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EXAMINING VALIDITY OF SOURCES OF MATHEMATICS SELF-EFFICACY SCALE IN TURKEY

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Abstract:
The main purpose of the current study is to examine the construct, convergent and discriminant validity of the Sources of Mathematics Self-Efficacy Scale (Usher & Pajares, 2009) in a Turkish sample. Bandura's Social Cognitive Theory (1986) served as the theoretical framework for the current study. According to Bandura (1986), people's self-efficacy develops from 4 sources: (1) Mastery Experiences, (2) Vicarious Experience (3) Social Persuasion and (4) Physiological States. Research studies in this area revealed that mastery experiences and social persuasion are highly correlated. Even it is not clear that these two constructs are distinct constructs. Confirmatory factor analysis was utilized to examine the construct validity of the scale. In order to see if mastery experiences and social persuasion are two distinct constructs, discriminant validity was examined. The participants were 616 secondary school students in Turkey. 3-factor and 4-factor models were nearly identical in terms of goodness of fit of data in the confirmatory factor analysis. The analysis of discriminant validity revealed that mastery experiences and social persuasion are not two different constructs.

Keywords: sources of mathematics self-efficacy, scale development, mathematics education

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1. Introduction

According to Social Cognitive Theory, human behavior can be best understood in a reciprocal relationship among personal factors, behavior and environment. Bandura (1986) claims that the most important personal factors affecting human behavior are self-efficacy and outcome expectations. Since people's outcome expectations depend mostly on their self-efficacy beliefs, this theory puts more emphasis on self-efficacy than outcome expectations to explain and predict human behavior.

Self-efficacy, by definition, is a belief regarding whether a person can accomplish a given task. This belief mobilizes people's efforts towards a given task and helps sustain their efforts until the task is successfully finished (Bandura, 1995). If a person encounters a difficult situation, self-efficacy directs their behavior (Pajares, 2002). In addition to behavior, self-efficacy also influences people's motivation, feelings and thoughts. For example, those who possess high self-efficacy tend to set high goals and have confidence in reaching them. If they fail in difficult tasks, they do not tend to attribute their failure to personal deficiencies. They challenge such tasks rather than avoiding doing them. On the other hand, those with low self-efficacy tend to set easily reachable goals. Since they feel that they have lack of personal qualifications, they become stressed easily (Bandura, 1995).

In addition to influencing people's daily lives in several ways, self-efficacy was found to affect mathematics–related behavior (Hackett & Betz, 1989). The development of mathematics self-efficacy is thought to be important in from grades 5 to 8 primary schools. Students in these grades should have high levels of self-efficacy so that they successfully understand complex topics of mathematics in higher grades and become successful in mathematics classes. Self-efficacy also plays a role in career choice. Those who possess high levels of mathematics self-efficacy tend to choose mathematics-related career (Bandura, Bararanelli, Caprara & Pastorelli, 1996).

1.1. Mathematics Self- Efficacy

Mathematics self-efficacy can be defined as a belief regarding how well they can learn mathematics (Tait-McCutcheon, 2008). The level of self-efficacy determines how the students approach mathematics tasks. Those who possess high self-efficacy perceive complex mathematics tasks as doable and maximize their efforts to solve those (Pajares, 1997). Such students tend to have high interests in mathematics problems and to be motivated to solve them (Pajares, 2005). Research found a positive correlation between mathematics self-efficacy and problem solving ability (Pajares & Miller, 1994; Pajares & Krenzler, 1995). It is important to note that high levels of self-efficacy do not guarantee problem solving ability when students face challenging mathematics tasks. Rather, high

self-efficacy motivates students to solve problem and give them persistence and tenacity until the problem is successfully solved (Pajares, 2005). Self-efficacy also influences students' use of correct cognitive strategies, which help them to solve mathematics problems (Pintrich & DeGroot, 1990).

Mathematics performance of students was found to be not at the desired level in Turkey as well as in other countries (Mullis, Martin, Robitaille & Foy, 2009). Researchers conducted many studies to explain this situation and came up with many variables that affect performance. Among these variables, anxiety, beliefs about mathematics and self-efficacy have received high attention (Walsh, 2008). Many studies showed that self-efficacy is the best predictor of mathematics success and performance (Chen, 2003; Fast et al.., 2010; Ferrari & Parker, 1992; Lindley & Borgen, 2002; Pajares & Miller, 1994; Pajares & Kranzler, 1995; Pajares, 1996; Siegel, Galassi & Ware, 1985; Stevens, Olivare, Lan & Tallent-Runnels, 2004; Schunk, 1989, 1991). Some studies found a positive correlation between self-efficacy and performance (Hackett & Betz, 1989; Pajares, 1996; Pajares & Graham, 1999; Peitsch, Walker & Chapman, 2003; Randhawa, Beamer & Lundberg, 1993; Stevens et al., 2004). It is important to note that there is no one-way relationship between self-efficacy and performance. These two variables affect each other reciprocally. In other words, self-efficacy increases performance. Performance, in turn, makes a positive contribution to self-efficacy.

