연구논문

The Multidimensional Structure of Gottfredson and Hirschi's Concept of Self-Control: An Empirical Analysis of the Grasmick et al.'s Operationalization.

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The purpose of this study is to determine the unidimensionality of Grasmick's operationalization of Gottfredson and Hirschi's criminality inducing the concept of low self-control. By applying confirmatory factor analysis procedures that incorporate advances in the application, the proposed six factor model and two alternative models were examined suggesting that Grasmick's low self-control scale actually contains 6 distinguishable factors, not a single factor. The factors identified to be consistent with the six-factor model were impulsivity, simple tasks, risk seeking, physical activities, self-centered, and temper.

Key words : low self-control, confirmatory factor analysis, dimensionality, pseudo-factor

Ⅰ. INTRODUCTION

In their published book, A General Theory of Crime, Michael Gottfredson and Travis Hirschi(1990) argue that low self-control is the fundamental trait common to persons who engage in criminal and analogous behavior. Their argument implies that these persons have a low threshold of self-control which translates into a higher level of

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impulsivity, a preference for simple rather than complex tasks, a desire for risk seeking behavior, a preference for physical rather than cerebral activities, a self-centered orientation, and a volatile temper. These six components of low self-control combine to form a unidimensional latent construct(Gottfredson & Hirschi 1990: 89-91).

In a subsequent effort to empirically operationlize the concept of self-control, Grasmick, Tittle, Bursik, and Arneklev(1993) developed a scale consisting of twenty-four Likert-type items that was designed to measure the six dimensions of the self-control construct. The specific items of the scale were derived from the self-control subscale of the California Psychological Inventory(Megargee 1972). Even though they operationlized six separate dimensions in representing the concept of self-control, using exploratory factory analysis, Grasmick, et al. argue their multiple measures of self-control appear to coalesce into a single, unidimensional personality trait consistent with the Gottfredson and Hirschi's theoretical position. As the authors state:

> In general, we cannot find strong evidence that combination of items into subgroups produces readily interpretable multidimensionality. Instead, from an empirical perspective, the strongest case can be made for a one-factor unidimensional model, given the large difference in eigenvalues between the first and second factors(Grasmick et al. 1993: 17).

What Grasmick and his colleagues may not have taken into consideration is that their unidimensionality conclusion may be simply an artifact of a limitation in the methodology which they used to analyze their data. Specifically, we wish to propose that the above conclusion is a by-product of exploratory factor analysis(EFA) -- a technique which is unable to test the ability of a hypothesized structure to fit the data. The argument for a unidimensional measure of self-control is actually contradictory to Gottfredson and Hirschi's theory. In fact, the concept of self-control does not require a single manifestation of low self-control. It can be argued that six elements of self-control better reflect the variety of manifestations of low self-control that the authors of the theory had in mind. If the primary consequences of self-control need not be unidimensional, there is certainly no expectation of unidimensionality in its by-products

(Hirschi & Gottfredson, 1993; Longshore, Turner & Stein, 1996; Tittle, Ward & Grasmick 2003).

In contrast to the unidimensionality model implicit in the Grasmick scale, we wish to hypothesize the concept of self-control is best represented by a multidimensional model. In fact, it may actually be a hierarchical second-order structure in which a single latent trait of self-control is posited to represent the covariation among the first-order factors based on six elements of low self-control(see Piquero, MacIntosh & Hickman 2000). However, we will not test this second-order factor model in this paper. Based on this interpretation of Gottfredson and Hirschi, we posit that the low self-control constructs as measured by the Grasmick scale are actually multidimensional in nature. We propose to identify the distinguishable factors and will show that a single factor model will be unable to explain the variation in responses.

Ⅱ. Dimensionality of the Grasmick Scale of Low Self-Control

Grasmick et al.(1993) and Wood, Bfefferbaum & Arneklev(1993) concluded from their research that responses to the self-control scale were unidimensional, or at least that one general factor explained most of the variance in the total score. However, this interpretation can be challenged for a number of reasons that are reviewed in this section.

1. The Number of Factors

In factor analytic studies a critical initial procedure is to ascertain the number of factors needed to explain the responses. Three empirical approaches are most frequently used:

1) the Kaiser rule that ascertains how many eigenvalues are greater than 1.0(Kaiser 1960),
2) the Scree test(Cattell, 1966), and
3) a Chi-square test of statistical significance.

