Evaluating Children's Fundamental Instincts in Secondary Schools: A Game Theory Approach in Pakerhat Union, Khansama Upazila, and Dinajpur Sadar, Dinajpur District, Bangladesh

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Abstract

In this comprehensive survey, human decision-making in the context of classic game theory dilemmas was thoroughly investigated. The study delved into the cognitive responses to various social dilemmas by employing a field survey with a cross-sectional design to better understand the dynamics of cooperation and defection. A series of carefully crafted 2 × 2 games were included in the questionnaire with a strategic emphasis on examining the interactions between different types of opponents. The survey aimed to explore how individuals navigate complex social scenarios and make decisions in the face of dilemmas. Through this approach, the study seeks to illuminate the underlying factors that influence cooperative behavior in game-theoretic contexts. The study examined how dilemma strength influences children's cooperation and decision-making in the Prisoner's Dilemma (PD) and Trivial game scenarios across Pakerhat Union, Khanshama Upazila, and Dinajpur Sadar, Bangladesh. The results showed that Dinajpur Sadar exhibited the highest levels of cooperation in both PD and Trivial settings, suggesting stronger engagement and consistent behavior compared to the other regions. The statistical analysis revealed that education played a significant role in Pakerhat, while the boy-girl ratio had a notable impact in Khanshama particularly in the Trivial game. Dinajpur Sadar was found to have the most pronounced effects from education and gender making it the best area for studying these factors. These findings highlight the importance of educational resources, social environment, and gender factors in shaping children's decision-making in social dilemmas.

Keywords: Dilemma strength; Cooperation fraction; Experimental survey; Game theory

1. Introduction

Surah Luqman (31:13-19) in Quran offers valuable insights into child development, emphasizing wisdom, moral upbringing, and the need for balanced guidance, which aligns with the study's goal to evaluate and support the instincts of children. It underscores the idea that a child's development [1] is influenced by both by their parents and broader society and community where they grow up. Children are seen as the embodiment of a better future for society in many aspects [2]. Moreover, children's interaction with peers and neighbors play a significant role in shaping their character and values from the young age. Through various activities such as preparing meals together, and engaging in communal events, they develop both bonds of friendship and cooperation that contribute to their social development.In communities, children often participate in collective activities such as group work, playing[3] which fosterteamwork, collaboration skils andlearning from others. For instance, they observe the actions of others and emulate behaviors that align with their communal values.However, children's behavior not always purely altruistic [4] as they may sometimes benefit [5] from the efforts of others without contributing equally. This mirrors social dilemmas [6] commonly encountered in mandane life where individual self-interest conflicts with the potential for greater collective gains.In these situations, individuals must balance immediate self-interest with the long-term benefits of collective action [7]. The choices made by children in such scenarios provide valuable insights into the dynamics of social cooperation [8] and the importance of fostering [9] a sense of community from a young age [10].As children grow [11], they learn to interpret the intentions, beliefs [12] of others, and develop the cognitive tools to formulate strategic plans and make rational decisions in game-like situations. Children progress from a state where they neither deduce nor show concern for others' thoughts to a state where they ascribe beliefs to others and demonstrate empathy towards them. The dynamics of cooperation in children can be related to the concept of the public goods game, which is often used to study cooperation in adults.

The Public Goods Game (PGG) [13] provides classical illustration of a social dilemma. In gaming context, "public goods" refers to resources that are available and consumed by all members of a group, regardless of the individual contributions made toward their provision. This concept extends beyond the game itself and finds real-world applications in public service provisioning and maintaining a clean environment [14]. The crux of the social dilemma presented in PGG lies in the tension between individual self-interest and collective benefit. The social optimum is achieved when individuals willingly contribute to the public good though their personal gains that could be maximized through a selfish strategy of free riding. Free riding [15] refers to the act of exploiting contribution of others while not contributing oneself. Essentially, PGG and similar social dilemma situation provide ample opportunities to observe and studying human behavior in cooperative decision-making. The dynamics of these

interactions uncovers delicate balance between self-interest, and cooperation within groups. Particularly, understanding how individual navigate these dilemmas sheds light on the mechanisms that promote cooperation and contribute to the formation of social norms and altruistic behaviors within communities. Park et al. [16] represents social interactions within a group can lead to cooperation, even in situations where self-interest might suggest otherwise. This cooperation is essential for addressing collective challenges that allow making decisions to benefitting greater good, fostering a sense of community, and sharing responsibility. Cooperation and a shared sense of responsibility play a significant role in shaping gender roles, stereotypes, and influencing how individuals vision plays a tremendous role in participation in collective decision-making, and community development.

