Different Psychological Perspectives on Cognitive Processes: Current Research Trends in Alps-Adria Region

Edited by

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CHAPTER TWENTY

TESTING MEDIATION WITH LEARNING AND COPING STRATEGIES: DIRECT AND MEDIATED EFFECTS OF ANXIETY AND SELF-EFFICACY ON SCHOOL PERFORMANCE

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1. Introduction

There is considerable empirical evidence suggesting that self-efficacy is one of the best motivational predictors of learning and achievement outcomes. Contemporary research using structural equation modelling (SEM) revealed that self-efficacy is the strongest predictor of academic performance (as measured by the grade point average [GPA]), when compared to other cognitive and motivational predictors (Coutinho & Neuman, 2008). Anxiety has a somewhat more complex relationship with academic achievement. Zeidner (1998) points out that a high level of anxiety usually leads to less adaptive cognitive processing and lower achievement, while Garcia and Pintrich (1994) suggest that some students can be motivated by anxiety to try harder and study more, thus increasing their achievement.

Numerous researches have also investigated different mediating variables, usually focusing on cognitive learning strategies (e.g., Dowson & McInery, 1998; Garavalia & Gredler, 2002). Research has also focused on the effects of coping strategies on academic achievement, but coping strategies were rarely considered as mediators of motivation-achievement relationship. Finally, until today, research has not fully recognized the

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importance of comparing mediational models that include different mediators from different lines of research (such as educational research that puts emphasis on learning strategies and clinical research that puts emphasis on coping strategies).

The primary goal of this study was to integrate isolated lines of research related to self-efficacy, test anxiety, coping and learning strategies into comparable mediational models that could explain academic achievement as measured by the GPA. Several methodological problems regarding measurement error, inconsistent mediation effects and artificial direct effects will be discussed, and some solutions and empirical example will be presented.

2. Testing mediation

There are several approaches to test for mediation between variables. Iacobucci (2008) describes testing of direct and indirect paths via causal paths, regression, and structural equations models. Mediational analyses are usually performed with either multiple regression (path analyses) or structural equation modelling (SEM). Although the logic is the same for all these approaches, SEM is the preferred method (Baron & Kenny, 1986; Hoyle & Smith, 1994; Iacobucci, 2008; Judd & Kenny, 1981; Kenny Kashy, & Bolger, 1998). The most important advantage of SEM over other procedures is that it allows control over measurement error in tested models. If mediators are measured with indicators that have lower reliability, the effect of the mediator on the outcome variable is underestimated and the direct effect of the predictor variable on the outcome variable is overestimated (Baron & Kenny, 1986; Judd & Kenny, 1981; Kenny et al., 1998). That leads to underestimation of the mediation effects in studies using statistical analyses that ignore measurement error (e.g., path analyses via multiple regressions). SEM is also a much more flexible statistical procedure because it can include a combination of observed and latent measures, multiple predictor variables, multiple outcome variables, and multiple mediators.

Kenny and colleagues (Baron & Kenny, 1986; Judd & Kenny, 1981; Kenny et al., 1998) proposed a widely used four-step framework for testing mediation: (1) significant association must occur between the predictor and the outcome; (2) significant association must occur between the predictor and the mediator; (3) significant association must occur between the mediator and the outcome, while controlling the effects of the predictor on the outcome; and (4), when the mediator is added to the

model, compared to Step (1), the effect of the predictor on the outcome should be reduced (partial mediation) or equal to zero (full mediation).

In the contemporary literature, there is increasing disagreement over the number of steps that have to be performed and the nature of relationships that has to be established in order to test for the mediation in the model (Collins et al., 1998; MacKinnon, 2000; MacKinnon et al., 2000). First, it is possible that the direct effect is opposite in sign to the indirect (mediated) effect(s) as described by Tzelgov and Henik, (1991). Also, there may be no significant relation between the predictor and the outcome because there are multiple mediators producing inconsistent (positive and negative) effects (Collins, Graham, & Flaherty, 1998; MacKinnon, 2000; MacKinnon, Krull, & Lockwood, 2000). In some cases, statistical removal of mediational or confounding effects could also increase the magnitude of the relationship between the predictor and the outcome. As acknowledged by Judd and Kenny (1981) and MacKinnon (2000), in all the described cases (sometimes referred to as inconsistent mediation or suppression effects), the correlation between the predictor and the outcome may not be significant (as described in Step 1), but there is still a mediation effect to be considered. Furthermore, if predictors and outcomes are distal in time (e.g., a test or GPA score recorded a few months after the predictor variables are measured), statistical analysis may lack the power to identify direct effects, while mediated effects can still be observed (Shrout and Bolger, 2002).

