IPA
International Journal of Psychology
Vol. 11, No. 1, Winter & Spring 2017
PP. 28-52

Iranian **P**sychological
Association

The Interactive Effects of Attributional Style and Experience of Failure on Children's Subsequent Mathematical Word Problem Solving

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Received: 22/ 7/ 2014 Revised :13/ 9/ 2016 Accepted: 22/ 9/ 2016

The reformulated learned helplessness theory predicts that the attributional style interacts with negative academic events, and results in performance deficits in future tasks. The aim of the present study was to evaluate the effects of experiences of failure on mathematical word problem solving performance and the moderating effect of the attributional style among students. The study was conducted on 80 female sixth grade students, 40 were chosen to test the most optimistic attributional style and 40 to have the most pessimistic, based on their scores in the attributional style questionnaire (ASQ). Employing a 2 × 2 factorial design with factors of attributional style (optimistic vs. pessimistic) and experience of failure (failure vs. success), half of the participants solved easy and the other half solved hard mathematical word problems in the first stage of the experiment. In the second stage, participants of all groups solved the same set of medium problems

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at the same time. The two-way ANOVA showed significant effects of the attributional style and experience of previous failure. Moreover, among those students who failed in the first step, students with optimistic attributional styles outperformed those with pessimistic attributional styles. It appears that individuals who experience failures in a specific domain are vulnerable to future failures, and having an optimistic attributional style results in higher performance in solving problems. The most striking result to emerge from the data is that performance outcomes are more likely to be a function of how we explain and respond to failures as opposed to being based on our explanations for success.

Keywords: attributional style, failure, problem-solving performance, learned helplessness,

Each year, a considerable amount of human and economic resources isbeing wasted due to the academic failure of students in different educational courses. These educational failures can lead to reduce the motivation of students and thus to ignore their abilities (Catheline, 2005). Recent formulations of academic failure emphasize the possible role of mis-attributional processes and dysfunctional problem solving in the onset and the preservation of academic anxiety and avoidance.

The concept of attributional style or explanatory style (Peterson, Seligman, & Vaillant, 1988) has been used to differentiate the types of reasons individuals consistently provide for a certain event. These attempts to understand the causes of events are the most important sources of human motivations and are the main principle for mastery. An individual's attributional style is useful in explaining why some individuals who are exposed to failedevents, which may include repeated failures over a period of time, develop negative psychological symptoms, such as depression, and others do not (Yee, Pierce, Ptacek, & Modzelesky, 2003). The attributional

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style has implications for many areas of daily life; it has been linked to suicide prevention (Kleiman, Miller, & Riskind, 2012), athletic performance (Gordon, 2008), psychological health (Sanjuán, Pérez, Rueda, & Ruiz, 2008), performance in an employment setting (Proudfoot, Corr, Guest, & Dunn, 2009), and academic performance (Bridges, 2001). The study of attribution in the educational field has also received a considerable amount of attention. In the classroom, the understanding students have of the causes of past events influences their ability to control what happens to them in the future.

Peterson and Barrett (1987) reported the first systematic study of attributional style in academic settings; they measured the explanatory style of 87 university students at the beginning of their first year in school. Students who explained bad academic events with internal, stable, and global causes received lower grades during their first year than did students who used external, unstable, and specific causes. This pattern held even when the initial ability and initial depression were held constant. Secondary analyses showed that students with a pessimistic (or helpless) explanatory style were less likely to have specific academic goals and less likely to make use of academic advice.

However, the results of the subsequent research has been inconsistent. On the one hand, some studies indicate that students with helpless attributional styles have lower academic achievement than do students with adaptive attributional styles. On the other hand, there are studies, which found that students with helpless attributional styles have higher academic performance.

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Some research corroborated the link between a pessimistic explanatory style and academic achievement (Henry, Martinko, & Pierce, 1994). Later research investigating academic performance found little support for the earlier findings and there is evidence of a reverse effect. Some researchers found that students who attributed failure to stable and global causes (helpless attributional style) performed well on academic tasks. Yee et.al (2003) examined the relationship between a helpless attributional style and examination performance over the semester, and whether prior examination failure moderated this association. Correlational analyses revealed that a helpless attributional style was unrelated to exam performance in the first half of the semester; however, in the second half, there was a positive relation between improvements in performance and helpless attributions. Regression analyses indicated that these enhancement effects were not moderated by previous performance on examinations in the course.