Research on gender differences in cooperative behavior in Public Goods Games (PGGs) represents mixed results. For instance, some studies indicate females are more cooperative [17], others suggest that males demonstrate higher levels of cooperation. Few studies report no significant gender effects [18] among children though others find boys are more inclined to free ride compared to girls [19]. The relationship between gender [20] and cooperation is influenced by factors like social norms, and individual differences. Interestingly, some studies found age-related factors may affect cooperative behavior where younger children contributing more [21]. However, others suggesting that older children may initially contribute more but relatively contribute less when faced with free riding behavior [22]. The complexities of age-related differences in cooperative behavior raise questions about whether these differences are influenced by individual strategies and peer actions. Additionally, in conditional cooperation, behavior adapts based on the actions of others, adds complexity to the study of cooperative behavior across different age groups, highlighting the need for further research in this area.

Researchers in cooperative behavior in Public Goods Games (PGGs) among children and adolescents has gained significant attention as this allows to understand children behavior [23]. Studies indicate that young children such as 5-year-olds are also able to adopt conditional cooperative strategies in simplified PGG scenarios [24]. Contributions of children between ages 5 and 12 initially align with those of adults but exhibit different patterns over time challenging the understanding of cooperative behavior development in PGGs. Methodological challenges and inconsistencies in the limited body of research underscore the need for caution in drawing conclusions about the developmental aspects of cooperative behavior in PGGs. To obtain more comprehensive understanding research still require addressing these issues. Additionally, the study explores equilibrium play in PGGs, decision-making processes, and strategies leading to stable cooperation over time [25]. Moreover, it delves into the role of committed individuals in coordination games and social dilemma games [26], addresses reducing screen time for preschool children through parental behavior [27] and emphasizes the significance of the human voice in conveying information [28].

To address a noted gap in validating game theory principles, a novel experimental game model was created to explore how individuals including children comprehend and manage dilemma situations in real-world contexts [29]. The model employed stochastic strategies rooted in game theory, allowing for deeper insights into human decision-making and behavior in real-world situations. The study explored whether people could effectively recognize social dilemma classes and gauge their strength in various games, including the Prisoner's Dilemma, Trivial, Chicken, and Stag-Hunt. Instead of children, the study conducted a questionnaire survey involving adults to assess whether children could recognize these dilemma classes. This research aimed to analyses the cognitive processes and reasoning abilities underlying children's recognition of social dilemmas and examined the influence of psychology and situational factors on children's behavior. Additionally, an investigated was carried out on how children's equilibrium rates varied considering strategic decisions from different vantage points. The study investigates careful consideration of the psychology of children in designing the games to reflect the complex decision-making processes they encounter in various situations. The results revealed that children's perceptions of the games' difficulty generally matched expectations, highlighting the intricate nature of their decision-making processes in challenging strategic situations.
The remaining part of this manuscript describing as follow: Section 2 describes experimental design, Section 3 reports results and give discussion, Section 4 represents statistical analysis, Section 5 provides concluding parts.

2. Experimental design

The questionnaire survey employed straightforward 2 × 2 games to establish a controlled and accessible framework for analysing human behavior and cooperation in social interactions. These simplified games streamlined the decision-making process, enabling the isolation of critical variables and offering valuable insights into how individuals understand and address various social dilemmas. Although they did not fully replicate the intricacies of real-world interactions, these games proved effective in investigating the core principles of underlying human behavior and cooperative dynamics.

2.1. General design

The study created a hypothetical scenario to explore children's perceptions and responses in symmetric 2 × 2 games to evaluate their understanding in different game types, measure the strength of dilemmas, and investigate how assumptions about opponents impacted cooperation decisions. This research is aimed to uncover the intricate relationships between game type, dilemma strength, assumptions, and cooperation levels. The questionnaire used in this study is presented in Table 2, with an overview of the questionnaire process provided in the Appendix.

2.1.1. Demographic information

The experimental field survey involved about 210 child participants from 9th and 10th standards in various parts of Dinajpur district of Bangladesh such as Dinajpur Sadar, Khanshama Upazila Sadar, and Pakerhat Union. The survey was conducted between March 2024 and October 2024 and aimed to explore the children's understanding and reaction to various game scenarios. Demographic data, including age, education, and gender: boy or girl were collected and are presented in Fig. 1, Fig. 2, and Fig. 3. Fig. 1, Fig. 2, and Fig. 3 represent results obtain in Pakerhat, Khanshama Upazila, and Dinajpur Sadar, respectively. Children were rewarded with chocolates and small gift items to encourage them insurvey participation. This extensive survey provides valuable insights into children's decision-making processes in social dilemmas and game-related scenarios.

2.1.2. Games and theory

This research seeks to develop accessible games that foster strategic thinking in children [30]. Although some studies have investigated multi-person strategy games, they often integrate them into physical environments, which makes it difficult to isolate the game-theoretic components [31].