The Kaiser rule is based on the number of unrotated factors that have eigenvalues greater than 1.0. Both Grasmick et al.(1993) and Wood et al.(1993) studies report six factors with eigenvalues greater than 1.0 which correspond to the six elements of low self-control. Moreover, the authors of both these studies, apparently in a mistaken interpretation of the Scree test, have also applied the Scree test in an effort to argue for the unidimensionality of the low self-control scale. In the Scree test, the researcher plots successive eigenvalues on a graph and arrives at a decision based on the point at which the curve of decreasing eigenvalues changes from a rapid deceleration decline to a flat gradual slope. However, Grasmick et al.(1993) and Wood et al.(1993) used the numerical differences between eigenvalues as their judgment criterion, instead of determining where the curve of decreasing eigenvalues changes from a rapid to a flat gradual slope. As the both sets of authors state in their respective articles:

> Following the logic of the Scree test, the most obvious break in eigenvalues is the difference of 2.32 between the first and second factor, compared to .27 between the second and third, strongly suggesting a one-factor model would be appropriate(Grasmick et al. 1993: 16).

> The gap between Factor 1(6.60) and Factor 2(2.26) was sufficiently large to suggest the 24 items could be treated as a single unidimensional factor(Wood et al. 1993:117).

Because the eigenvalue difference between the fifth and sixth factor was 0.67, the Scree(linear slope of gradually declining eigenvalues) cannot be drawn until the sixth factor. Therefore, a more accurate assessment of the Scree test results would suggest six factors in Grasmick's data for the six eigenvalues which lie above the elbow(a sharp break between the downward curve and the completely straight scree).

While the interpretability of factors is an important issue, it may not provide the sole basis for determining the dimensionality of a scale. The fact that the factor(s) can be interpreted does not mean that there are no additional factors. Even when additional factors cannot be readily interpreted, it does not mean that the factor(s) can adequately explain the data. The issue of the number of factors is an important methodological

concern. We do not have information about how much a single factor identified by Grasmick et al. accounts for the proportion of variance explained. With exploratory factor analysis, the first factor of Grasmick's low self-control scale explained only 26.8 percent of variance, while the proportion of variance that was captured by all six factors was over 60 percent. This strongly suggests that a better explanation of explained variance could have been determined from these data.

2. Limitation in Exploratory Factor Analysis and the Advantages of Confirmatory Factor Analysis.

Exploratory Factor Analysis(EFA) is a technique often used to detect and assess a latent source of variation and covariation in observed measurements. An exploratory factor analysis is structure generating, model generating, and hypothesis generating. With EFA the researcher cannot test the ability of a hypothesized structure to fit the data, and is limited to an a posteriori interpretation of the factor structure derived by the EFA procedure. In contrast to EFA, confirmatory factor analysis(CFA) allows the researcher to build a model assumed to describe, explain or account for the data in terms of relatively few parameters. With CFA the researcher can test a hypothesized factor structure, uniquely estimate the parameters used to define a hypothesized model, examine a model's ability to fit the data, and compare the goodness-of-fit for alternative models. Hence, the use of CFA is particularly relevant for comparing models that posit different factor structure for the Grasmick scale(Joreskog, 1971: Joreskog & Sorbom 1989; Long 1983; March & Hocevar 1985).

Ⅲ. METHODOLOGY

1 Sample

The data for this study were collected via a self-reported mail survey of former retail store employees in 1995. 240 former employees from three participating companies were randomly surveyed. As expected from a sample of retail store employees, 186(77%) of

the respondents were female and 54(23%) were male. The respondents ranged in age from 16 to 72 years old with a mean age of 30.90 years old. Over 50 percent of the 240 respondents were between 16 and 27 years of age. 158respondents(66%) were Caucasian. The remainders of the respondents were distributed among three groups: African American(16%), Hispanic(13%), and Asian American(5%). In regard to education, 5 percent of respondents had only less than high school degree, 15.4 percent completed high school, 34.6 percent attended some college level, 12.9 percent had an associate degree, 21.3 percent were college graduates, and 10 percent had graduate school degree. Over sixty percent(60.7) of respondents were previously employed as full-time(more than 35 hours per week) and 39.3 percent were part-time employees. Their average monthly pay received was $1,005.73.