As for Step 4, Kenny asserts that it is not advisable to test the relative fit of structural models with and without mediators (Kenny, 1998). The reason lies in the fact that the models contain different variables, so basically they are not nested and therefore not directly comparable. That implies that Step 4 cannot be performed through the comparison of models with and without a mediator in the model. Finally, Kenny concludes that the essential steps in establishing mediation are Steps 2 and 3. Strategies for testing mediational models via SEM usually follow the described four-step procedure (Holmbeck, 1997) or adopt a somewhat simpler approach as described by Hoyle and Smith (1994).

The preceding review indicates that Step 1 is not necessary to establish mediation and that Step 4 is not appropriate as it would require comparing non-nested models. Therefore, in this paper, only the significance of the mediated effect will be tested as described in Holmbeck (1997) and in the final step of the procedure as described by Hoyle and Smith (1994) and Rice, Ashby and Slaney (1998). In line with this procedure, initial models included all direct and indirect effects of the predictors on the dependent variables (partially mediated models) and mediation was tested in the

second step, when direct paths from the predictor to the outcome were removed (fully mediated models). If fully mediated models had similar fit indices as partially mediated models, evidence for full mediation was to be established. If fit indices were significantly reduced, suggesting the existence of considerable direct effects, this was considered as evidence for partial mediation.

3. Testing mediation with the SEM procedure: empirical example

The structural equation modelling (SEM) technique was used to investigate how anxiety and self-efficacy affect coping and learning strategies and school achievement. Measures were selected from a larger investigation of motivational and cognitive determinants of academic achievement (presented in Loncaric, 2008b). In this paper, measurement models will be presented in addition to structural models to inform readers about metric characteristics of used measures (Figures 1 and 2; standardized factor loadings, path coefficients, measurement error terms for indicators and residual terms for endogenous factors are presented). The data were collected from 461 children and young adolescents (243 girls and 218 boys) ranging from 11 to 14 years of age (upper elementary school equivalent) with a mean age of 12.68 years (SD = 1.15) and analyzed by the LISREL 8.5 program (Jöreskog & Sörbom, 2001). Two main sets of analyses were conducted: (a) coping strategies were tested as mediators of anxiety and self-efficacy effects on school achievement, and (b) learning strategies were also tested as mediators of anxiety and self-efficacy effects on school achievement.

Most of the manifest measures (especially motivational measures and self-regulation strategies) were extremely skewed and kurtotic, violating the assumption of multivariate normal distribution. When this assumption is violated, the use of maximum likelihood (ML) estimation can potentially lead to biased standard error of parameter estimates and inflation of chi-square statistic with an increasing Type 1 error rate (Curran, West, & Finch, 1996). Therefore, the maximum likelihood estimation method with robust standard errors (sometimes called robust maximum likelihood: RML) is used (Browne, 1987) in combination with Satorra and Bentler's (1994) extension that provides the correctly scaled chi-square test statistic. The asymptotic covariance matrix of the sample variances and covariances was used for input. Simulation studies demonstrated that RML estimators with Satorra-Bentler's scaled χ^2 statistic outperform least squares estimators (Bosma & Hoogland, 2001).

Also, robust standard errors yielded the least biased standard errors, especially when the distributions of the observed variables were extremely non-normal (Chou & Bentler, 1995).

Anderson and Gerbing (1988) recommend testing the measurement model with confirmatory factor analysis prior to testing the structural and measurement model simultaneously. In this paper, measurement models are just described with test results detailed in previous manuscripts and are available from the author upon request (Loncaric, 2008b). Modification of measurement models will also be described.