Game theory

Game theory is a mathematical and strategic approach in decision making [32]focusing on cooperation, defection, and fundamental in social interactions. It provides a structured model to analyse the choices of individuals or entities that affect outcomes [33]. In games, participants choose strategies based on payoffs, aiming to maximize their benefit. An inter play between cooperation and defection is pivotal to classical games such as the Prisoner's Dilemma and Tragedy of the Commons as they reveal the impact of social dynamics on human decision-making. Thus, the versatile framework of game theory is applicable to various fields [34]. A significant way in game theory is the 2-player and 2-strategy symmetric game, commonly referred to as the 2 × 2 game. In the context of a 2 × 2 game, two anonymous players, often representing members of an infinite and well-mixed population, are faced with a binary choice: to cooperate (C) or to defect (D). The structure of the game is represented by a payoff matrix, typically denoted as $\begin{bmatrix} R & S \\ T & P \end{bmatrix}$, the letter R (P) represents the payoff received when both players mutually cooperate (defect), while S (T) reflects the focal player's payoff when they cooperate (defect), and their opponent chooses to defect (cooperate). While the foundational principles of game theory and evolutionary game theory (EGT) have been explored by numerous precursors, a novel and valuable concept has emerged: the quantification of the "dilemma strength" for the 2 × 2 game [35]. This idea, which seeks to measure the degree of difficulty or conflict inherent in the game, provides valuable insights into the dynamics of cooperation and defection which allows researchers to assess the balance between individual self-interest and

collective benefit, shedding light on the forces that influence decision-making in social dilemmas. Numerous precursor works have contributed to the recognition of game theory and evolutionary game theory (EGT). Therefore, a novel approach to quantifying the 'dilemma strength' in 2 × 2 games has been introduced [6]

$$D_g = T - R \quad (1) \qquad D_r = P - S \quad (2) \qquad D_g^{/} = \frac{D_g}{(R-P)} \quad (3) \qquad D_r^{/} = \frac{D_r}{(R-P)} \quad (4)$$

Where D_g symbolizes the Gamble-Intending Dilemma (GID) reflecting the propensity of the two equally positioned players to engage in exploitation with each other. While D_r stands for the Risk-Aversion Dilemma (RAD) illustrating the inclination of the equally positioned players to avoid ever being exploited. Professor Tanimoto and his colleagues went on to introduce two additional measures, denoted as $D_g^{/}$ and $D_r^{/}$ which are the respective normalized versions of D_g and D_r. This normalization is implemented because the dilemma strength is quantitatively influenced by the addition of social viscosity through a specific mechanism, and it is connected to the R - P values [36].