Rowe and Lockhart (2005) investigated whether attributional style would predict grades of predominantly Hispanic college students. The Extended Attributional Style Questionnaire, EASQ subscales "*generality*", *"consequences"*, and "*self"*correlated negatively with final course grades. However, the *"internal"* subscale didnot significantly correlate with grades. These results characterize students who achieve lower academic performance as having a more pessimistic attributional style.

Attribution theory hypothesizes that the causal attributions individuals make about aversive events predict their vulnerability to learned helplessness. Abramson, Seligman and Teasdale (1978) introduced an adaptation of the helplessness

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theory that gave causal attributions a key role. According to this reformulation, when individuals confront aversive events that are perceived as uncontrollable, they try to find explanations. The way in which they explain the events will cause learned helplessness and influence how they react to these events. Motivational deficits linked with learned helplessness include task withdrawal or avoidance. Emotional deficits connected with learned helplessness consist of sadness, fear, frustration, anxiety, and depression. The logic of this theory proposes that the helpless person possesses an attributional style concerning a tendency to attribute negative events to internal, global and stable factors. When individuals with this style encounterexperiences of failure, they attribute a particular event to an internal, stable and global cause and as a result are more likely to develop learned helplessness accompanied by lowered self-esteem.

The reformulated learned helplessness theory predicts that the attributional style interacts with negative academic events (failure), and results in performance deficit in future tasks. In other words, a pessimistic attributional style will increase the risk of a helpless reaction only if students experience a failure. This implication of the theory has received very little research focus in the area of academic performance. As such, it is predicted that performance deficits will be observed following anexperience of failure in students who possess a pessimistic attributional style.

The fact that the helpless attributional style has both positive and negative relationships with performance after failure across academic, athletic, and work settings (Yee et al., 2003) poses the question that whether, in fact, individuals with a helpless

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attributional style are necessarily inclined to experience more failure as compared to those who do not possess such a style. As literature implies, it is clear that the attributional style can affect students'overall academic performance. Nevertheless, what is yet to be determined is whether the attributional style and experience of failure are effective predictors of problem solving performance. Since many students struggle with mathematics and given the importance of mathematics for students' future lives, the aim of the present study was to evaluate the effect of experiences of failure on mathematical word problem solving performance and the moderating effect of the attributional style among students. In addition, we examined whether students with a helpless attributional style were more likely to experience failure in subsequent performances regardless of the previous record of failure.

Method

Participants

The study was conducted on eighty female sixth grade students in Tehran in the 2012-2013 school year. These students were selected from a larger sample of 120 students based on scoring in the extreme ranges of the attributional style questionnaire (ASQ) to maximize variation in the attributional style. Forty students were selected to have the most optimistic attributional style and 40 to have the most pessimistic attributional style. There was no significant difference between the groups with respect to their math scores in school. Inclusion Criteria: the students had to be between the ages of 11 and 13 and in sixth grade within the district of Tehran and present at

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school. Exclusionary criteria included: any previous academic failure disqualifying a student from participating in the study.

Instruments

Two assessment tools were employed: attributional style questionnaire (ASQ), and mathematical word problems.

Attributional Style Questionnaire (ASQ). As mentioned above, the attributional style questionnaire (ASQ) (Rodríguez-Naranjo & Caño, 2010) was completed by all participants to subcategorize them into different levels of attributional style. The questionnaire consisted of 12 hypothetical situations, six positive and six negative. Participants were asked to vividly imaginethe event happening to them and to fill in the most likely cause of the situation. They were then asked to rate the cause they offered, on a seven point Likert scale, for internal (7) vs. external (1), stable (7) vs. unstable (1), and global (7) vs. specific (1). These three characteristics were assessed separately for negative and positive events. This measure yielded two sets of scores: composite optimistic attributional style and composite pessimistic attributional style. The composite attributional style was the composite score for the six positive or negative events, summing up internal, stable and global dimensions. The score was higher to the extent that participants attributed events to more internal, stable, and global factors. Internal consistency (the Cronbach's coefficient α) for an Iranian sample was measured which ranged from .56 to .75 for different subscales of the questionnaire (Motamedi Sharek & Afrooz, 2007).

Mathematical word problems. The mathematical word problems protocol consisted of 45written problems, requiring

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paper and pencil calculations organized in three sets based on their levels of difficulty - easy, medium and challenging. (15easy, 15medium and 15 hard problems). Each set of problems was two pages long. Problems were typed in a fairly large, easy to read font and single-spaced with a considerable amount of white space between each problem. These problems were selected based on their previous 'difficulty Index' from a pool of potential problems gathered by three math teachers. Questions within each set were ordered by the difficulty of responses. The comparison of the "mean difficulty indices" of the three sets of problems confirmed the levels of their difficulty.