In the structural models presented here (Figure 1 and 2), latent predictor (exogenous) variables were allowed to correlate (different motivational and cognitive constructs were assumed to be multidimensional and correlated). Residual errors of latent mediator (endogenous) variables were also allowed to correlate, allowing thus the estimation of partial correlations between the endogenous variables, using the exogenous predictors as control variables. A latent outcome variable, that is, school achievement, was measured with only one indicator (mid-term GPA score; 1 to 5 range; smaller values indicating lower academic performance) with error variance fixed to zero and factor loading fixed to 1. All parameter estimates were standardized for a final model presentation, so they can be interpreted with reference to other parameters estimated in the model and the relative strength of pathways within the model can be compared.

3.1 Goodness of fit criteria

Consistent with Hoyle and Panter's (1995) recommendations, the goodness of model fit was assessed by examining several indices. The measures of absolute (Satorra-Bentler scaled χ^2 with degrees-of-freedom, χ^2/df ratio; goodness of fit index [GFI]; parsimony goodness of fit Index [PGFI]) and incremental (comparative fit index [CFI]) fit indexes were used in addition to the root mean square error of approximation (RMSEA) and expected cross-validation index (ECVI) for comparison of non-nested models.

The chi-square statistic (Satorra & Bentler, 1994) is affected by the sample size (increasing Type 1 error in large samples). Therefore, the χ^2/df ratio was used to evaluate a model fit with values >2 suggesting poorer fitting models (Byrne, 1989). Some authors consider values <5 as indicators of an acceptable fit (Marsh & Hocevar, 1985; Ullman, 2001). The GFI (Jöreskog & Sörbom, 1993) indicates the percent of observed covariances explained by the covariances implied by the model, with values closer to 1 indicating a better fit. By convention, a GFI >0.90 indicates a model with a good fit. It is affected by the sample size (biased

towards smaller values in small samples and higher values in large samples). The PGFI is a variant of the GFI which penalizes for the lack of parsimony and is markedly lower than the GFI (has no conventional criteria). The CFI (Bentler, 1990) compares the existing model fit with a null model or independence model and varies from 0 to 1, with values close to 1 indicating a better fit. By convention, a CFI >0.90 indicates model with a good fit. The RMSEA (Browne & Cudeck, 1993) is a popular measure of fit because it does not require comparison with a null model and is less affected by the sample size. Hu and Bentler (1999) have suggested RMSEA ≤0.06 as the cut-off for a good model fit. By convention, there is a good model fit if RMSEA ≤0.05, an acceptable model fit if the values are in the 0.05 to 0.08 range, a marginal fit if the values are in the 0.08 to 0.10 range, and a poor fit if the values are greater than 0.10 (Browne & Cudek, 1992). The ECVI (Browne & Cudeck, 1989) measure is based on information theory and has no conventional cut-off points that would indicate a good fitting model. It can be used as an index of how well a solution obtained in one sample is likely to fit an independent sample. It can also be used for comparison of non-nested models. A lower ECVI indicates a model with a better fit.

3.2 Comparison of nested models

A procedure for comparing nested models is used as described by Anderson and Gerbing (1988). First, the initial model that includes all direct and indirect effects of the predictors on the dependent variables (mediators and outcome) is tested. This partially mediated model is statistically equivalent to the confirmatory measurement model. Mediation is tested in the second step of this procedure, when direct paths from the predictor to the outcome are constrained to be zero, resulting in a fully mediated model. Partially mediated and fully mediated models are directly comparable nested models, allowing for χ^2 difference tests. The null hypothesis in such tests is that there is no difference in the fit between the partially and the fully mediated model. The non-significant χ^2 difference test indicates that estimating direct paths from the predictor to the outcome does not significantly improve the model, so the fully mediated model with fewer parameters has a similar fit as the more complex partially mediated model. In such cases, the more parsimonious result is preferred and full mediation is suggested. On the other hand, the significant χ^2 difference test indicates that a constraining direct effect parameter estimated to be zero resulted in a significantly poorer fit for the data, suggesting a considerable direct effect. In such cases, the better fitting

partial mediation model is a more plausible solution. Finally, trimming was performed on the selected model (Klem, 1995), with careful consideration of theoretical and statistical arguments for model modification. In a sequential manner, non-significant parameter estimates were fixed to be zero, starting from the parameter estimate with the lowest t-value. Although there is a risk of the inflation of Type 1 error, this procedure has several advantages. Standard errors of parameter estimates are typically smaller when the paths that are known to have zero weight are eliminated from the model (Shrout & Bolger, 2002). Also, this increased the parsimony of the final structural model.