In most studies, self-efficacy was used in conjunction with other variables to predict mathematics performance. (Dumais, 2009; Pajares & Kranzler, 1995; Pajares & Miller, 1994, 1995; Stevens et al., 2004). In one study (Pajares & Miller, 1995), a negative correlation between self-efficacy and mathematics anxiety existed and self-efficacy was found to be more predictive of performance than anxiety. In another study (Bryan, Glynn & Kittlesson, 2011), mathematics performance was found to be correlated with self-efficacy, intrinsic motivation and self-regulated decision making. Among these variables, self-efficacy was found to be the best predictor of performance.

A number of studies examined the relationship between sources of self-efficacy and mathematics self-efficacy in the US (Lent, Lopez & Bieschke, 1991; Lopez & Lent, 1992). Lent Lopez and Bieschke (1991) found that all of the sources of self-efficacy are significantly correlated with each other and overall mathematics self-efficacy scores. These researchers also examined the relationship between sources of self-efficacy and mathematics achievement and found that three of the sources (mastery experiences ($r = 0.54$), social persuasion ($r = .44$), and physiological states ($r = -.38$) are significantly correlated with performance. Lopez and Lent (1992) found similar results. Both studies revealed that mastery experiences have the highest correlation with self-efficacy followed by social persuasion.

The relationship between sources of self-efficacy and mathematics self-efficacy were investigated in studies conducted in Turkey and France (Arslan, 2012; Joët, Usher & Bressoux, 2011). Arslan (2012) examined the role of sources of self-efficacy in self-efficacy for learning mathematics and performance on 1049 secondary school student in Turkey. His study revealed that only mastery experiences and social persuasion were significantly correlated with self-efficacy for learning mathematics and performance with mastery experiences had a higher correlation with these two variables than social persuasion.

Self-efficacy springs from 4 sources: (1) Mastery Experiences, (2) Vicarious Experience (3) Social Persuasion, (4) Physiological States. Mastery experiences can be thought of previous experiences regarding a given task. Previous successful experiences increase self-efficacy while unsuccessful ones diminish it. Sometimes people observe others' behavior to learn and establish their self-efficacy based on their observation. If others complete a task, they might think that they can do it by themselves. The third source of self-efficacy is social persuasion. Sometimes, other people tells "*you can do it*", "*you have necessary skills to do it*" to a person who face a challenging task. These types of expressions may make a positive contribution to self-efficacy. The last source of self-efficacy is physiological states. Some people may sweat and their heartbeats accelerate in a given task. Based on these symptoms, these people may believe that they do not have sufficient skills to complete the task.

Lent, Lopez, Brown and Gore (1996) developed sources of self-efficacy scale for high school students. These researchers tested 4 different models and found that 4-factor model fitted the data best. This scale was translated into Turkish by Ozyurek (2010). This researcher conducted both exploratory factor analysis and confirmatory factor analysis to establish the construct validity of the scale. Mastery experiences and verbal persuasion items loaded in the same factor in the exploratory factor analysis. He explained this finding by arguing that students receive feedback from their social environment as a result of their performance and experience. Although exploratory factor analysis supported the 3-factor solution, 4-factor model seemed to have better psychometric properties than the 3-factor model in the confirmatory factor analysis.

Usher and Pajares (2009) developed a 24-item source of self-efficacy scale with 6 items in each dimension of source. The Cronbach's Alpha values were found to be .80 for the overall scale, .88 for mastery experiences, .84 for vicarious experience, .88 for verbal persuasion, and .87 for Physiological states. These values showed that the participants in their study consistently replied to the scale items. Furthermore, they reported chi-square/df value of 2.44, CFI value of .96 and RMSEA and SRMR value of .04 for the 4-factor model. These results provided evidence that the data fitted well to the proposed model.