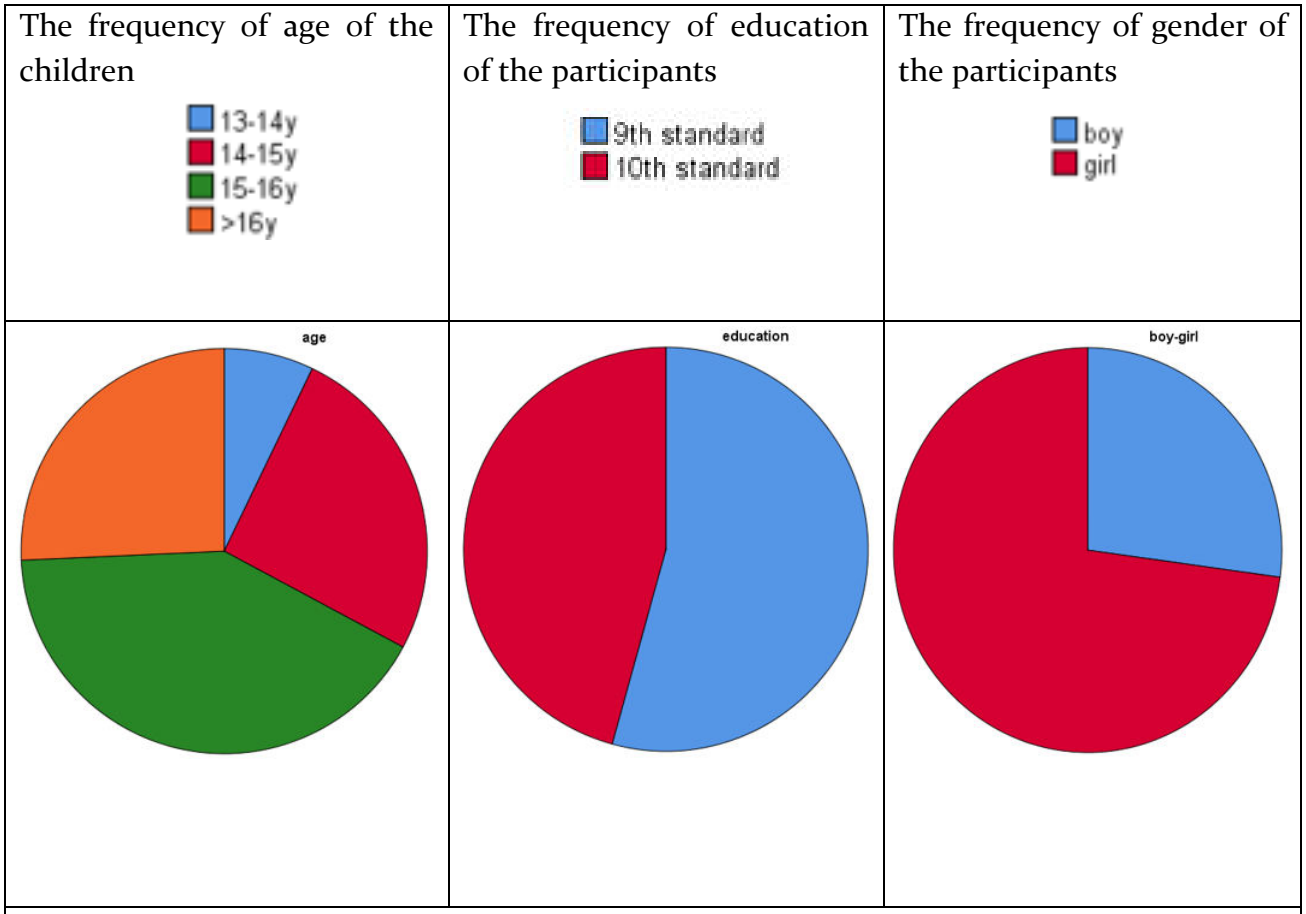

Fig.1 Illustrating the frequency of the children of Pakerhat union

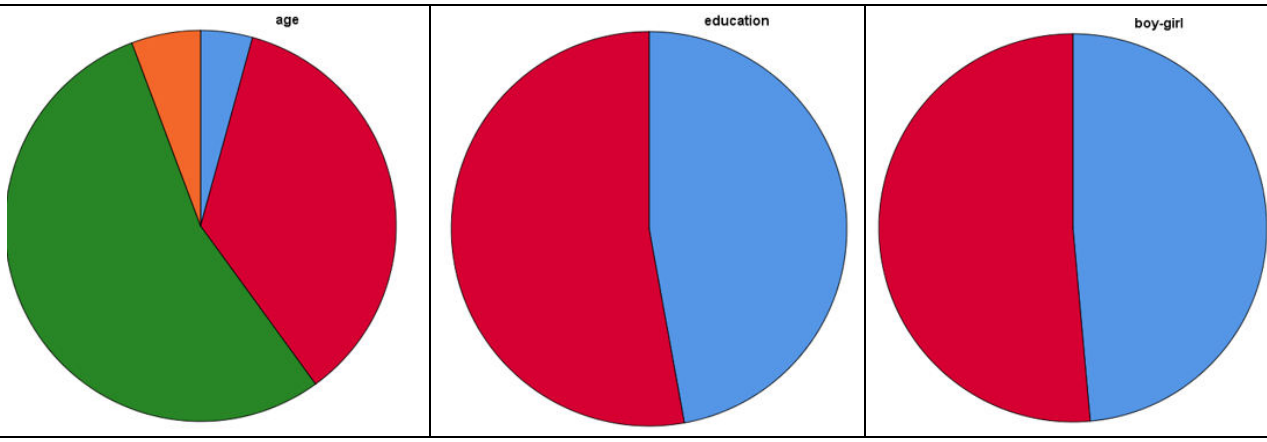

Fig.2 Represents the frequency of the children of Khanshama upazila

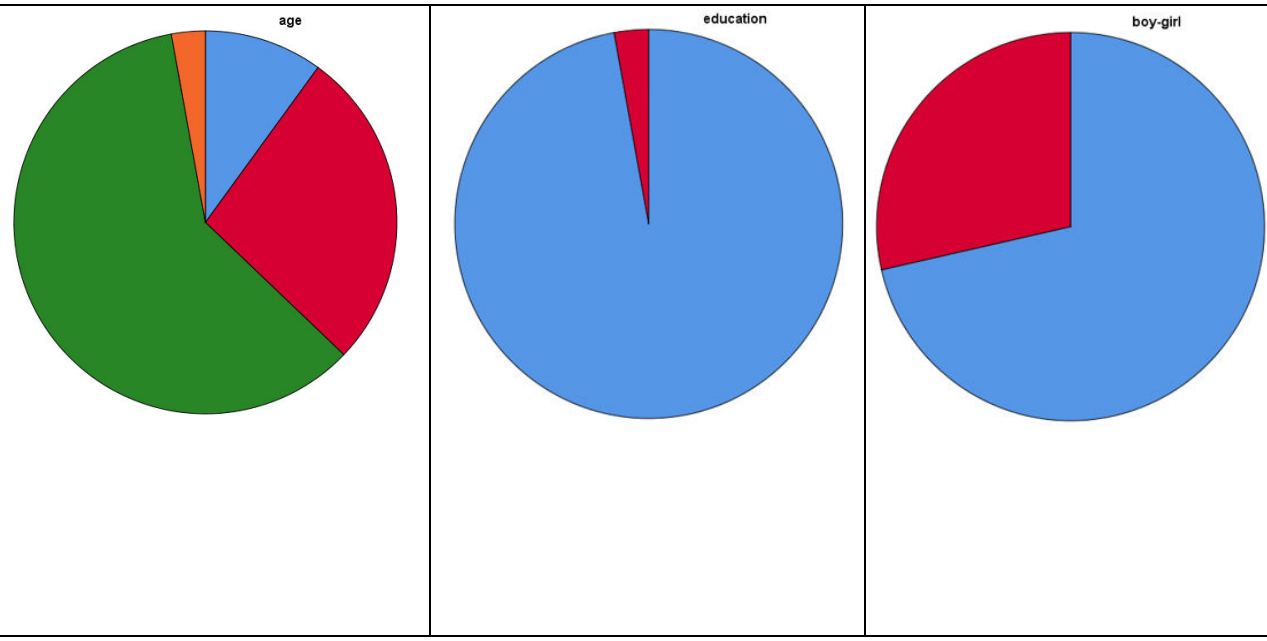

Fig.3Demonstrating the frequency of the children of Dinajpur sadar upazila

2.1.3. Predictions

Consistent with the development of the logical thinking presuming the infinite and well-mixed situation for symmetric 2 × 2 game where a query for the recognition of the four game classes in addition to the dilemma strength either be comprehensible for participants or otherwise during the experiment with (out) social viscosity. The prediction of game is represented in Table 1.

Table 1: Representation of a 2×2 game dynamics analytically [6].

Game class	Sign of D_g	Sign of D_r	Nash equilibrium	Phase
Prisoner's Dilemma (PD)	+	+	(0,1)	D-dominate
Chicken (CH)	+	-	$(\frac{D_r}{D_r-D_g},\frac{-D_g}{D_r-D_g})$	Polymorphic
Stag Hunt (SH)	-	+	(0,1) or (1,0)	Bi-sTable
Trivial	-	-	(1,0)	C-dominate

3. Results and discussion