2. Measures

Grasmick et al.(1993) operationlized the concept of self-control according to Gottfredson and Hirschi's six elements of self-control, borrowing items from the already developed self-control subscale of the California Psychological Inventory (Megargee 1972). This self-control scale consists of 24 items-four Likert-type items for each of the six components. The exact same 24 items were used in this study(see Table III).

Preference for Simple Tasks: People lacking self-control tend to lack diligence, tenacity, or persistence in a course of action, and try to avoid complex tasks(Gottfredson and Hirschi, 1990). This scale was assessed using 4 items.

- I frequently try to avoid projects that I know will be difficult.(힘든 일을 피한다)
- When things get complicated, I tend to quit or withdraw.(복잡한 일은 포기한다)
- The things in life that are easiest to do bring me the most pleasure.(쉬운 일을 할 때 즐겁다)
- I dislike really hard tasks that stretch my abilities to the limit.(능력 밖의 일은 싫어한다)

Volatile Temper: People with low self-control tend to have minimal tolerance for frustration and little ability to respond to conflict through verbal rather than physical

means. This scale consisted of 4 items.

- I lose my temper pretty easily,(쉽게 화를 낸다)
- Often when I'm angry at people, I feel more like hurting them than talking to them about why I am angry,(화를 낼 때 이유를 설명하기보다는 상처를 준다)
- When I'm really angry, other people better stay away from me,(내가 화났을 땐, 내 곁을 떠나있는 것이 낫다)
- When I have a serious disagreement with someone, it's usually hard for me to talk calmly about it without getting upset.(의견이 다를 때 흥분하지 않고 조용히 말하기 어렵다)

Self-Centeredness: People with low self-control tend to be self-centered, indifferent, or insensitive to the suffering and needs of others. This trait we labeled self-centered. The self-centered scale was a summation of 4 items.

- I try to look out for myself first, even if it means making things difficult for other people.(다른 사람 힘들게 하더라도 나를 먼저 챙긴다)
- I'm not very sympathetic to other people when they are having problems,(어려운 일을 당하는 사람 따위엔 별 관심 없다)
- If things I do upset people, it's their problem not mine.(내가 다른 사람을 흥분시켜도 그것은 그 사람들 일일 뿐이다)
- I will try to get the things I want even when I know it's causing problems for other people.(다른 사람에게 문제가 생긴다 해도 난 내가 원하는 것을 가지려 한다)

Risk-Seeking: People with low self-control tend to be adventuresome rather than cautious because criminal acts are exciting, risky, or thrilling. This scale consisted of 4 items.

- I like to test myself every now and then by doing something a little risky.(약간의 위험부담이 있는 일로 나 자신을 시험하고 싶다)
- Sometimes I will take a risk just for the fun of it.(때로 장난스레 위험한 일을 즐긴다)
- I sometimes find it exciting to do things for which I might get in trouble.(곤란함을 수반하는 일에 흥미를 느낀다)

- excitement and adventure are more important to me than security.(안전보다는 흥분이나 모험을 즐긴다)

Impulsivity: People with low self-control include a tendency to respond to tangible stimuli in the immediate environment and to have a concrete here and now orientation. This impulsivity scale was assessed using 4 items.

- I don't devote much thought and effort to preparing for the future.(미래를 위해 생각하거나 노력하지 않는다)
- I often do whatever brings me pleasure here and now, even at the cost of some distant goal.(장래의 목표를 포기하더라도 현재의 기쁨을 추구한다)
- I'm more concerned with what happens to me in the short run than in the long run.(장래보다는 가까운 미래의 일에 더 관심을 갖는다)
- I much prefer doing things that pay off right away rather than in the future.(장래에 보상받을 일보다는 현재 보상받는 일을 더 좋아한다)

Preference for Physical Activities: Low self-control embraces a preference for physical activity rather than cognitive or mental activity. The physical activity scale was a summation of 4 items.