Yurt and Sunbul (2014) translated this scale into Turkish and examined its reliability and validity on 750 secondary students in Konya, Turkey The Cronbach's alpha values were found to be .87 for mastery experiences, .80 for vicarious experience, .93 for verbal persuasion, and .94 for physiological states**.** These values showed that the participants in their study consistently replied to the scale items. These researchers reported CFI value of 0.88, GFI value of 0.78, AGFI value of 0.74, RMSEA value of 0.09, SRMR value of 0.07 and NFI value of 0.83 for the 4-factor model in the initial analysis. In order to have a better model and more acceptable fit indices values, they connected error terms and found CFI value of 0.95, GFI value of 0.87, AGFI value of 0.85, RMSEA and SRMR value of 0.07 and NFI value of 0.90. It can be clearly seen that the proposed model did not reach acceptable fit indices values in the initial analysis. By connecting error terms, the fit indices values exceeded threshold values.

1.2. Current Study

Although we appreciated the work of Yurt and Sunbul (2014), we believe that there are a number of methodological shortcomings to be addressed in their study. First, these researchers connected error terms to have a good model which has acceptable fit indices values. This way seems to be wrong because connecting error terms do not seem to have a theoretical background. Second, the participants in their study replied to the scale items using a scale ranging from 0 to 100. Since these students are secondary students, they might have difficulty using this scale to give an answer that reflects their beliefs best. Also, Turkish students are not used to this type of scale. Instead, we proposed in our study to use a 5 point scale and to name each point. Third, Yurt and Sunbul (2014) directly translated some items from English to Turkish. For example, they directly translated the item "*My classmates like to work with me in math because they think I am good at it*" to Turkish. We believe that this item should be more concrete and simple. In addition, the expression "I am good at" might apply praising oneself, which is considered improper and immodest in Turkish. Students work with each other in group works. We also believe that it is not necessary to write "*because they think I am good at it"* because students tend to like to work with students who are good at math and this expression might imply praising oneself. Therefore, we translated this item to Turkish as "*My classmates like to work with me in group works in mathematics classes*".

The current study was undertaken to address the shortcomings of Yurt and Sunbul's study (2014). We are well aware that there a number of sources of mathematics self-efficacy scales in the literature whose validity and reliability were established very well. However, very high correlation between mastery experiences and verbal persuasion existed in almost all of the studies. More importantly, mastery experiences and verbal persuasion items loaded in the same factor in Ozturk's study (2010)

conducted in Turkey. Our study might enable us to see if mastery experiences and verbal persuasion are distinct sources. In addition, we think that each scale can be improved by making modifications considering cultural differences. Thus, we introduced new items which we think measure sources of self-efficacy. For example, there is an item in the Usher and Pajares's scale (2009): "*My teachers have told that I am good at learning math*". In Turkey, mathematics teachers interact with their students in the classroom environment. If they say "*you are good at learning math*" to a student, other students might be jealous. For this reason, they do not tend to use this kind of expression. Instead of this item we introduced a new item "*My teacher appreciates me when I solve a math problem on the blackboard*" in our study.

1.3. The Aim of Current Study

In short, we learned from the literature and research in this area that (a) self-efficacy is a powerful predictor of performance, (b) very high correlation between mastery experiences and social persuasion existed. Even it is not clear that these two constructs are distinct constructs. (c) mastery experience was found to be the most important source of mathematics self-efficacy followed by social persuasion. Thus, it would be helpful to know, examine and accurately measure factors (sources) that influence the level of self-efficacy and to test if mastery experiences and social persuasion are two distinct constructs. Two research questions are addressed in the current study:

1. What is the validity of Sources of Mathematics Self-Efficacy Scale (Usher & Pajares, 2009) in Turkey?
2. Are mastery experiences and social persuasion two distinct sources of mathematics self-efficacy?

2. Material and Method

2.1. Participants of the Study

We used conventional sampling technique in which the researchers choose the participants due to convenient accessibility. The participants consisted of 616 secondary education students (310 Male, 306 Female) in three different schools in the province of Altieylul, Balikesir/Turkey where one of the researchers of the current study worked in the past. 123 of the participants were in 5th grade, 149 in 6th grade, 165 in 7th grade and 181 in the 8th grade.

