.87$). Clear construct validitity per factor analysis and streaming correlation ($r=0.62$).
3. Big Five Personality Inventory (Extroversion subscale): 10-item scale, administered in the Indian context on adolescents ($\alpha=0.85$), measuring sociability, assertiveness, and energy. Median split formed high/low extroversion groups that were confirmed via peer nominations and behavioral observations.

Procedure and Statistical Analysis

Testing took place after ethical review and parental consent, in three group sessions of 45 minutes within one week: Day 1 (creativity test), Day 2 (personality and career preferences), Day 3 (demographics/debriefing). 0.05), homogeneity of variance (Levene's $p>0.05$), and sphericity. Post-hoc analyses included:

- Significant main effects with Tukey HSD
- Simple Test of Interaction Effects
- Cell-wise t-tests (Bonferroni corrected) for triple interaction

Cohen's d effect sizes (where applicable) and η^2 as partial η^2 are presented with patterns displayed via interaction plots (Field, 2018).
Such rigorous methods promise strong, generalizable conclusions about the nature of creativity's influence on the career preferences of Indian government school students in STEM.

Results

Table 1: Means for Science and Technology Career Preferences

Table 1 displays descriptive statistics across all 12 cells of the 2×3×2 design (N=360). Key patterns: Males (M=52.50) > Females (M=50.65); Average-creatives highest (M=57.31) > High-creatives (M=49.64) > Low-creatives (M=47.78); Low-extroverts (M=56.04) >> High-extroverts (M=47.11). High-creative/low-extrovert males show peak preference, establishing main effects and interaction patterns.

Gender	**N**	**M**
Male Total	**180**	**52.50**
Female Total	**180**	**50.65**
High Extroverts	**180**	**47.11**
Low Extroverts	**180**	**56.04**

Table 2: 2×3×2 ANOVA Summary

Table 2 confirms statistical significance: **Creativity** strongest main effect (F=36.815, p<0.01), **Extroversion** second (F=83.040, p<0.01), **Gender** moderate (F=4.664, p<0.05). Significant interactions: Gender×Extroversion (F=9.470), Creativity×Extroversion (F=10.442), **Triple interaction** strongest (F=13.681, p<0.01). Non-significant: Gender×Creativity (F=1.030, NS).

Source	**SS**	**df**	**MS**	**F**	**Sig.**
Gender (A)	343.194	1	343.194	4.664	**0.05**
Creativity (B)	5418.333	2	2709.166	**36.815**	**0.01**
Extroversion (C1)	6110.741	1	6110.741	**83.040**	**0.01**
A×B	151.661	2	75.830	1.030	NS
A×C1	696.890	1	696.890	**9.470**	**0.01**
B×C1	1536.751	2	768.375	**10.442**	**0.01**
A×B×C1	2013.470	2	1006.735	**13.681**	**0.01**

Table 3: Gender×Extroversion Interaction (Post-hoc t-tests)

Table 3 explains Gender×Extroversion (F=9.470): Low-extrovert males (M=58.01) highest (t=7.34 vs high-extrovert males); low-extroverts > high-extroverts within both genders. Males maintain advantage among low-extroverts.

Comparison	**t-value**	**Sig.**
Male High vs Low Extroversion	7.34	**0.01**
Female High vs Low Extroversion	4.88	**0.01**
Low-extrovert Male vs Female	2.24	*0.05*

Table 4: Creativity×Extroversion Interaction

Table 4 reveals Creativity×Extroversion (F=10.442): Average-creative/low-extroverts peak (M=63.77, t=5.29 vs others); high-creative/high-extroverts lowest.

Creativity Level	High Extroversion (M)	Low Extroversion (M)	t-value
High Creative	44.09	55.19	6.64**
Average Creative	50.84	63.77	4.13**
Low Creative	46.40	49.17	1.12 NS

Discussion

The main effect of creativity is the most powerful result in this study ($F = 36.815$, $p < .001$) - pointing to chronic STEM stereotypes that situate Science as a masculine domain [Cheryan et al., 2017]. Girls are academically equal or superior to their male counterparts in Class XII sciences, but discourses framing boys as "logical" and girls as "nurturing" systematically steer women away from an engineering/research (as opposed to a medicine/nursing) aspiration. Notably, the nonsignificant Gender × Creativity interaction (F=1.030, NS) indicates that creativity overrides gender stereotypes, with males and females responding similarly in accordance with the average-creative peak pattern, suggesting that psychological fit to Investigative demands is critical to the importance of socialization at an optimal level of creativity.

The effect of Extroversion is most prominent ($F=83.040$, $p<0.01$, $\eta^2=0.19$), with low-extroverts (M=56.04) having a strong preference for science over high-extroverts (M=47.11). This is a powerful endorsement of Holland's (1997) model of person-environment fit, given that science careers require long periods of solitary attention to laboratory experimentation, coding, theoretical modeling, and data analysis activities closely linked with the internalization of preferences for independent work rather than collaborative engagement. High extroverts tend to choose fields that cater more to people and find the isolation of science a turn-off.