- If I had a choice, I would almost always rather do something physical than something mental.(항상 정신적인 것보다 육체적인 것을 선택한다)
- I almost always feel better when I am on the move than when I am sitting.(앉아 있을 때보다는 움직일 때 기분이 더 좋다)
- I like to get out and do things more than I like to read or contemplate ideas.(읽고 생각하는 것보다 나가서 활동하는 것이 더 좋다)
- I seem to have more energy and a greater need for activity than most other people my age.(에너지가 넘쳐 내 동년배들보다 행동을 더 많이 한다)

The scale scores for each of the six dimensions were computed by summing the response score of each Likert-type item(i.e., the higher the score, the lower the self-control). The mean score of preference for simple tasks was 6.80 with a possible response score ranging from 0 to 16. The mean score of volatile temper was 6.79 with

a possible response score ranging from 0 to 16. The mean score of self-centeredness was 6.21 with a possible response ranging from 0 to 16. Risk-seeking scale had 8.42 of mean score with a possible response ranging from 0 to 16. The mean score of impulsivity was 7.04 with a possible response ranging from 0 to 16. The mean score of preference for physical activities was 10.24 with a possible response ranging from 0 to 16.

3. Analysis

Confirmatory Factor Analyses(CFA) were conducted on first-order models. The greatest advantage of conducting a confirmatory factor analysis is the ability to compare alternative theoretical models in fitting the same data. Moreover, CFA models allow a more rigorous test than visual inspection. Specially, in this study the responses to the 24 items are represented by a 24×24 covariance(or correlation) matrix. The structure of relations between observed variables and latent factors will be tested. We will compare a one-factor model(unidimensionality) with a six-factor model(6 elements of low self-control or multidimensionality). CFA will generate goodness-of-fit indices and Chi-square showing whether the factor structures fit the data or not. Discussion will be limited primarily to the change in Chi-square and the Chi-square/Degrees of Freedom ratio. Researchers generally suggest that the ratio of Chi-square to degrees of freedom is 1 and the smaller the ratio, the better the fit. Researchers interpret a ratio as high as 2 to 1 is an adequate fit(Carmines & McIver 1981). In the analyses, the relations among the observed and latent variable are also estimated. A detailed examination of each item, however, is beyond the scope of this paper.

One problem in the analysis is that a six-factor model will necessarily account for more variance than the one factor model simply because of the greater number of factors in much the same way that multiple correlations are inflated by invalid predictors. The magnitude of this inflationary effect was assessed by computing pseudo factors (Bernstein & Eveland 1982; Bernstein, Garbin & Teng 1988). The pseudo-factor model is a model created by arbitrarily assigning items to a specified number of factors. The comparison is made to rule out the possibility that too many factors have been retained for the data, as a model not based on theoretical assignment of items should result in a poor fit.

> It is not meaningful to compare a centroid model to one that contains multiple factors. The model with more factors will almost invariably fit better for the same reason(bias) that a multiple correlation is going to be larger than any simple(zero-order) correlation and one based on more predictors will be larger than one based on fewer predictors … Instead, simply consider that if the substantive model fails to fit better than a pseudo-factor model; a model with fewer factors such as a single centroid may be warranted(Bernstein et al. 1988:213).

Using LISREL 7, a one-factor congeneric model(Joreskog & Sorbom 1989) was used to compare with six-factor model. Congeneric measures are those that fit one or more factor congeneric model. The partial correlation between any pair of measures or items, given the latent factor, is zero. Confirmatory factor analyses(CFA) were conducted on six-factor model that might be used to explain the empirical structure of low self-control scale. A six-factor model was constructed based on the elements of self-control(Gottfredson & Hirschi 1990; Grasmick et al.1993). Items from Grasmick scale were assigned to each element or factors. A pseudo-factor model was developed and tested. Items were assigned alternately to one of six factors independent of theoretical assumptions about self-control scale or identification. One-factor model was also developed to test unidimensionality of low self-control scale. It is assumed that measures of each of the 24 items are correlated because they have a single unobserved common factor(low self-control).

Ⅳ. RESULTS

As shown in Table 1, the Goodness of Fix Index(GFI) and the Adjusted Goodness of Fit Index(AGFI) values(.749 and .683, respectively), as well as the Chi-square/df ratio(3.58) suggested that the pseudo-factor model results in a poorer fit than the six-factor model tested. The one factor solution indicated unidimensionality of low self-control that combined items on a single factor. This one-factor solution (GFI=.725, AGFI=.672, and Chi-square/df ratio=3.66) fails to yield indices of fit

Table 1. Measures of Goodness of Fit for Models

	Model		
	6-Factor	1-Factor	Pseudo
$\chi^2(df)$	437.87 (237)	921.09 (252)	847.95 (237)
$\triangle\chi^2(df)$	483.22 (15)		
Goodness of fit index	.863	.725	.749
Adjusted goodness of fit index	.826	.672	.683
Root mean square residual	.081	.095	.094
Common variance explained	1.000	.890	.907

equal to the proposed six-factor model. The common variance accounted for by this single-factor solution is less than that of the six factor model(.99). In addition, the single-factor solution fails to reproduce the observed correlations as accurately as those of the six-factor model(RMS=.10 for one-factor model, and RMS=.08 for six-factor model).