2.2. Research Instrument

The research instrument utilized in the current study was adapted from 24-item Sources of Self-Efficacy Scale developed by Usher and Pajares (2009) in the US. Consistent with

the theoretical framework, the scale consisted of 4 sub-scales which measure 4 sources of self-efficacy with 6 items in each source. This scale was translated into Turkish by other researchers (Yurt & Sunbul, 2014). We examined these two scales and tried to come up with a new Turkish version of the Sources of Self-Efficacy Scale. In doing so, we considered the Turkish culture and the way expressions are written in Turkish. Thus, made remarkable changes in the way 4 items are written. For example, in Turkey we think that except for few circumstances, mathematics teachers do not say to a student "*My teachers have told that I am good at learning math*" in front of others because they might be jealous of this student. In the traditional way of teaching of mathematics in Turkey, mathematics teachers shows a problem on a blackboard (or an interactive board) and ask students who want to solve that problem. Then, they select one of the students to solve it in front of other students. If he/she solves it correctly, the teacher gives feedback such as saying "good job" to a student. Thus, instead of using the item in the Usher and Pajares' scale (2009) "*My teachers have told that I am good at learning math" we came up with another item*". My teachers appreciates me (*like telling me "good job")* if I solve math problems correctly on the chalkboard" to measure social persuasion.

We made changes in 3 items more. For example, we think that in the item "*I get depressed when I think about learning math*" the expression "*I get depressed*" should be changed because Turkish people tend to use this term when they have major depression. Instead of this item, we came up with *a new item: "I* get bored when I think about learning a new topic in mathematics classes". We also made changes in two items "*My classmates like to work with me in math because they think I am good at it*" and "*My mind goes blank and I am unable to think clearly when doing math work*". All of the changes we made in Usher and Pajares' scale (2009) are indicated in Table 1.

Table 1: Comparing Some Items in the Original Scale and Our Scale

Items in the Usher and Pajares' Study (2009)	**Items in the Current Study**
My teachers have told that I am good at learning math.	My teachers appreciates me (*like telling me "good job")* if I solve math problems correctly on the blackboard (or interactive whiteboard).
My classmates like to work with me in math because they think I am good at it.	My friends like to work with me in group works in mathematics classes.
I get depressed when I think about learning math.	I get bored when I think about learning a new topic in mathematics classes
My mind goes blank and I am unable to think clearly when doing math work.	When doing mathematics works, as if my brain stops working.

Participants indicated their response for each item on a 5- point scale ranging from 1 (strongly disagree) to 5 (strongly agree). One item in the mastery experiences scale "*Even when I study very hard, I do poorly in math*" and all of the **physiological states** items were reverse scored before the analysis since they are negatively worded. The participants' scores were averaged in each source, creating a mean score for all of the 4 sources of self-efficacy ranging from 1 to 5.

2.3. Data Analysis

As indicated in the introduction, Ozyurek (2010) found that mastery experiences and social persuasion items loaded in the same factor in the factor analysis and other studies found a very high between these two sources (Usher & Pajares, 2009; Yurt & Sunbul,2014). Thus, we conducted two different confirmatory factor analyses to establish the construct validity of the scale. Based on the theoretical framework, we first tested a 4-factor model which all of the sources reflect different constructs. Then, we tested a 3-factor model in which mastery experiences and social persuasion items reflected a unitary construct. Chi-square/df, CFI, NFI, RMSEA and SRMR values were used as the indicators of the goodness of fit of the models. SRMR, RMSEA values of .08, CFI, NFI values of .90 and chi-square/df value of 5 were used as cutoff points in the analysis (Bollen, 1989; Browne & Cudeck, 1993; Sümer, 2000). Since we proposed a four factor model (See Figure 1) based on the theoretical framework, we focused on factor loadings of each item in their respective factor.