Design and Procedure

The present experimental study employed a 2 × 2 factorial design with the factors attributional style (optimistic vs. pessimistic) and experience of failure (failure vs. success). Participants in each group were randomly assigned to either a failure condition (to solve hard problems in the first stage of the study) or a success condition (to solve easy problems in the first stage of the study). Accordingly, the study sample included four subgroups each containing 20 students: optimistic attributional style students who had to solve easy problems, optimistic attributional style students who had to solve hard problems, pessimistic attributional style students who solve easy problems and pessimistic attributional style students who had to solve hard problems. Uniform written instructions were presented to all participants for the tasks.

In the first step of the experiment, participants of 'failure' conditions of both optimistic and pessimistic attributional styles,

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solved a hard set of problems, and members of 'success' conditions solved the easy problems. The difficulty level of the problems was so that all participants in failure conditions failed to solve any problem, and all participants in success conditions solved all problems. The tests were scored for accuracy of responses to the math problems. In the second stage, participants of all four groups solved the same set of medium problems at the same time.

Results

Descriptive Statistics

Means and standard deviations for composite optimistic and composite pessimistic attributional style scores, and scores of participants' performance in solving problems in the first and second stage of the experimentas dependent measures are presented in Table 1.

Attributional Style

In order to ensure that there is a significant difference between the scores of the attributional styles of students with optimistic and pessimistic attributional styles, composite optimistic and pessimistic scores of the two groups were compared using independent t-tests. Results showed a significant difference between the composite optimistic scores of optimistic (M= 2.48, SD= .78) and pessimistic (M= 5.84, SD= .47) attributional style students ($t= 23.21$, $p < .001$).There was also a significant difference between the composite pessimistic scores of optimistic (M= 3.76, SD= .86) and pessimistic (M= 5.60, SD= .66) attributional style students ($t= 10.67$, $p < .001$).

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Table 1
Means and SDs of Attributional Style and Problem Solving Scores across Conditions

Variable		Failure Condition		Success Condition	
		Mean	SD	Mean	SD
Attributional Style	Composite Optimistic	4.22	1.75	4.10	1.90
	Composite pessimistic	4.59	1.04	4.78	1.37
Problem solving performance	First stage	4.12	1.09	6.89	0.6
	Second Stage	3.90	1.60	4.97	1.70

Manipulation Check

With the purpose of ensuring that the manipulations of previous experiences of success and failure were successful, an independent t-test was conducted on the problem-solving performance of the failure group (those who solved hard problems) and the success group (those who solved easy problems) in the first stage of the experiment. The performance of the success group (M= 6.89, SD= .61) was significantly better than that of the failure group (M= 4.12, SD= 1.09) in solving mathematical word problems ($t= 14.28$, $p < .001$).

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Performance on the Medium Problems

Since both the attributional style and experience of failure are between subject factors in this study, a between subjects two-way ANOVA was employed to analyze the scores of participants in solving medium problems of the second stage. Homogeneity of variance was examined using Levene's test for equality of variances. No statistically significant differences between the two groups' variances were noted (Levene's Test for Homogeneity of Variances=1.88, p = .14).

The ANOVA showed a significant main effect of attributional styles for problem-solving performance (F(1, 76)= 5.94, p= .017, η^2= .07). The observed partial Eta squared (η^2) is considered a medium effect size when applying Cohen's (1988) criteria. Students with an optimistic attributional style (M= 3.88, SD= .67) outperformed those with pessimistic attributional styles (M= 3.88, SD= .67). The main effect of the experience of failure yielded a significant F ratio of F(1, 76) = 8.06, p< .001, η^2= .1, indicating that the mean problem-solving score was significantly higher in the success condition (M= 4.97, SD= 1.70) than in the failure condition (M= 3.90, SD= 1.61). Those students who faced success in the first step had higher levels of performance in the second step compared with those who faced failure in the first step. In other words, failure in problem

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solving can lead to a in the level of problem solving performance in future problems.

Table 2

ANOVA Examining Problem Solving Scores by Experience of Failure and Participant's Attributional Style

Source	Sum of Squares	df	Mean Square	F	Sig.
experience of failure	20.886	1	20.886	8.056	.006
attributional style	15.412	1	15.412	5.944	.017
attributional style * experience of failure	.313	1	.313	.121	.729
Error	197.049	76	2.593		
Total	1793.000	80			

The main interaction effect was non-significant, F(1, 76) = .12, p> .05.However, among those students who failed in the first step, students with optimistic attributional styles (M= 4.50, SD= .92)outperformed those with pessimistic attributional styles (M= 3.55, SD= 1 .92) in solving medium problems of the second stage (t= 2.06, p = .048). There was no significant difference betweenstudents with optimistic (M = 5.29, SD = 17 .93) and pessimistic (M= 4.44, SD= 1 .62) attributional styles who

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successfully solved theeasy problems of the first stage, in terms of their problem-solving performance in the second stage.