4. Effects of test anxiety and self-efficacy mediated by coping strategies

The six-factor measurement model was hypothesized to account adequately for the covariation among the 14 observed measures. Predictors included two latent factors: test anxiety and academic self-efficacy. Coping strategies represented mediators and were modelled with three latent factors: problem-focused coping; emotion-protective disengagement; and ego-protective disengagement. Only the mid-term GPA factor had one indicator with the error variance fixed to 0 and factor loading fixed to 1.

The initial test of the measurement model did not include the cross-loading presented in Figure 1. That model resulted in less than desirable fit indexes (χ^2 (63)= 189.55, p <.001; χ^2/df 3.00). The examination of standardized residuals and modification indexes suggested that the cognitive and behavioural component of anxiety might be an indicator of both test anxiety and academic self-efficacy. The negative effects of anxiety on academic performance have been well established (Zeidner, 1998), and several investigations (El-Anzi, 2005; Dijker & Koomen, 2003; Mavis, 2001; Benmansour, 1999) have found negative correlations between different self-efficacy and anxiety measures. Some authors suggest that self-efficacy should be regarded as a cognitive precursor or component of anxiety (Comunian, 1989). The model was re-specified allowing the cognitive and behavioural component of anxiety to load onto both the test anxiety and academic self-efficacy factors. It should be noted that the cognitive and behavioural component of anxiety was a positive indicator of the test anxiety and a negative indicator of academic self-efficacy. Thus, academic self-efficacy was, in measurement terms, defined as high attribution of success to effort, high sense of self-efficacy in a learning process, and the absence of cognitive and behavioural components of test anxiety.

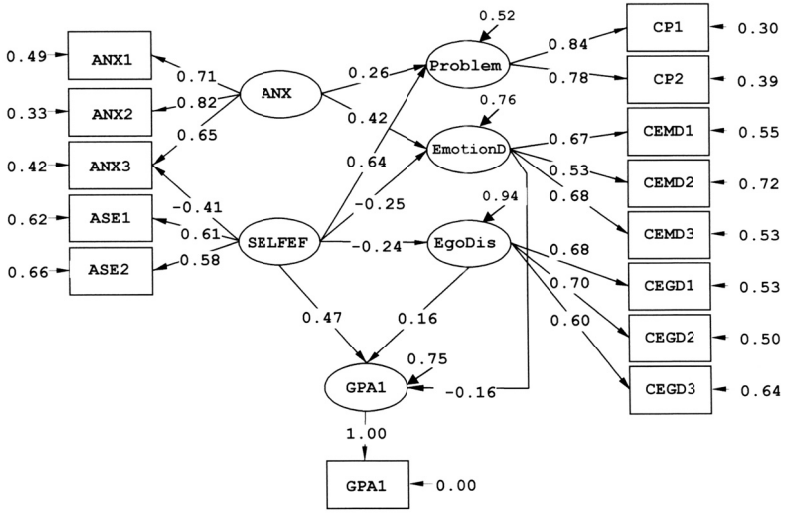

Figure 20-1. Effects of anxiety and self-efficacy on the GPA score partially mediated by coping strategies. Variables: Problem-Focused Coping ("Problem"; CP1-2: Problem Solving Behaviour; Problem Solving Cognitions), Emotion-Protective Disengagement ("EmotionD"; CEMD1-3: Avoidance; Wishful Thinking; Distraction), Ego-Protective Disengagement ("EgoDis"; CEGD1-3: Giving Up and Reinterpretation; Ignoring the Problem; Using Humour), Test Anxiety ("ANX"; ANX1-3: Physiological Component of Anxiety; Emotional Component of Anxiety; Cognitive and Behavioural Component of Anxiety), Academic Self-Efficacy ("SELFEF": ASE1-2: Self-Efficacy in Learning Process; Attribution of Success to Effort), and mid-term GPA (GPA1).

The re-specified measurement model resulted in acceptable fit indexes (χ^2 (62)= 127.34, p <.001; χ^2/df 2.05). Convergent validity was supported for all measures, as the absolute magnitude of the factor loadings ranged from .404 to .829 (all were highly significant at the p <.001 level). The absolute magnitude of the correlations between the factors ranged from .012 to .668 and provided evidence for discriminant validity between the constructs.