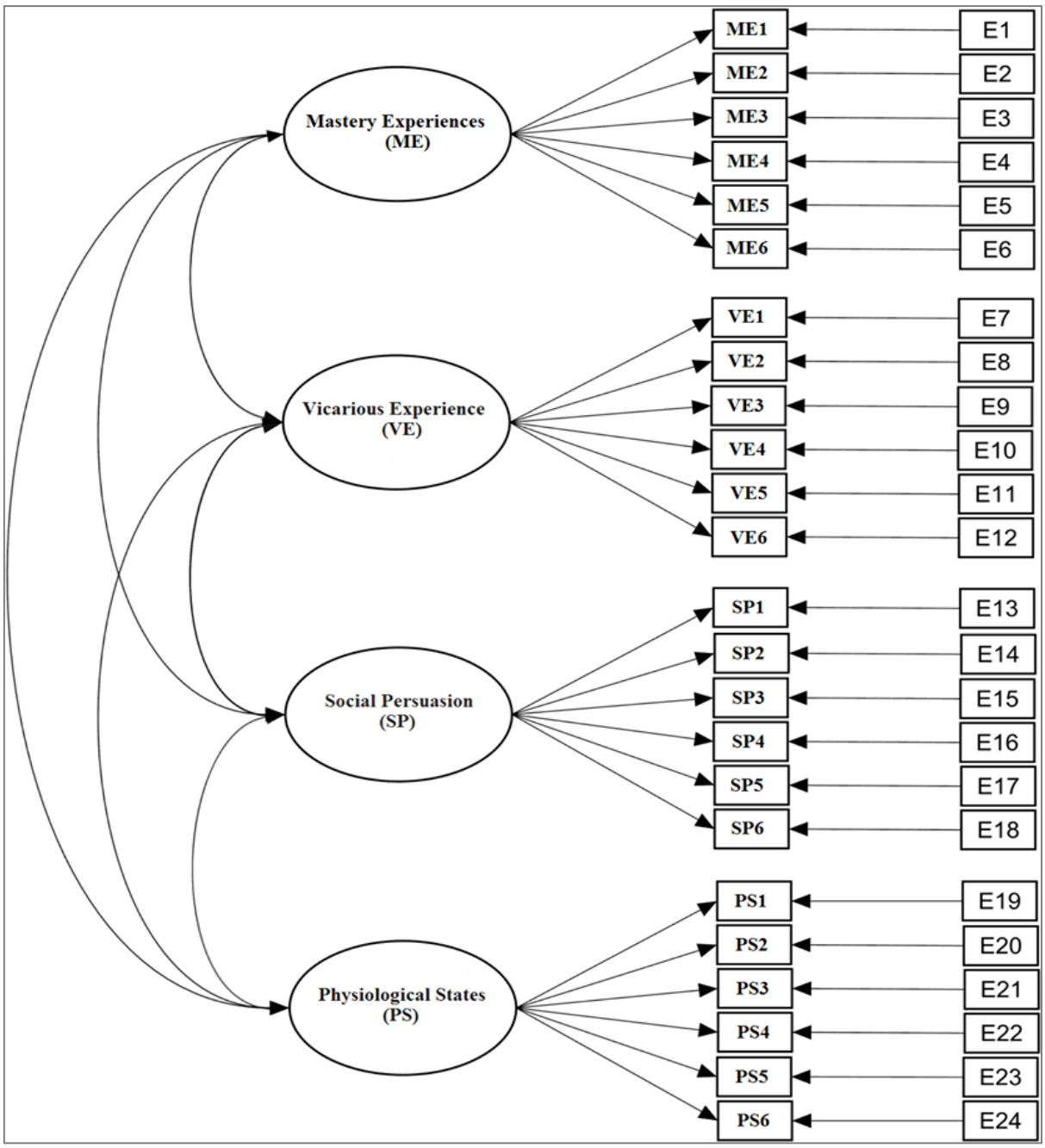

Figure 1: 4-Factor Model

To establish the convergent and discriminant validity of the scale, average variance extracted (AVE) was calculated. This value should be more than .4 to establish the convergent validity. The square root of AVE should be higher than inter-construct correlations to establish discriminant validity (Nevitt & Hancock, 2001).

The Cronbach's Alpha and Composite Reliability values were used to determine the internal consistency. We also examined corrected item-total correlation, which is the correlation between an item and the rest of the test. High correlation suggests that the item is assessing the same thing the rest of the test is trying to assess. In order to understand the discriminative power of the items, we selected the top 27 and lowest 27

percent of the students in terms of total score. Then, we conducted a t test to examine if there is a significant difference between the two groups.

3. Results

RMSEA value of .06, SRMR value of .05, CFI value of .98 and NFI value of .97 were found in 3-factor and 4-factor models, which suggested that there was no difference between the two in terms of goodness of fit. Chi-square/df value of 3.38 and 3.35 were found in 4-factor model and 3-factor model, respectively. This suggested that data fitted the model better in the 4-factor than the 3-factor model.

Since the current and other studies (Usher & Pajares, 2009; Yurt & Sunbul, 2014) were based on the 4-factor model we compared the results of goodness of fit of the models in these studies. As the table 3 shows, Usher and Pajares' study (2009) had better goodness of fit values than the other two studies.