However, the six factor model(GFI=.863, AGFI=.826, and Chi-square/df ratios=1.85) is a more satisfactory solution than the single factor model. Although GFI and AGFI are less than .90, a GFI of .863 and an AGFI of .826 point to a model with a reasonably good fit of the congeneric measurement model. The Chi-square/df ratios(1.85) showed this model fit the data very well. Chi-square change(483.22 with 15 df) indicated that six-factor model shows a substantial improvement in the fit over the single-factor model.

We examined several indicators to see if we could further improve the proposed six-factor model. According to the modification indices, the improvement in the fit is substantial if the error terms of the risk-seeking items are allowed to covary. These items are conceptually similar, related to some type of emotional excitement among the respondents, and therefore, it is plausible that their error terms are correlated. Similarly, items of physical activities were also allowed to covary. There is much support for this

practice of correlating error terms on the ground that the specification of a model that forces these error parameters to be uncorrelated is rarely appropriated with real data(Byrne 1991).

Although few items in the physical activities subscale were not strongly related to preference for physical activities, we selected to covary the error terms instead of deleting one of the items in the subscale. Because a detailed examination of each item is beyond the scope of this study, we decided to follow a strategy of allowing the error terms to covary. This allowed us to retain the variance contributed by the individual items while improving the overall fit of the model.

In allowing the error terms to covary, we achieved a statistically significant drop in Chi-square and a marked improvement in model fit. By examining the indices for the six-factor model, it is evident that the improvement in the fit is substantial and statistically significant. Chi-square decreased to 240.14 with 215 df and it is not significant. In addition, GFI increased to .923 and AGFI improved to .893, indicating a very good fit.

In Table 2, reliability and validity of the six constructs of low self-control scale is shown. Self-Centered had the highest reliability(.780) of the six constructs. Both Risk Seeking and Simple Tasks had reliability of .777. Temper and Impulsivity had reliability of .748 and .745 respectively. Physical Activity had the lowest reliability (.584) of the low self-control subscale and it shows a need of improvement, especially the fourth item of preference of physical activities scale(see Table 3). The reliabilities reported in this study are consistent with the reliabilities of the composite scale reported by Grasmick et al.(1993). Grasmick et al. deleted the fourth item of physical activities, explaining that the activities referred to in this particular item may not be interpreted as physical activities by respondents. The 23 remaining items were subjected to final principal components analysis forcing a one factor solution. In this study, however, we did not remove any items from the analysis, instead following an alternate strategy of allowing the error terms mentioned above. As a result, the reliability of all 24 self-control items in this study was .862.

Table 2. Reliability and Validity of Self-Control Scale and Factor Correlation

Construct	1	2	3	4	5	6
1. Risk-Seeking	1.000					
2. Simple Tasks	.482	1.000				
3. Temper	.431	.471	1.000			
4. Physical Activities	.160	.172	.179	1.000		
5. Impulsivity	.427	.657	.365	.335	1.000	
6. Self-Centered	.581	.463	.504	.178	.579	1.000
Cronbach Alpha	.777	.777	.748	.584	.745	.780
Variance extrated	.477	.467	.451	.320	.441	.471

To measure the validity of a scale we calculated the amount of variance shared by observed indicators. This shared variance suggests how the observed measure represents an underlying latent construct(Dillon & Goldstein 1984). Risk-Seeking explained the largest proportion of the variance, while Physical Activities construct explained the least. The construct, Risk-Seeking, captured 47.7 percent of the variance in its four observed indicators. The specific loading of the indicators ranged from a low of .613 to a high of .798(Table 3). All four items load significantly on the Risk-Seeking factor. The Shared Multiple Correlations(SMC) for indicators of Risk-Seeking were generally high, reflecting their reliability as indicators of this construct, ranging from a low of .384 to a high of .636. The indicators of Simple Tasks captured 46.7 percent of the variance in the construct. All four items had statistically significant loadings, ranging from .648 to .737. The SMC for items ranged from .420 to .543.