The two nested structural models were analyzed in order to investigate whether coping strategies can explain the effects of test anxiety and academic self-efficacy on academic achievement (Table 20-1). First, the partially mediated model was tested allowing all direct and indirect effects. Following that test, the mediation effect was tested by removing the direct paths from test anxiety and academic self-efficacy to academic achievement

(constraining them to zero), resulting in the fully mediated model. Comparison between this constrained, fully mediated model and the unconstrained, partially mediated model indicated that path constraining resulted in a significantly poorer fit for the data ($\Delta\chi^2(2) = 25{,}722$; $p<.001$). Further modifications were performed on the partially mediated model by constraining non-significant parameter estimates to be zero, resulting in the final structural model presented in Figure 1. The final model had reasonable fit indexes, demonstrating a superior fit to the alternative models on several fit indexes.

Model:	χ^2	df	χ^2/df	GFI	PGFI	RMSEA	CFI	ECVI
1. Partially mediated	127.34	62	2.05	0.96	0.57	0.05	0.96	0.47
2. Fully mediated	153.06	64	2.39	0.95	0.58	0.06	0.95	0.52
1a. Final (reduced, partially mediated)	131.58	65	2.02	0.96	0.59	0.05	0.96	0.47

Table 20-1. Fit Indices[a] of Comparative Models with Coping Strategies as Mediators [[a]Robust Maximum Likelihood (RML) estimation method with Satorra-Bentler Scaled Chi-Square]

The objective of this study was to investigate anxiety and self-efficacy as determinants of students' strategic behaviour and their academic achievement. It was hypothesized that coping and learning strategies mediate the effects of cognition and motivation on academic achievement. Coping and learning strategies can serve as mediators only if they have direct effects on the GPA as a measure of school achievement. Therefore, it seems reasonable to start with description of the relationships between coping and academic achievement in both models. Direct and mediated effects of anxiety and self-efficacy will be simultaneously discussed in a subsequent chapter.

According to previous findings (Causey & Dubow, 1992; Rijavec & Brdar, 2002; Brdar & Rijavec, 2001; Shields, 2001; Loncaric, 2008a), we expected that problem-focused coping would have a positive effect, while emotion-focused coping would have a negative effect on the GPA. However, modelling the relationship between self-efficacy, anxiety, coping strategies and the GPA (Figure 1) indicated that problem-focused coping has no significant effect on the GPA. Regarding the same model,

self-efficacy had strong direct positive effects on both problem-focused coping and the GPA. It seems that problem-focused coping had no direct effect on the GPA score that would be independent of academic self-efficacy. While emotion-protective disengagement had expected negative effects on the GPA, ego-protective disengagement strategies (protecting self-esteem through reinterpretation, ignoring the problem, giving up and using humour) had an unexpected positive effect on the GPA. Previous conceptualisations and measures of coping with academic failure did not include this strategy, so the supporting evidence for this finding is scarce. Avoidant coping is similar to this strategy, and Tremblay and colleagues (1999) indicate that it could be associated with children's better behavioural functioning as reported by parents (such as less externalizing behaviour problems). According to Roth and Cohen's study (1986), the use of certain avoidant strategies in an appropriate manner may diminish the distress children feel. The avoidant coping strategy from the Academic Stress Coping Scale ([ASC] Scale: Loncaric, 2006; 2008a) has some similarities with this scale, and the findings also suggest that using avoidant strategies need not result in a lower GPA score. More detailed inspection of Figure 1 indicates that the 'using humour' subscale (CEGD3) had the highest loading onto the ego-protective disengagement component, followed by the 'giving up' and 'reinterpretation' subscales. It can be speculated that gifted students and students with high intellectual abilities would be more inclined to react to a bad grade with humour and positive reinterpretations of such an event. They also have an above average GPA, and a bad grade would be an exception to their academic record. This interpretation would suggest that intelligence has positive effects on both ego-protective disengagement and GPA, increasing their intercorrelation.