Table 3: Values of Goodness of Fit in Three Studies

Study	ChiSquare/df	CFI	NFI	RMSEA	SRMR
Usher and Pajares (2009)	2.44	0.96	-	0.04	0.04
Yurt and Sunbul (2014)	3.24	0.88	0.83	0.09	0.07
Current Study	3.38	0.98	0.97	0.06	0.05

Figure 2 shows the factor loadings and error variance of each item in their respective factor in the 4-factor model. Factor loadings ranged from .61 to .86 for mastery experiences, .45 to .76 for vicarious experience, .48 to .73 for social persuasion and .62 to .79 for the physiological states items. These results suggested that all of the items had acceptable levels of factor loadings.

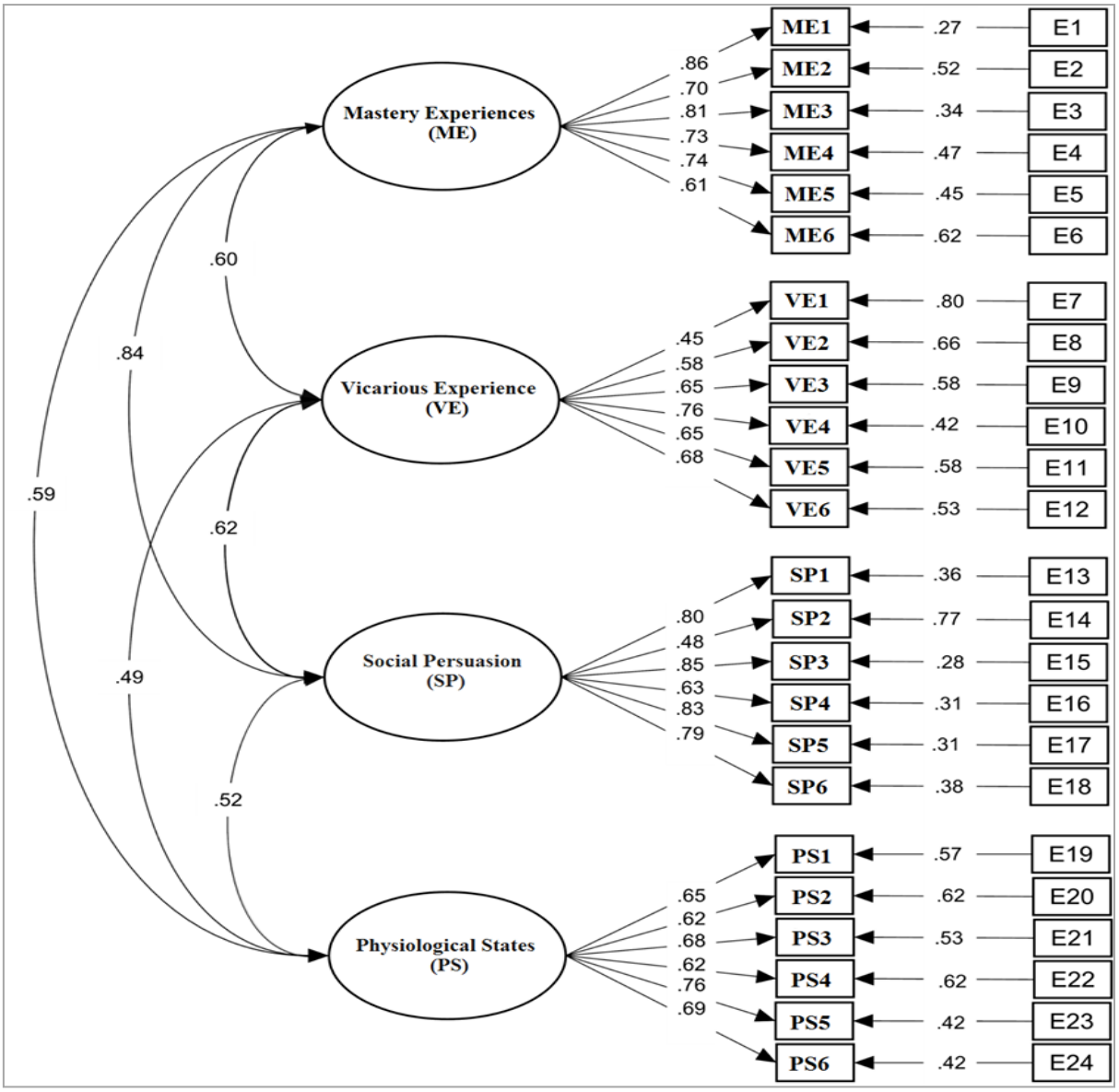

Figure 2: Factor Loadings and Error Variance in 4-Factor Model

In order to establish to discriminant validity, the square root of all average variance extracted should be higher than the correlations shown below them or to their left. As the Table 4 reveals, square root of AVE (.75) is smaller than the correlation between mastery experiences and social persuasion (r = .84). Thus, we failed to prove that mastery experiences and social persuasion items are different constructs. On the other hand, all of the other square roots of all average variance extracted are higher than the correlations shown below them or to their left. This suggests that vicarious experiences and physiological states are independent of other constructs. It should be noted that all of the AVE is higher than the threshold value of 0.4, which suggests that our scale possesses convergent validity.