An avenue worth exploring further involves a deeper investigation into thechildren's psychological mechanisms that underlie children's decision-making across different game scenarios, including PD, and Trivial.

Table 2: PD, and Trivial game have Table 2-1, Table 2-2, Table 2-3, and Table 2-4 question and Table 2-5, Table 2-6, Table 2-7, and Table 2-8 questions.

You \ Your Friend	C	D
A	5, 5	-5, 10
B	10, -5	0, 0

Table 2-1

You \ Your Friend	C	D
A	1, 1	-5, 6
B	6, -5	0, 0

Table 2-2

You \ Your Friend	C	D
A	5, 5	-1, 6
B	6, -1	0, 0

Table 2-3

You \ Your Friend	C	D
A	1, 1	-1, 2
B	2, -1	0, 0

Table 2-4

You \ Your Friend	C	D
A	4, 4	3, 1
B	1, 3	0, 0

Table 2-5

You \ Your Friend	C	D
A	2, 2	1, 1
B	1, 1	0, 0

Table 2-6

You \ Your Friend	C	D
A	15, 15	1, 14
B	14, 1	0, 0

Table 2-7

You \ Your Friend	C	D
A	3, 3	1, 2
B	2, 1	0, 0

Table 2-8

Table 3: Summary of the subjective responses according to the questionnaire for PD, and Trivial game by the children go through different dilemma strengths (D_g, D_r, $D_g^/$, $D_r^/$). There are 4 questions in which Table 2-1, Table 2-2, Table 2-3,Table 2-4 belong to PD, and Trivial game (fc ± SD = Average cooperation fraction ± standard deviation) have Table 2-5, Table 2-6, Table 2-7, and Table 2-8 questions.