5. Effects of test anxiety and self-efficacy mediated by learning strategies

The model that includes learning strategies as mediators (Figure 2) was the same as the first model presented in Figure 1, only with different mediating variables. Predictors included two latent factors: test anxiety and academic self-efficacy. The mediators included three learning strategy latent factors: (meta)cognitive control circle; deep cognitive processing; and surface cognitive processing. The outcome variable was the mid-term GPA factor, with one indicator, error variance fixed to 0 and factor loading fixed to 1.

The measurement model was fit to the data and resulted in marginal fit indexes (χ^2 (62)= 218.56, p <.001; χ^2/df 3.53). As there were no theoretically

acceptable modification indices, mediational analysis was performed on the original measurement model. All the indicators had expected factor loadings. Convergent validity was supported for the measures, as the absolute magnitude of the factor loadings ranged from .38 to .82 (all were highly significant at the $p < .001$ level).

The absolute magnitude of the correlations between the factors ranged from .005 to .78, providing evidence for discriminant validity between the constructs.

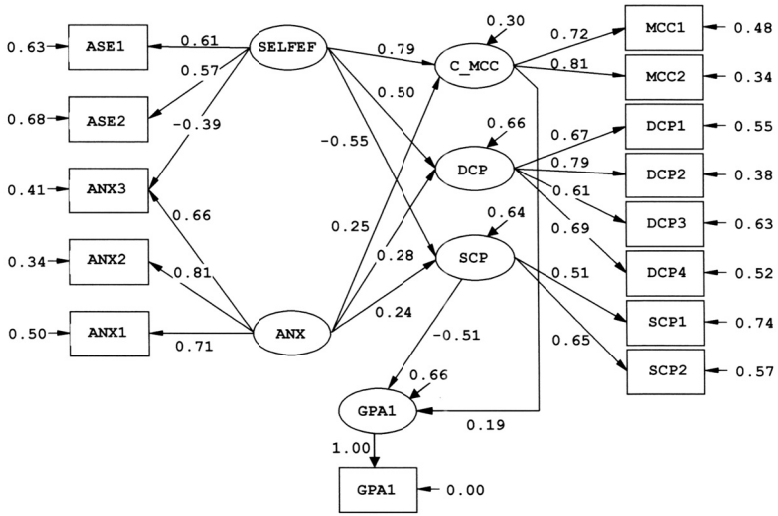

Figure 20-2. Effects of anxiety and self-esteem on the GPA score fully mediated by learning strategies. Variables: (Meta)Cognitive Control Circle ("C_MCC"; MCC1-2: Repetition and Exercise; Controlling Learning Process and Outcome), Deep Cognitive Processing ("DCP"; DCP1-4: Elaboration; Organization; Application; Critical Thinking) and Surface Cognitive Processing ("SCP"; SCP1-2: Focusing on Minimal Requirements; Memorizing). Other variables are the same as presented in Figure 20-1.

The two nested structural models were analyzed in order to investigate whether learning strategies can explain the effects of test anxiety and academic self-efficacy on academic achievement (Table 20-2). First, the partially mediated model was tested, allowing for all direct and indirect effects. Following that test, the mediation effect was tested by constraining the direct paths from test anxiety and self-efficacy to academic

achievement to be zero, resulting in the fully mediated model. Comparison between this constrained, fully mediated model and the unconstrained, partially mediated model indicated that path constraining resulted in a marginally significant reduction in the fit index ($\Delta\chi^2(2) = 6{,}16$; p=.04). In order to identify whether there were any direct effects present, further modifications were performed on the partially mediated model by constraining the non-significant parameter estimates to be zero. After all non-significant mediated pathways were constrained to be zero, all the remaining direct paths were still non-significant, so they were also constrained, resulting in the final, fully mediated model shown in Figure 2. The data reported in Table 20-2 indicate that the final model resulted in a reasonable fit, with several indexes indicating the final model as the best fitting and the most parsimonious model.

Model:	χ^2	df	χ^2/df	GFI	PGFI	RMSEA	CFI	ECVI
1. Partially mediated	218.56	62	3.53	0.93	0.55	0.08	0.94	0.68
2. Fully mediated	224.72	64	3.51	0.93	0.57	0.08	0.94	0.69
1a. Final (reduced, fully mediated)	224.85	65	3.46	0.93	0.57	0.07	0.94	0.68

Table 20-2. Fit Indices[a] of Comparative Models with Learning Strategies as Mediators [[a]Robust Maximum Likelihood (RML) estimation method with Satorra-Bentler Scaled Chi-Square].