Table 4: Results of Discriminant Validity

	1	2	3	4
1. Mastery Experiences	(.75)			
2. Vicarious Experience	.60	(.63)		
3. Social Persuasion	.84	.62	(.75)	
4. Physiological States	.59	.49	.52	(.67)

Note: Square roots of average variances extracted are shown on diagonal.

Cronbach's Alpha values were found to be .87 for mastery experiences, .80 for vicarious experience, .87 for social persuasion and .83 for physiological states. Composite Reliability values were found to be .88 for mastery experiences, .79 for vicarious experience, .88 for social persuasion and .83 for physiological states. Since all of these values are higher than 0.70, it can be concluded that the participants consistently responded to the scale items.

Table 5 shows the results of correct item-total item correlation scores and Upper 27% and Lower 27% t test in the current study and Yurt and Sunbul's study (2014). Corrected Item-Total Item Correlation scores were close in mastery experiences, vicarious experiences and social persuasion scores; however, these scores were found to be substantially higher in physiological states in our study. t test scores were found to be substantially higher in all of the sources of self-efficacy in our study than the Yurt and Sunbul's study (2014). In addition, a close examination of corrected item-total item correlation and t test scores in Yurt and Sunbul's study (2014) revealed that these scores were very low in physiological states. Thus, Yurt and Sunbul's study (2014) seem to have a number of reliability concerns, and discriminative power of the items in physiological states source of their scales was not satisfactory.

Table 5: Results of Item Analysis in Two Different Studies

	Corrected Item-Total Item Correlation		**t test (Upper %27-Lower %27)**	
	Current Study	**Yurtand Sunbul's Study (2014)**	**Current Study**	**Yurt and Sunbul's Study (2014)**
ME1- I make excellent grades on math tests.	0.79	0.72	27.98	15.92
ME2- Even when I study very hard, I do poorly in math.	0.63	0.72	19.35	17.45
ME3- I have always been successful with math.	0.76	0.35	24.45	4.79
ME4- I do well on even the most difficult math assignments.	0.65	0.62	25.74	11.9
ME5-I got good grades in math on my last report card.	0.69	0.53	19.84	13.7
ME6- I do well on math assignments.	0.55	0.63	18.11	18.43
VE1- Seeing adults do well in math pushes me to do better.	0.43	0.62	9.89	15.34
VE2- Seeing kids to do better than me in math pushes me to do better.	0.54	0.52	13.39	15.05
VE3-When I see how my math teacher solves a problem, I can picture myself solving the problem in the same way.	0.58	0.56	17.20	13.45
VE4- I compete with myself in math.	0.63	0.56	21.87	18.31
VE5- When I see how another student solves a problem, I can picture myself solving problem in the same way	0.60	0.65	16.60	16.25
VE6- I imagine myself working through challenging math problems successfully	0.55	0.51	19.47	9.83
Sİ1- Adults in my family have told me what a good math student I am.	0.72	0.72	23.96	21.61
Sİ2- *My teachers appreciates me (like telling me "good job") if I solve math problems correctly on the blackboard.*	0.45	0.74	14.03	19.43
SP3- Other students have told me that I am good at learning math.	0.78	0.73	26.32	19.51
SP4- *My friends like to work with me in group works in mathematics classes.*	0.60	0.77	17.25	26.89
SP5- People have told me that I have a talent for math.	0.77	0.77	28.43	28.56
SP6- I have been praised for my ability in math.	0.75	0.70	26.29	28.28
PS1- I start to feel stressed-out as soon as I begin my math work	0.59	0.28	13.64	4.29
PS2- Doing math work takes all of my energy	0.58	0.25	13.13	2.33
PS3- My whole body becomes tense when I have to do math.	0.62	0.31	15.08	3.11
PS4- *I get bored when I think about learning a new topic in mathematics classes.*	0.53	0.27	15.51	3.08
PS5- *When doing mathematics works, as if my brain stops working.*	0.66	0.33	19.11	4.03
PS6- Just being in math class makes me feels stressed and nervous.	0.59	0.35	17.13	3.72

4. Conclusion and Discussion

The main purpose of the current study was to examine the reliability and validity of the Sources of 24-item Self-Efficacy scale developed by Usher and Pajares (2009) and translated into Turkish by Yurt and Sunbul (2014). The participants were secondary school students in three schools in Balikesir, Turkey. Findings, in general, were consistent with the Social Cognitive Theory and other studies.