	PD setting vs Trivial setting			
	PD setting			
Table	Table 2-1	Table 2-2	Table 2-3	Table 2-4
D_g (= D_r)	5(5)	5(5)	1(1)	1(1)
$D_g^/$ (= $D_r^/$)	1(1)	5(5)	0.2(0.2)	1(1)
	Trivial setting			
	Table 2-5	Table 2-6	Table 2-7	Table 2-8
D_g (= D_r)	-3(-3)	-1(-1)	-1(-1)	-1(-1)
$D_g^/$ (= $D_r^/$)	-0.75(-0.75)	-0.5(-0.5)	-0.75(-0.75)	-0.33(-0.33)
	PD setting (fc ± SD)		**Trivial setting** (fc ± SD)	
Pakerhat union	0.24±0.430		0.5±0.501	
Khanshama upazila	0.27±0.445		0.53±0.500	
Dinajpur Sadar	0.3± 0.331		0.72± 0.449	

3.1 PD versus Trivial

These settings reflect the manipulation of dilemma strength in the PD and Trivial scenarios and provide a basis for understanding how different levels of dilemma strength impact participants' decision-making in these games. In the PD (Prisoner's Dilemma Table 2-1, Table 2-2, Table 2-3,Table 2-4) setting, the dilemma strength (D_g) is equal to the original dilemma strength (D_r). This means that in the PD setting, the dilemma strength is 5(Table 2-1), 5(Table 2-2), 1(Table 2-3), and1(Table 2-4) in Table 3. In the Trivial setting(Table 2-5, Table 2-6, Table 2-7, and Table 2-8 questions), the dilemma strength (D_g) is equal to the original dilemma strength (D_r), and both are set at -3(Table 2-5), -1(Table 2-6), -1(Table 2-7), and -1(Table 2-8). in Table 3. This means that in the Trivial setting, the dilemma strength also remains unchanged but is significantly lower than in the PD setting. The values in parentheses represent the normalized dilemma strengths ($D_g^/$ and$D_r^/$). In the PD setting, both the normalized dilemma strengths ($D_g^/$ ($D_r^/$)) are set at 1(1) (Table 2-1), 5(5)(Table 2-2), 0.2(0.2)(Table 2-3), and 1(1) (Table 2-4), indicating a moderate level of normalized dilemma strength. In the Trivial setting, both the normalized dilemma strengths ($D_g^/$ ($D_r^/$)) are set at-0.75(-0.75) (Table 2-5), -0.5(-0.5)(Table 2-6), -0.75(-0.75)(Table 2-7), and -0.33(-0.33)(Table 2-8) questions which suggests a much lower level of normalized dilemma

strength. Insights into how the level of cooperation among children is affected by the dilemma strength in both the Prisoner's Dilemma (PD) and Trivial games are provided by the results presented in Table 3. This assumption contributes to the exploration of the impact of different dilemma strengths on children's cooperation/defection behavior and how such behavior varies between the two games, PD and Trivial. The results provide an insight on the interplay between dilemma characteristics and children's decision-making processes, providing valuable insights into their behavior in strategic situations.

The observed cooperation fractions are approximately 0.24 in PD regarding Pakerhat union and notably higher but not perfectly cooperative in Trivial (0.5), again approximately 0.27 in PD regarding Khanshama upazila and notably higher but not perfectly cooperative in Trivial (0.53), and once again approximately 0.3 in PD regarding Dinajpur Sadar and notably higher but not perfectly cooperative in Trivial (0.72)in Table 3, deviate from the idealized predictions of evolutionary game theory. Ideal conditions of perfect cooperation or non-cooperation in PD are not always met when studying children due to real-world complexities. Children's decision-making is influenced by social environments, emotions, and personal experiences. These differences emphasize how the specific game context impacts children's cooperative behavior and their ability to adapt to different scenarios, shedding light on their cognitive development and decision-making processes which provide implications for education and child psychology. Based on the data regarding Table 3, Dinajpur Sadar emerges as the best area for fostering children's fundamental instincts. It shows the highest values in both the PD setting (0.3 ± 0.331) and the Trivial setting (0.72 ± 0.449) compared to the other areas. These higher mean values suggest stronger performance and engagement in both assessed contexts. The lower standard deviation in the PD setting also indicates more consistency among the students in this area. In contrast, Pakerhat Union and Khanshama Upazila exhibit lower mean values and higher variability, reflecting weaker and less consistent outcomes. The superior performance in Dinajpur Sadar may be attributed to better educational resources, supportive environments, or effective teaching practices which make Dinajpur Sadar a more conducive area for developing children's instincts.

