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Formidability and Aggressive Responses to Public Criticism Between Sex in Adolescents: An Evolutionary Approach

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Abstract. This study focuses on whether sex differences in adolescents' reactions to a teacher's public critical feedback can be explained by formidability within an evolutionary bargaining framework. The paper proposes that public criticism lowers the target's perceived Welfare Tradeoff Ratio (WTR), creating a social evaluative threat that elicits either shame (accepting lower status) or anger (pressuring others to raise their WTR). Boys on average, have higher formidability, so the prediction is that there will be many direct aggressive responses among boys and a positive link between boys' formidability and aggression. Girls, in contrast, should show lower direct aggression and little or no association between formidability and aggression. The study will use a classroom simulation with actor-teachers and students, self-reports of anger and cooperation, behavioral coding of verbal and nonverbal defiance, and pinch meter with self-ratings as formidability measures. Some alternative accounts (e.g., gender role theory) will be discussed, such as institutional constraints that may mute physical bargaining power in schools, and implications for feedback practices that protect students' status while maintaining classroom order.

Keywords: formidability, public criticism, welfare tradeoff ratio (WTR), adolescent aggression, sex differences

1. Introduction

Classroom interactions often include moments of evaluation. Specifically, giving public critical feedback which is when teachers openly point out a student's mistakes, shortcomings, or bad performance in front of peers represents one of the social interaction experiences for adolescents. Such feedback not only signals students' academic deficiency but also challenges the individual's social standing within the peer group. A common observation in public educational settings is that when faced with public criticism from teachers, boys tend to show more aggressive responses, such as verbal confrontation, provocative behaviors, or emotional resistance, than girls, while girls are more likely to withdraw or rely on indirect strategies [1]. This area is worth exploring because it might help to improve the education of adolescents through strategies that acknowledge sex differences.

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Previous studies documented the consequences of teacher feedback for student-teacher relationships, showing that person-oriented criticism, which is the feedback targeting the individual rather than the process, tends to undermine students' perceptions of teacher support and harm motivation [2]. Work in developmental and social psychology also documents reliable sex differences in aggressive behavior. Males more often engage in direct physical or verbal aggression, whereas females favor indirect or relational strategies such as exclusion or gossip [1,3,4]. These prior perspectives largely emphasize such sex differences in a broad social context, but they are not specifically focused on the adolescent group and the social context they most frequently encounter in their daily lives, which is the classroom. This study introduces the Welfare Tradeoff Ratio (WTR) theory of evolutionary psychology and proposes that this specific sex difference observed in adolescents is essentially an expression of adaptive behavioral strategies formed through human evolution under different formidability between sex.

Evolutionary psychology provides a framework by linking aggressive responses to bargaining strategies over social value. Welfare Tradeoff Ratio (WTR) refers to the extent to which a person values the well-being of others when interacting with them, or the degree of weight to which they are willing to trade their own interests for those of others [5]. Signal that public criticism conveys to an individual can be understood as that the other does not value the feelings or disrespect the social values of it, and implies "you are not important" or "your dignity means nothing to me, and it does not need to be protected". Unlike private criticisms, public criticisms imply that not only is the teacher dissatisfied with the individual, but also other students in the classroom should be opposed to the behavior, keep away from the person who does it, and even feel ashamed of it. This information is equal to the other, giving a lower WTR to the individual. Even without directly depriving the benefits, words and scenes have already expressed a low level of respect for the individual. Social evaluative threat (SET) points out that when an individual is placed in a situation that may trigger negative judgments from others, it activates the psychological defense system of the self-as-social entity. It triggers responses of shame, anxiety, or anger [6,7].

In response to reduced social valuation or a social-evaluative threat, two distinct strategies may be used by human. The first one is shame, which means recalibrating one's expectations of others' WTR by accepting lowered status or treatment [8], and the other one is anger, functioning to recalibrate others' WTR by threatening or imposing costs on others [9].

The decision of whether anger will be shown as direct aggression depends on formidability, which is an individual's potential ability to impose costs, such as harm threats, on others based on their physical strength and combat capabilities. Individuals with greater physical strength can make threats that are more believable, thereby increasing the possibility of using direct aggression [9,10]. Since males on average possess higher formidability than females, their aggressive responses to public criticism may reflect an adaptive bargaining strategy shaped by evolutionary pressures on status competition. By contrast, females are more likely to use shame expressing or indirect strategies, and formidability will be less related to direct aggression among females.