Although Sources of Mathematics Self-Efficacy Scale (Usher & Pajares, 2009) was translated into Turkish (Yurt & Sunbul, 2014), we believed that this scale might have better psychometric properties by making a number of modifications in the way the scale items are written. Compared to the other study conducted in Turkey (Yurt & Sunbul, 2014), our data fitted to the 4 factor model better, our scale items had more powerful discriminative powers and higher item- total item correlation values. Thus, the results of the current study were more consistent with the study of Usher and Pajares (2009) and Social Cognitive Theory.

Although our data fitted into 4 factor model well and each item had high factor loadings in their respective factor, 3-factor and 4- factor models were nearly identical in term of goodness of fit of data. Analysis of discriminant validity also revealed similar findings. In addition, very high correlation between mastery experiences and verbal persuasion existed. This result contradicts with Social Cognitive Theory. It seems that the feedback that students receive from their teachers, parents and friends play a paramount role in these students' reflections of their mathematics experiences. For example, if a student receives feedback from their social environment indicating that he/she has high abilities in mathematics, this student is highly likely to assess his experiences positively. Although verbal persuasion seem to be third important source of self-efficacy, this result shows that it plays an important role in judging mastery experiences and thus helps to make a remarkable contribution to the development of self-efficacy. At first glance, it might be surprising to find a very high correlation between mastery experiences and verbal persuasion; however, Usher and Pajares (2009) and Yurt and Sunbul (2014) found a similar correlation between these two sources. Usher and Pajares (2009) indicated that this is not surprising since these two sources develop in the same context. How students receive feedback from other people depends on their experiences. If they successfully finish a mathematics task, other people might probably give feedback such as "*you are good at Math*", "*You have high math abilities*".

Mathematics performance of students is not at the desired level in Turkey as well as in other countries of the world. Research found a positive correlation between mathematics self-efficacy and performance (Lopez, Lent, Brown & Gore, 1997; Pajares & Kranzler, 1995). Thus, it would be helpful to examine how the students' self-efficacy

develops and which sources play an important role in its development. The sources of mathematic scale whose validity and reliability were established in the current study helps to learn why some students have high self-efficacy while others low.

5. Recommendations

Mathematics teachers may benefit from this scale. They can administer this scale to their students at the beginning of the semester and learn their source of self-efficacy. They might focus on students who perceive their mathematics previous experiences negative, receive negative feedback from their friends, parents. In addition, some parents whose child has low mathematics performance may talk to mathematics teachers. Mathematics teachers might assist them in reviewing and interpreting these test results and give some ideas concerning how to increase the self-efficacy of their child.

Although this scale is designed to measure sources of self-efficacy, it can give an idea of people's mathematics self-efficacy. Thus, it can help measure self-efficacy indirectly. For example, Cassidy and Eachus (2002) indirectly measured user's computer self-efficacy by looking at its indicators such as perceived usefulness of computers, computer anxiety and perceived ease of use of computers. Since mastery experiences, vicarious experiences, verbal persuasion and physiological states are not only sources but indicators of self-efficacy, total points that students receive from these sources can be considered as their overall self-efficacy scores. For example, if students perceive their previous mathematics experiences positive, receive positive feedback from others as a result of their experiences, their mathematics self-efficacy can be considered high.

This study only focused on the internal validity of the scale, which was one of its limitations. Other studies might examine the relationship between sources of self-efficacy and other variables such as mathematics performance, motivation and attitude to provide evidence for its external validity. We also collected data from only three schools in one city. Thus, we cannot generalize our findings to other settings. This was another limitation of the current study.

Although our study has a number of limitations, we think that our study is valuable for three reasons: (1) we proved the cultural validity of Usher and Pajares' scale (2009), (2) we addressed the shortcomings of Yurt and Sunbul's study (2014), (3) We introduced a number of new items to measure sources of self-efficacy. Future researchers and teachers may confidently use our scale to measure students' source of self-efficacy and examine the psychometric properties of the new items we introduced.

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