4. Statistical Analysis

Following to the previous discussions this section provides a detail analysis of statistical tests [38]. Statistical analysis is an essential tool in research and data-driven decision-making across various fields, including science, social sciences, economics, business, healthcare etc. Because the ability to extract meaningful insights from data, make informed decisions, and draw reliable [39].This analysis will provide a deeper understanding of the test's methodology and its implications. Based on the provided data regarding Table 4 with respect to the dependent of Prisoners dilemma, Pakerhat appears to be the most favorable area. While none of the areas show a significant

impact of "age" or "boy-girl ratio" on outcomes the factor "education" in Pakerhat has a borderline significance level (Sig. = 0.073), indicating an influence in outcomes more effectively compared to Khanshama upazila (Sig. = 0.394) and Dinajpur Sadar (Sig. = 0.999). The positive B-value (1.536) for education in Pakerhat union further highlights its potential contribution to better results, compared to the weaker influence in Khanshama and the lack of impact in Dinajpur. In contrast, Khanshama upazila and Dinajpur have much less promising results, with education showing little to no impact on outcomes. Particularly Dinajpur Sadar has an extremely high Sig. value (0.999) for education and a negative B-value (-18.918), suggesting no meaningful influence. This makes Pakerhat stand out as the area with the greatest potential for leveraging education to improve outcomes, despite the lack of strong statistical significance in other factors.

Based on the data regarding Table 5 with respect to the dependent of trivial case, Khanshama upazila appears to be the most favorable area for the factors affecting the dependent variable (Trivial game). Among the three locations, the boy-girl factor in Khanshama upazila shows statistical significance (Sig. = 0.001), with a strong positive B-value (2.009), indicating a meaningful impact on outcomes. This contrasts sharply with Pakerhat union (Sig. = 0.924) and Dinajpur Sadar (Sig. = 0.796), where boy-girl ratios have no significant effect. For the other factors, age and education do not show significant effects in any area, as their Sig. values are above 0.05. While education in Dinajpur Sadar has an exceptionally high B-value (18.142), its Sig. value (.999) confirms that the result is not statistically meaningful. Similarly, the age factor is insignificant across all three areas.

Table 4: Represents the factors affecting [dependent as Prisoner's dilemma]: Age, Education, and Gender regarding Pakerhat union, Khanshama upazila, and Dinajpur Sadar.

	Pakerhat union			**Khanshama upazila**			**Dinajpur Sadar**		
	B	Wald	Sig.	B	Wald	Sig.	B	Wald	Sig.
Age	-0.670	2.020	0.155	-0.192	0.194	0.659	-0.158	0.120	0.729
Education	1.536	3.211	0.073	0.490	0.726	0.394	-18.918	0.000	0.999
Boy-girl	-0.134	0.044	0.834	-0.102	0.035	0.851	0.675	0.749	0.387

Table 5: Showing factors affecting [dependent as Trivial game]: Age, Education, and Gender regarding Pakerhat union, Khanshama upazila, and Dinajpur Sadar.

	Pakerhat			Khanshama Sadar			Dinajpur Sadar		
	B	Wald	Sig.	B	Wald	Sig.	B	Wald	Sig.
Age	-0.141	0.122	0.727	0.303	0.423	0.515	0.400	0.536	0.464
Education	0.987	1.770	0.183	-0.956	2.573	0.109	18.142	0.000	0.999
Boy-girl	0.060	0.009	0.924	2.009	11.889	0.001	-0.265	0.067	0.796

Based on the comparative analysis in Table 6, Dinajpur Sadar stands out as the best area for examining the effects of games, education, age, and gender. For pair1 (PD vs. TR game), Dinajpur Sadar exhibits the most significant difference with the highest t-value (-18.254), indicating a stronger distinction between the two game types compared to Pakerhat union (-7.079) and Khanshama upazila (-6.339).For pair3 (Education vs. Gender), Dinajpur Sadar again shows the largest t-value (145.784), suggesting education and gender effects are most distinctly observed in this area. While pair2 (Age vs. Education) and pair4 (Gender vs. Age) exhibit consistent differences across all areas, Dinajpur Sadar maintains high t-values, reinforcing its robustness in terms of differentiation. The consistently strong and significant distinctions in Dinajpur Sadar make it the best area for investigating these parameters. The significant differences likely reflect a well-defined variation in how these factors influence outcomes, making Dinajpur Sadar an ideal area for further research or interventions.

Table 6: Showing a Comparative Analysis of Games, Education, Age, and Gender Effects.

		Pakerhat union		Khanshama upazila		Dinajpur sadar	
	Game parameters comparison	t	Sig.(2.Tailed)	t	Sig.(2.Tailed)	t	Sig.(2.Tailed)
Pair 1	PD (Prisoner's dilemma) vs	-7.079	0.000	-6.339	0 .000	-18.254	0 .000

	TR(Trivial) game						
pair 2	Age vs Education	67.623	0.000	62.990	0.000	66.441	0.000
pair 3	Education vs Gender(boy-girl)	101.325	0.000	103.012	0.000	145.784	0.000
pair 4	Gender (boy-girl) vs Age	-111.292	0.000	-128.339	0.000	-122.232	0.000