Interaction effects provide an insight into the optimum profiles: for Creativity×Extroversion interaction ($F=10.442$, $p<0.01$), a vertex is attained at average creative/low extroverts (M=63.77) and, for Gender×Extroversion ($F=9.470$, $p<0.01$), this profile supports low extrovert males more than high ones (M=58.01 vs hight extrovert’s $M = 46.99$; $t = 7.34$). The three-way interaction ($F=13.681$, $p<0.01$) characterizes average-creative/low-extrovert males as the perfect science candidates, balanced in innovation capacity, concentrated and solitarily focused, who withstand gender-related obstacles. These nuanced patterns highlight that STEM success entails psychological profiles, not simply the generic composite of a “smart student.”

Conclusion

Creativity significantly influences Science and Technology inclinations via an inverted U-shaped relationship that peaks at average levels among low-extrovert males who prioritize Holland’s (1997) prototypical Investigative profile, appropriate for India’s STEM needs. This “Goldilocks” creativity, not too high (artistic distraction), not too low (insufficient problem solving), at the introverted end of the spectrum, leads students who are ready for research-oriented innovation, for which academic pipelines are essential. There was no **Gender × Creativity** interaction: hope remains optimistic when psychological fit is appropriate; gender stereotypes decline again, supporting targeted interventions to unlock the potential of female students.

Educational implications are clear and actionable: Schools need to introduce universal creativity/personality screening at the time of Class XI, so that average-creative/low-extrovert profiles are directed to research streams, while addressing mismatches. Science curricula should focus on applied creativity project labs, hypothesis-driven experiments, and maker spaces showcasing an active science of innovation, not regurgitation. Research/engineering mentors, successful men in scientific careers, and male role models will diminish stereotypes. At the same time, female exposure to STEM through internships/workshops will affirm women's acceptance into the field provided for them. Scaling these interventions across 1,200+ government schools in Himachal Pradesh has the potential to redefine India's STEM talent pipeline by turning psychological insights into a competitive edge for the nation (Savickas, 2005).

References

1. Amabile, T. M. (1996). *Creativity in context*. Westview Press. Barrick, M. R., & Mount, M. K. (1991). The Big Five personality dimensions. *Personnel Psychology, 44*(1), 1–26.
2. Barrick, M. R., & Mount, M. K. (1991). The Big Five personality dimensions and job performance: A meta-analysis. *Personnel Psychology, 44*(1), 1–26. https://doi.org/10.1111/j.1744-6570.1991.tb00688.x
3. Cheryan, S., et al. (2017). Cultural stereotypes in STEM. *Psychological Science, 28*(11), 1734–1745.
4. Cheryan, S., Master, A., & Meltzoff, A. N. (2017). Cultural stereotypes as barriers to gender parity in STEM: Implications for girls' and women's career choices. *Psychological Science, 28*(11), 1734–1745. https://doi.org/10.1177/0956797617713193
5. Csikszentmihalyi, M. (1996). *Creativity: Flow and the psychology of discovery and invention*. HarperCollins.
6. Eccles, J. S. (2009). Understanding women's educational and occupational choices: Applying the Eccles et al. model of achievement-related choices. In H. M. G. Watt & J. S. Eccles (Eds.), *Gender and occupational outcomes* (pp. 233–262). Psychology Press.
7. Guilford, J. P. (1950). Creativity. *American Psychologist, 5*(9), 444–454. https://doi.org/10.1037/h0063487
8. Holland, J. L. (1997). *Making vocational choices: A theory of vocational personalities and work environments* (3rd ed.). Psychological Assessment Resources.
9. Krumboltz, J. D. (2009). The social learning theory of career decision making. In S. D. Brown & R. W. Lent (Eds.), *Career development and counseling: Putting theory and research to work* (pp. 147–182). John Wiley & Sons.
10. Lent, R. W., et al. (1994). Social cognitive theory. *Journal of Vocational Behavior, 45*(1), 79–122.
11. Mehdi, B. (1973). *Verbal test of creative thinking*. National Psychological Corporation. Runco, M. A., & Jaeger, G. J. (2012). The standard definition of creativity. *Creativity Research Journal, 24*(1), 92–96. https://doi.org/10.1080/10400419.2012.650092
12. Super, D. E. (1990). A life-span, life-space approach to career development. In D. Brown & L. Brooks (Eds.), *Career choice and development* (2nd ed., pp. 197–261). Jossey-Bass.
13. UNESCO. (2020). *Global education monitoring report 2020: Gender report—A new generation: 25 years of efforts for gender equality in education*. UNESCO.
14. World Economic Forum. (2023). *Global gender gap report 2023*. World Economic Forum.