These tendencies can be explained by Parental Investment Theory as well. Females' evolutionary success or fitness depended more on sustained social support and high parental investment, so they faced strong reproductive pressures of avoiding severe physical harm. According to Campbell's study [3], women are more likely to rely on indirect aggression strategies as direct aggression carries higher costs for their survival and offspring care.

Building on previous insights, the paper will apply the WTR and formidability framework to the school-based context. The study aims to test whether sex differences in adolescents' responses to public teacher criticism can be explained through differences in formidability. Specifically, in the

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scenario of students' reactions to public negative feedback from teachers, the predictions are that first, male and female students will differ in their responses to public negative feedback from teachers. Secondly, among male students, formidability shows a strong relationship with aggressive response, and lastly, among female students, formidability shows no significant relationship with aggressive response.

2. Methodology

A total of 200 adolescents (100 boys, 100 girls), aged 13–16, will be recruited from local middle and high schools. Participants will be recruited in cohorts of 6–8 per session. Written parental consent and adolescent assent will be obtained. Exclusion criteria include a history of severe emotional disorders or disciplinary actions that could bias responses to criticism.

It will be a simulation-based design where each participant will have a typical simulated class experience where a trained actor acting as a teacher provides public critical feedback to the participant in front of their peers. Its objective is to determine whether greater formidability is correlated with greater aggressive response in male respondents while no such relationship is anticipated for female respondents.

There will be 24-28 student actors and a teacher actor per session. Real participants, 6-8 teenagers per session, are part of the group without prior notice about which peers are acting. The teacher then will teach a typical 15-minute lesson before selecting certain participants for public feedbacks. These feedbacks will be harsh, based on a lack of effort or disruption behavior-wise but not involving any personal insults or humiliating comments.

After class participation, individuals will be brought in one at a time to a different room for self-reporting measures of cooperation and emotion as well as physical strength testing. Formidability will be measured with a grip-strength dynamometer and a self-rating questionary including items such as ("Compared with peers of my age, I am physically strong") on a 7-point rating. Self-rated anger and hostility after the scene will be measured on a 7-point scale as well, with items such as (e.g., "I felt angry," "I wanted to argue back"). Willingness for future cooperation will be measured by a scale that has items such as (e.g., "I would like to cooperate with this teacher again"), reverse coded as a proxy for perceived WTR calibration. The scene will also be fully recorded through the process and the video recording will be coded by blind raters for any verbal defiance (e.g., arguing, interrupting), nonverbal hostility (e.g., eye-rolling, slamming materials), and other forms of withdrawal from cooperation.

Independent-samples t-tests will compare girls versus boys on aggression outcomes in response to public criticism. Simple linear regression within each sex will determine whether formidability (grip power + self-rating) is a predictor for aggression outcomes.

Public critique scripts should have enough solidity to reflect low valuation but still be free of insults or discriminatory tones. Participants shall receive immediate debriefing where scripted nature of the scenario shall be clearly explained. On-site qualified counselors shall be available. Data confidentiality shall be assured by anonymization techniques as well as proper storage security practices.

3. Expected results

Male participants are expected to show higher levels of hostility and anger compared to female participants after the public criticism. Video analysis observations should show that boys are more

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likely to show verbal opposition and nonverbally displayed aggressions. Female participants should show a lower likelihood for direct aggression and may respond with withdrawal or silence.

For males in general, a positive relationship is predicted between formidability and aggression outcomes. Males higher grip strength and self-estimated physical strength are likely to report higher angry feelings, showing a greater number of defiant behaviors, and show less desire for future cooperation with the teacher. Such a trend implies an increased formidability would lower costs for conflict initiation so making aggressive responses a more credible signal which would act as an adaptive adjustment mechanism.

Among females, formidability would not correlate with aggression. Even female with high physical power would be expected to respond with averagely low angry affect and will not show great aggressive behaviors, consistent with evolutionary accounts which prioritize relationship preservation as a factor in female's solution for their adaptive problems.