Discussion

Our objective in the present research was to highlight the importance of attributional styles in students' performance following failure. The present study shed light on the patterns of attributions and may increase the understanding of links between attribution and students' reaction to failure.

Three main findings emerged from this study. First, we could demonstrate that a history of success in problem solving was accompanied with higher levels of future problem-solving performance than with having previous failure in this performance. In other words,the students who had been exposed to failure displayed performance decrements on a subsequent task presented as being relevant to previous failure. This result lends support to the hypothesis that individuals who experience failures in a specific domains are vulnerable to future failures. The success and failure groups of the present study started out with different levels of task difficulty, and subsequently had different levels of initial task success. Based on the research literature, it was expected that the incidence of failure inmath problems would lead to learned helplessness and consequently to a decrease in subsequent problem-solving performance.When

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people experience learned helplessness, they have a tendency to give up easily or fail more often at somewhat easier tasks.

Learned helplessness is a conditioned responseto failure that creates cognitive, motivational, and emotional deficits. The motivational deficit stops learning by aborting the students' initiation of efforts. Students with learned helpless believe they have no control over the situation,and, after repeated failures, they give up trying because it costs too much to try. Mere exposure to failure is not sufficient to make the students helpless, but they come to expect that failure is inevitable. In other words, learned helplessness is more likely to result from situations where failure is uncontrollable. For example, Gernigon, Fleurance, and Reine (2000) conducted a study on failure in controlled and uncontrolled circumstances. They found that failure was more likely to occur in uncontrollable circumstances. According to Seligman's learned helplessness theory after individuals repeatedly face uncontrollable situations, encountering a controllable situation may result in failure again, because they expect another uncontrollable situation (Diener & Dweck, 1980; Oakes, 1982). In addition, in children with learned helpless there is cognitive debilitation and a decrease of logical perception and thinking. The emotional deficit leads to depression and lowered self-esteem. In the present study,as hypothesized, the group that underwent failure also had a significant decrease in math problem performance,

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similar to the previous literature on the relationship between failure and performance (e.g. Brunstein & Gollwitzer, 1996).

The second main finding is that students with optimistic attributional styles were more successful in further problem solving than those with pessimistic attributional styles. Regardless of the previous record of failure, having an optimistic attributional style results in higher performance in solving mathematical problems that has been similarly shown in other studies (Ciarrochi, Heaven, & Davies, 2007; Spence, Sheffield, & Donovan, 2002). The individuals with optimistic attributional style attribute their failures to external, instable, and specific factors, while they attribute their achievements to internal, stable, and general factors; these patterns are involved in almost all aspects of their life events. In fact, these students take this style in every difficult and stressful situation of life; thus, their self-esteem and self-efficacy remainintact.Therefore, they tend to have a better performance in any circumstance(Ralph & Mineka, 1998).

In contrast, those with pessimistic attributional styles usually attribute bad events to internal, global and stable, and good events to external, instable, and specific factors, leading to affected self-concept and self-efficacy and thus improper performance in future challenges(Yeo & Tan, 2012). Such students engage in self-handicapping activities. Self-

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handicapping activities involve any action or choice of performance setting that enhances the opportunity to externalize, or excuse failure, thus enabling the individual to avoid or discount negative implications of a performance (Stuart, 2013).Self-handicappers create barriers to successful performance on tests and tasks considered by the individual as important.

The third important finding that emerges from this study has to do with how experiences of failure are related to attributional style and performance. Among those students who had previous experiences of failure, students with optimistic attributional styles performed better on subsequent problems, compared to those with pessimistic attributional styles.However, such a difference was not observed in students with previous experiences of success. As previous research shows, performance outcomes are more likely to be a function of how we respond to failure as opposed to being based on our explanations for success (Gordon, 2008). Attributional style is the way an individual processes feedback from his/her activity, and therefore it should moderate the effects of successes and failures upon future performance. In fact, attributional style is the way an individual understands any given situation in the light of his/her unique tendencies, which results in helplessness or motivated activity, as early studies have shown. Pessimistic explanations of negative events may increase anxiety and

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motivate failure-avoidance efforts(Gordeeva & Osin, 2011). This heightens depression proneness. Pessimistic attributional style decreases success expectations, which explains the nearly zero association between explanatory style for negative events and success expectations in previous research.