The majority of the effects of learning strategies on the GPA can be supported with previous research findings (Dowson & McInery, 1998; Proctor et al., 2006; Trainin & Swanson, 2005; Garavalia & Gredler, 2002). Repetition, exercise and metacognitive control of a learning process and outcomes had positive effect on the GPA, while surface cognitive processing strategies, such as focusing on minimal requirements and memorising, had a negative effect on the GPA. On the other hand, less support can be found for the non-significant effects of deep cognitive processing learning strategies, such as elaboration, organization, application and critical thinking. Some research shows that students who approach tasks with a mastery goal employ deep cognitive processing strategies, such as linking new material with previous knowledge (Anderman & Maehr, 1994; Dowson & McInerney, 2003). Such students may perceive themselves as being more capable due to their effective

employment of learning strategies and this may positively affect their academic self-concept and achievement. Barker, Dowson, and McInerney (2006) also concluded that mastery goals are associated with deep levels of processing and the employment of more effective learning strategies that positively influence the development of self-concept and affect subsequent achievement. It remains unclear why the effects of deep cognitive processing did not reach statistical significance in this study.

It should be noted that most studies did not investigate the mediational role of self-regulation strategies via the SEM procedure and did not include numerous cognitive and motivational predictors present in this study. These findings might also be culturally specific, as most Croatian public schools demand hard work, exercise and unrelated memorising, rarely providing incentives or a context for the activation of deep cognitive processing strategies. It is possible that under these conditions some learning strategies, such as critical thinking and application of knowledge, are not effective (at least in terms of the GPA) for upper elementary students as they are focused on acquiring large quantities of new knowledge with scarce opportunities to apply it in different life situations or reflect upon it in a critical manner.

Garcia and Pintrich (1994) suggested that some of the strategies that involve rather complicated cognitive and metacognitive processes are not applicable for elementary school students for they may lack some of cognitive capabilities or a capability to coordinate multiple schemas, strategies or integrate different goals. They also underline the problem of insufficiently supportive environments, as elementary schools may not afford students the opportunity to develop and use different strategies. Schools may also fail to provide students with enough choice and control over tasks in the classroom, limiting them in the application of different strategies.

6. Direct and indirect effects of anxiety and self-efficacy on academic achievement

The results presented in Figures 1 and 2 indicate that academic self-efficacy has an artificial direct effect (further discussed in the next section) and an inconsistent mediation effect on the GPA. The positive effects of self-efficacy beliefs on a GPA score are fully mediated by coping and learning strategies. Self-efficacy facilitates (meta)cognitive control circle learning strategies that are positively related with GPA and inhibits some strategies that are inversely related to the GPA, such as surface cognitive processing strategies and emotion-focused coping. These findings are in

line with previous research suggesting that self-efficacy is one of the best motivational predictors of learning and achievement outcomes (Bandura, 1997; Eccles et al., 1998; Pintrich & Schunk, 2002).

It seems that high academic self-efficacy protects students from defensive coping strategies and facilitates problem-focused coping, but the positive effects on the GPA score are transmitted only by the decreased use of the emotion-protective disengagement coping strategy and increased use of (meta)cognitive control circle learning strategy.

The results suggest that self-efficacy has a negative effect on the GPA through the decrease in ego-protective disengagement coping strategies (using humour, reinterpretation, ignoring the problem and giving up), which are positively related to the GPA. These findings provide support for the conceptualisation of ego-protective coping strategies as valuable and protective coping resources at least for students with lower academic-self-efficacy. If students have higher academic-self efficacy, the use of these strategies might impair their academic success. We should bear in mind that including students' ability level into mediational models might further advance our understanding of these effects. The integration of the findings indicates that self-efficacy has no direct effects on the GPA as a direct effect presented in Figure 1 is a result of model misspecification or failure to include relevant mediators, in this case learning strategies.

Coping and learning strategies provide inconsistent mediation of test anxiety effects on academic achievement. Test anxiety has a negative effect on the GPA via the increase in the use of the emotion-protective disengagement coping strategy and surface cognitive processing learning strategy, and a positive effect on academic achievement via the increase in the use of the (meta)cognitive control circle learning strategy. Test anxiety has a positive effect on the problem-focused coping strategy and the deep cognitive processing learning strategy, but these effects are not transmitted to the GPA score.