If the study does not observe the expected results, there may be some explanations to it. There may not be a relationship between formidability and aggressive responses in male participants, which implies that even males with low formidability can display a high level of aggressiveness. If male students do not exhibit the expected high level of aggressive behavior, this may indicate that high formidability is not as important in classroom settings as it is in the broader social or evolutionary context. Teachers often hold institutional power backed by school policies, which basically limits the effectiveness of physical strength. A strong adolescent cannot "win" against a teacher in the same way they could against a peer outside the classroom. The failure of prediction may imply that institutional factors in modern school education, such as the authority of teachers and social norms against confrontation, may override the mechanism of human adaptation. Schools strongly discourage public aggression and students who display defiance will take risks of disciplinary actions, which imposes high costs that may outweigh the benefits of showing strength. Further, formidability may not be the only factor in predicting boys' aggressiveness. Other factors such as status among peers, number of friends, or self-esteem may also play great roles in shaping boys' responses to public criticism than physical strength [11].

If female students with higher formidability do show aggressive behaviors after being criticized, this result will also challenge the predictions of female responses. The possible explanation could be that formidability in fact affects girls' behavior more directly than expected. Also, a typical middle school classroom is where people are not fully grown, which means that the formidability of students across sex is quite similar, the significant difference of physical strength between sex has not been shown yet in their age. The cultural norms that don't encourage women to be more aggressive may be weakening and allow physically stronger girls to express their anger more openly in society nowadays. This might indicate that when the social environment magnifies competitive pressure, direct aggression may also occur in women. Therefore, this result may suggest that the mechanisms of anger and recalibration are more sex-similar rather than sex-differentiated, and the differences in aggressive expression are more regulated by cultural coercion rather than evolutionary sex-specific strategies.

4. Discussion

This study applied the WTR theory to examine sex differences in students' aggressive responses to public criticism, proposing that males' higher formidability drives their stronger anger reactions as an evolved bargaining strategy. According to the predictions, boys are highly likely to show significantly higher levels of aggression after being publicly criticized, especially those with stronger upper-body strength.

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When negative information is openly conveyed, the social status of the criticized person will be diminished; that is, the WTR will significantly decrease. The individual may not be able to restore social value through strategies such as withdrawal, compliance, or cooperation. At this point, aggressive behavior may become an alternative means to negotiate social interests [8]. Moreover, when an individual has a higher capacity to impose costs, it implies that the retaliatory costs they might face in aggressive behavior are relatively lower, and thus they may be more inclined to launch attacks frequently [12]. Thus, stronger individuals are more prone to be angry because their threats or cooperative signals carry greater effects, enabling them to force concessions more effectively.

In educational settings, a teacher's public criticism can be interpreted as a functional response to a student's low WTR behavior. Rather than merely serving as punishment, it acts as a costly social signal that threatens the student's reputation and social standing among peers. Its evolutionary function is to penalize uncooperative behavior, raise the costs of maintaining a low WTR, and initiate a renegotiation of relational expectations. Crucially, it is the perceived devaluation of one's welfare, not merely the immediate harm, that triggers anger. The resulting aggression can be viewed as a strategic attempt to compel the other party to recalibrate their WTR [13].

Furthermore, as proposed by Sell, Tooby & Cosmides [13], individuals with high formidability are not inherently more aggressive but have evolved to leverage their physical advantages as part of a social bargaining strategy. Because greater strength reduces the anticipated costs of conflict and increases the likelihood of success, highly formidable individuals are more inclined to use aggressive threats to extract concessions. This helps explain why boys, especially those with high formidability, tend to respond to critical feedback from teachers with stronger and more intense aggressive behavior. As a result, aggressive behaviors are more pronounced in men than in women.

The Parental Investment Theory provides an ultimate explanation for this sex difference from a fundamental evolutionary perspective. Due to the significant asymmetry in reproductive investment between the two sexes (with females investing extremely high and males extremely low), females, have evolved a strong risk-averse tendency to avoid high-risk aggressive behaviors that could endanger their survival and reproduction; males, on the other hand, must outcompete their peers to gain mating opportunities, and thus natural selection has shaped their higher aggression and risk-taking tendencies as a strategy to enhance reproductive fitness [14].