In case of failure, the optimistic attributional style may help in the recovery of helpful emotional states, making it easier to perform difficult activities. Although the attributional style is a stable personality characteristic, it is likely that a rigid and unchangeable explanatory style, either pessimistic or optimistic, is less useful regarding performance than a flexible, realistic attributional style, reflecting not only personal inclination, but also specific dimensions of different events(Gordeeva & Osin, 2011).

Attributing failure to lack of effort is typically adaptive, whereas attributing failure to lack of ability is likely to be maladaptive. Attributing negative outcomes to external factors may be adaptive if such factors are likely to change, but maladaptive if such factors are perceived as stable and uncontrollable. Research has found that students who attribute failure internally tend to focus on failure and do not consider ways to remediate it. Furthermore, Diener and Dweck (1978) found that mastery-oriented children attributed their failure to

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lack of effort while helpless children attributed failure to incompetence.

Attributions arerelated to self-efficacy beliefs. Self-efficacy is the students' judgments of their own capability to organize and perform courses of action necessary to reach selected types of goals(Bandura, 1997). Self-efficacy beliefs determine how people feel, think, and motivate themselves to behave. Self-efficacy concerns the students' perceived capabilities to reach goals and achieve results and affects their choices of activities, efforts, or preservations of behavior. It is assumed that people with a high level of self-efficacy try challengingtasks more frequently and persist for longer with them (Bandura, 1997). Furthermore, they can overcome obstacles and focus on opportunities which is why they perceive stressful situations as more challenging than people with low self-efficacy (Jungert & Gustafson, 2009).

Implications for Education and Sports

In educational settings, even if students acquire the essential abilities of performing a task, if they possessa pessimistic attributional style, they may still fail or perhaps even not attempt the task. Children's attitudes about their capacity to perform effectively in school have important implications for their academic development (Bandura, 2006). As failure takes place for many students, especially in the early phases of learning,

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implications of failure and pessimistic attributional style for their efficacy and subsequent academic performance would be beneficial for teachers and parents to better understand.

In sports, an athlete's attributional style has been one of common psychological factors thought to affect performance (Gordon, 2008). Sport psychologists have devoted a significant amount of attention to the examination of the relationship between attributional processes and athletic performance. Previous research on the relationship between the explanatory style of athletes and their athletic performance has shown that optimism is positively related to the performance of soccer players (Gordon, 2008), and basketball players(Martin-Krumm, Sarrazin, Peterson, & Famose, 2003). One practical area for future research is how to strengthen the optimistic attributional style in the face of sports losses and failures.

Limitations and Future Directions

As with any study, certain limitations point to areas for additional work. Since participants of the current study were affected by only one encounter with failure, a limitation was that it was not possible from these data to determine how long that effect endured. Future research should investigate the length of time (or number of trials) for which the effect failure has on performance persists.

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It seems that additional research on the relationship between causal explanation and academic achievement is needed to provide a method for schools to identify vulnerable students. The early recognition of pessimistic explanatory styles among students and then conducting attribution therapy is an effective answer to the problems of poor academic performers which results in changing their ineffective help-seeking behavior.

The causal nature and direction of the associations between attributional style and problem-solving performance still has to be clarified. The impact of failure and attributional style on problem solving can be further examined through research that tries to manipulate the attributional style of a student in order to affect the student's performance. It may alsobe helpful, in upcoming studies, to track students for a longer time, to explore how relations between failure, pessimistic attributional style and performance may change, as they get experienced with performance. Moreover, it isuseful to investigate performance in other areas, for example in sports or work settings, to explore the generalizability of findings.

Conclusion

The present study supported the hypothesis that helpless students who experienced failure show a decline in problem-solving performance compared to students who experienced success. Attributions of failure or achievement often show a

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strong relationship with consequent motivation and performance, and deserve further investigation. If the attributional style is an individual difference variable or trait, as many researchers contend (e.g. Leeson, Ciarrochi, & Heaven, 2008),it should remain relatively stable over the course of academic life. As failure in most situations may occur even after initial success, identifying how failure can affect an individual's attributional style in this instance may help prepare the individual for future attempts at the task.

Finally, an important limitation needs to be considered. The current research was not specifically designed to evaluate factors related to gender. The current study has only examined female students. It would be interesting to assess the interactive effects of gender and attributional style on problem solving under failure conditions.

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