These results support some previous research findings. A review of both experimental and correlational studies (Zeidner, 1998) indicates that high levels of anxiety usually lead to less adaptive cognitive processing and lower levels of achievement, although some authors (Garcia & Pintrich, 1994) suggest that some students can be motivated by anxiety to try harder and study more, which in this case leads to better achievement.

7. Problems related to interpretation of partial mediation models

Shrout and Bolger (2002) describe several situations in which partial mediation can be observed. They suggest that most of these situations can be interpreted as model misspecification errors rather than partial mediation. Partial mediation is usually described as a situation where a predictor has a specific and direct effect on the outcome in addition to its indirect effect through a mediator. This may not be the most common case, and we should consider other possibilities that include some kind of model misspecification error. The empirical examples presented here demonstrate some of the mechanisms that would create an artificial partial mediation.

A possible explanation for partial mediation includes a situation where there are several processes which, taken together, completely mediate the relation between a predictor and an outcome (as in Bollen, 1987 or MacKinnon, 2000), but only a subset is specified explicitly in the mediation analysis. In this situation, the direct effect actually reflects possible mediated effects that are not captured by the mediators included in the model. Other mediators would capture these effects if they were included in the model. This model is basically misspecified, suggesting that relevant mediators are not included in the model. Comparing the models that include coping strategies as mediators with the models that include learning strategies as mediators, such an interpretation would explain the direct effects of academic self-efficacy on the GPA score.

Another situation that could be misinterpreted as partial mediation is a situation where the mediator variable is measured with error. In that case, the mediator's relationship with a predictor and the outcome are underestimated, and hence the indirect effect would be as well (Bollen, 1989). The use of SEM analysis reduces the possibility of such a methodological artefact. This is a model misspecification that does not require refining the theory, but rather using a more adequate methodology and advanced statistical procedures instead.

8. Concluding remarks

This research has confirmed that coping and learning strategies are important mediators of the relationship between anxiety, self-esteem and school achievement. Simultaneous investigation of these mediators revealed some new findings and demonstrated some important methodological issues. Anxiety can lead to different outcomes (GPA) depending on the self-regulation strategies used. It increases GPA via increased use of

proactive strategies, including cognitive and metacognitive control, and decreases GPA via increased use of defensive strategies like emotion-protective disengagement and surface cognitive processing. Self-efficacy generally has positive mediated effects on academic achievement. It increases GPA via an increased use of proactive strategies and via a decreased use of some defensive strategies (but it could also lead to a lower GPA via a decreased use of defensive strategies like humour, reinterpretation and ignoring the problem).

It has been demonstrated that learning and coping strategies need to be simultaneously (or, at least consecutively, through parallel models) analyzed as mediators to avoid unreliable conclusions about the direct effects of self-efficacy on academic achievement. Students' intelligence level and basic abilities need to be taken into account, as they may operate as confounder variables that falsely accentuate the relationship between some defensive strategies and academic achievement. Finally, other academic and motivational outcomes, such as school dropout, truancy, students' choice of activities, involvement in a task, task choice, task value and persistence, should be considered in future research.

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Summary

Anxiety and self-efficacy are among best investigated correlates of academic achievement. There is considerable evidence suggesting that these effects are mediated by the use of different strategies. Unfortunately, segmented empirical research is usually limited to specific strategic behaviours (e.g., learning or coping strategies), missing out on the opportunity to identify inconsistent mediation and artificial direct effects. Most of the research also disregards the effects of measurement error on mediated models.

In order to address this problem, the SEM approach to testing mediation is described. Learning and coping strategies are used as mediators to demonstrate inconsistent mediation effects and artificial direct effects. Upper elementary students participated in this investigation. The self-reports were assessed by the Components of Self-Regulated Learning Scale and the Academic Stress Coping Scale.

The results show that learning and coping strategies fully mediate anxiety and self-efficacy effects. Some inconsistent mediation effects are identified, explaining the inconsistencies in previous empirical research. Also, some artificial direct effects of self-efficacy on academic achievement appear only in the models that do not consider learning strategies as mediators.