5. Conclusion

The study explored how dilemma strength influences children's cooperation and decision-making in Prisoner's Dilemma (PD) and Trivial game scenarios across different regions of Dinajpur district of Bangladesh such as Pakerhat Union, Khansama Upazila, and Dinajpur Sadar using an evolutionary 2 ×2 game theory. This research aimed to explore if children can accurately identify social dilemmas. A questionnaire survey, focusing on the four game classes (Prisoner's dilemma ($D_g > 0$ & $D_r > 0$), and Trivial ($D_g < 0$ &$D_r < 0$)), was designed for children to understand their cognitive capacities in perceiving and comprehending social dilemmas. Regarding PD and Trivial setting, Dinajpur Sadar demonstrates the highest cooperation in both PD (0.3) and Trivial (0.72) settings, suggesting a stronger engagement and more consistent behavior compared to Pakerhat and Khanshama Upazila. The differences in cooperation levels highlight the influence of the game context, social environment, and educational factors on children's decision-making. Dinajpur Sadar's superior performance may be attributed to better educational resources and supportive environments, making it the best area for fostering children's fundamental instincts.

The statistical analysis of the data reveals key insights into the factors influencing children's behavior in the Prisoner's Dilemma and Trivial game scenarios. In the Prisoner's Dilemma, Pakerhat shows the most promising results, with education having a borderline significance, suggesting its potential to positively influence outcomes. The education factor in Khanshama and Dinajpur Sadar has a weaker impact, with the results in Dinajpur Sadar showing no meaningful influence at all. In the Trivial game, Khanshama stands out due to the significant effect of the boy-girl ratio, which positively impacts the outcomes, unlike in Pakerhat and Dinajpur Sadar, where it shows no significant effect. Overall, while education plays a crucial role in Pakerhat for the Prisoner's Dilemma, Khanshama demonstrates a stronger influence from gender factors in the Trivial game.

Dinajpur Sadar stands out as the most suitable area for studying the effects of games, education, age, and gender, based on the comparative analysis. It shows the strongest

distinction between the PD and TR games, highlighting a clear difference between the two game types. Additionally, the area demonstrates the most pronounced effects of education and gender, suggesting these factors play a significant role in this region. While differences in age and education, as well as gender and age, are consistent across all areas, Dinajpur Sadar consistently exhibits the most notable variations. These consistent and significant distinctions make Dinajpur Sadar the ideal location for further research and potential interventions.

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Conflicts of Interest

The authors declare that there is no conflict of interest regarding the publication of this paper.

Acknowledgement

Funding: This work was supported by the Jatiya Kabi Kazi Nazrul Islam University under Research and Extension Center for the fiscal year of 2023-2024.

Appendix

The sessions were based on the PD and Trivial game, lasting approximately 50-60 minutes, including participant rewards, which were provided in the form of snacks for each game.

Instructions for the experiment with the children

The main instructions provided here are specifically tailored to the psychology of children in primary schools located in khanshama upazila, Dinajpur, Bangladesh. The playing procedure, rules, and regulations of the game are thoroughly explained to the participants before the game begins. In the game, there are two participants referred to as "you" and their counterpart as "friend.

Hi, I am [Experimenter's name]. May I know your name? [ask each child]

I've brought you some games to play. Would you like to engage in some gaming?

A1.1 Prisoners Dilemma (PD) game

Game theory is the process of modelling a strategic interaction between two or more players in a situation containing set rules and outcomes. Suppose a situation where you are playing a game with your opponent. The game may bring you a reward or may bring a loss to you as well as to your opponent. In the table, red colour is for your value i.e. you (A, B) and black colour is for your opponent value i.e. your friend (C, D). See the Table 2-1.

- If both of you and your friend take A and C then you and your friend are given5$ each as reward i. e (You A, Your friend C) = (5, 5).
- If you take A but your friend takes B, you are given -5$ (i.e , lost 5$), while your friend is given 10$ i.e. (You A, friend D) = (-5, 10).
- Inversely, if you take B but your friend takes C, you are given 10$, while your friend is given-5$ i.e. (You B, Opponent C) = (10, -5).
- If both of you take B, nothing is given to both of you i.e. (0, 0).

Let your game-opponent be selected from your friend. Thus, you possibly play games with the same opponent several times in your future. In this context, now you are humbly asked whether offer A or B would be chosen by yourself by considering the tables. **Please think about your benefit, not yours opponent**. The same scenario with different values for the question, Table 2-1.

[Visit child #1, The scenarios were explained to the primary children first, and then they were asked.]

Areyou prepared? Alright, now you can choose.

[Go to child #1, ask:]What do you think regarding this situation in terms of your benefit?[Note answer Child #1]

[Go back to child #2, ask:]What do you think regarding this situation in terms of your benefit? [Note answer Child #2]

Then go for the next child and one after another.[record the answers]

Same as for the **Trivial game.**