While the evolutionary perspective offers a powerful explanation, the sex difference in aggression is not a simple, absolute biological determinism. Its significance and manifestation are significantly modulated by social and cultural factors, and this study also has many limitations. A crucial alternative explanation comes from the Social Role Theory. Classic experiments have shown that in deindividuated (eliminating social role identity) situations, the level of aggressive behavior in females is comparable to or even higher than that in males, but their self-assessment is still significantly lower than that of males; while in normal social role salient situations, the difference becomes significant [15]. This profoundly reveals that the observed behavioral differences largely stem from the internalization of social norms and gender expectations that the society encourages and even expects men to display aggression as a manifestation of ability and dominance, while it requires women to be affable, compliant, and suppress aggression, otherwise they will face negative social evaluations such as "unfriendly" and "cold". This powerful social script systematically shapes the behavioral patterns and self-perceptions of different sexes, and its influence may be strong enough to mask or modify potential evolutionary tendencies. This is why girls tend to exhibit less aggressive behavior.

However, from the evolutionary psychology perspective of the Welfare Tradeoff Ratio (WTR), the teacher-student relationship may still maintain extremely high stability when facing public

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criticism due to its unique deep computational logic. WTR does not measure short-term emotions or single events but is a cognitive parameter that represents the weight of long-term relationships. The uniqueness of the teacher-student relationship lies in that its WTR is built on an evolutionary template of “asymmetric investment-return”. Teachers invest high costs such as knowledge, energy, and care to obtain delayed and diffused returns from students' growth, such as reputation inheritance and cultural adaptability. This mechanism makes the brain prioritize interpreting “public criticism” as an expensive commitment signal - the teacher's willingness to bear emotional costs and reputation risks to correct the student strongly indicates his high regard for the student's long-term welfare (i.e., the authenticity of high WTR), rather than a conflict of interest or malicious attack.

Although evolutionary theories such as the parental investment theory usually predict that women have lower direct aggression, it does not rule out that some girls may show aggression comparable to boys when facing public criticism. This finding can be strongly explained by the precise framework proposed by Campbell [3]. Campbell argues that women's aggression is not non-existent but mainly situational and relational, functioning to protect valuable resources and social status when threatened [3]. In the classroom environment, a teacher's public criticism constitutes a direct and serious threat to a key female resource, which is social reputation and relationship capital. For adolescents who prioritize peer status, being publicly humiliated by an authority figure can severely damage their social status, potentially leading to exclusion, loss of allies, and a perceived decline in partner value. According to Campbell's model [3], when facing such a high-risk threat to resources, the potential cost of not responding (permanent loss of status and influence) may outweigh the risk of an aggressive response. Therefore, when facing a teacher's public critical feedback, some girls may exhibit the same aggressive behavior as boys.

5. Limitations

First, the sample is limited to a specific age group and cultural background, raising doubts about its generalizability. Second, the simulation degree of the experimental situation is different from the real and complex classroom ecology, and individual variables such as personality traits were not fully controlled, which affected the external validity. Third, the measurement methods relying on self-reports and behavioral observations are susceptible to social expectation bias and subjective judgment and using “upper limb strength” as a proxy indicator of deterrence fails to cover multiple dimensions such as social influence. Fourth, the theoretical framework has not completely excluded competing explanations, such as socialized gender roles and lacks control over third-party variables, such as hormone levels. Finally, due to research ethics, it is impossible to trigger high-intensity conflicts, which may systematically underestimate the intensity of responses, and there is a lack of long-term tracking. Therefore, aggressive behavior is the product of the complex interaction between biological evolutionary predispositions and social and cultural construction. The conclusions of this study should be understood within this composite framework, and its explanatory power has clear boundaries and contexts.

6. Conclusion

The proposed study focuses on investigating the strategy of bargaining on the social value by aggressive behaviors of adolescents to public criticism of their teachers and how this bargaining is affected by the sex difference of formidability. The first prediction of the study is that physically stronger males react more aggressively toward criticism, and the second prediction is that girls would not show a clear relationship between formidability and aggressiveness, as they tend toward

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withdrawal and compliance. To measure feelings and monitor reactions and WTR recalibrations after the criticism of teachers, this study could reveal whether formidability is considered a factor affecting the behavior of adolescents after being publicly criticized in different sex. Regarding the potential implications of the proposed study, the expected result of the study could offer guidance on the conditions under which criticism should remain restricted and safer regarding criticism given through individual consultation, while preserving the social value of students together with maintaining the constraints set by teachers. Some of the variables that could be considered that could affect the result of the study and should therefore be considered in the subsequent study could include status among peers, disciplinary norms at schools, gender roles and social norms.

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