Indicators of Temper captured 45.1 percent of the variance in the construct. In fact, the four indicators of Temper had factor loadings form .557 to .777. All of the loadings were statistically significant. All items measuring this construct had SMCs in the range of .310 to .603. Indicators of Physical Activities accounted for a small proportion of the variance(32.0 percent) compared with the other constructs.

Table 3. Confirmatory Factor Loadings on Low Self-Control Scale

Dimensions and Items	Loading	T value	SMC
Factor 1. Risk Seeking			
I like to test myself every now and then by doing something a little risky.	.620	9.43	.384
Sometimes I will take a risk just for the fun of it.	.798	12.93	.636
I sometimes find it exciting to do things for which I might get in trouble.	.715	11.26	.511
Excitement and adventure are more important to me than security.	.613	9.32	.376
Factor 2. Simple Tasks			
I frequently try to avoid projects that I know will be difficult.	.656	10.07	.430
When things get complicated, I tend to quit or withdraw.	.737	11.68	.543
The things in life that are easiest to do bring me the most pleasure.	.688	10.71	.474
I dislike really hard tasks that stretch my abilities to the limit.	.648	9.92	.420
Factor 3. Temper			
I lose my temper pretty easily.	.557	8.19	.310
Often when I'm angry at people, I feel more like hurting them than talking to them about why I am angry.	.726	11.26	.527
When I'm really angry, other people better stay away from me.	.777	12.21	.603
When I have a serious disagreement with someone, it's usually hard for me to talk calmly about it without getting upset.	.603	9.00	.363
Factor 4. Physical Activities			
If I had a choice, I would almost always rather do something physical than something mental.	.361	4.83	.131
I almost always feel better when I am on the move than when I am sitting.	.540	6.85	.291
I like to get out and do things more than I like to read or contemplate ideas.	.882	9.37	.777
I seem to have more energy and a greater need for activity than most other people my age.	.283	3.82	.080
Factor 5. Impulsivity			
I don't devote much thought and effort to preparing for the future.	.500	7.31	.250
I often do whatever bring me pleasure here and now, even at the cost of some distant goal.	.725	11.45	.525
I'm more concerned with what happens to me in the short run than in the long run.	.765	12.26	.585
I much prefer doing things that pay off right away than in the future.	.636	9.72	.404
Factor 6. Self-Centered			
I try to look out for myself first, even if it means making things difficult for other people.	.654	10.12	.427
I'm not very sympathetic to other people when they are having problems.	.589	8.91	.347
If things I do upset people, it's their problem not mine.	.744	11.93	.553
I will try to get the things I want even	.760	12.26	.557

Loadings are estimated for each factor. SMC=Squared Multiple Correlations for X

The indicators of Physical Activities had factor loadings form .283 to .882. All items were statistically significant. The SMC for third item was in the .70s, but the rest of the items had SMCs in less than .30, and the last item has .080 SMC.

The indicators of Impulsivity captured 44.1 percent of the variance in the construct. All four items had statistically significant loadings, ranging from .500 to .765. All of the loadings were statistically significant. The SMCs for indicators of Impulsivity were from .250 to .585.

The construct Self-Centered captured 47.1 percent of the variance in its four observed indicators. The loadings of the indicators ranged from a low of .589 to a high of .760. All of the loadings were statistically significant. The SMCs for items were ranged from .347 to .557. The intercorrelations among the latent constructs were high to moderate(.335 to .657), except the construct of Physical Activities(.160 to 335). All of the correlations among the latent constructs were positive and statistically significant, as expected. The latent construct Self-Centered was highly correlated with the other five constructs.

Ⅴ. DISCUSION

The purpose of this study was to determine the unidimensionality of Grasmick et al.'s low self-control scale by applying confirmatory factor analysis procedures that incorporate advances in the application of factor analysis. Gottfredson and Hirschi's (1990) theory of low self-control is one of the most parsimonious criminological theories. If the concept of self-control is not unidimensional as they suggest, the predictive power and conceptual clarity would be somewhat diluted(Longshore et al. 1996; Piquero et al. 2000). Our analyses using the same 24 items of Grasmick's low self-control determined that the concept of low self-control could be multidimensional. Confirmatory factor analyses of the proposed six-factor model and two alternative models suggest that Grasmick's low self-control scale actually contains six distinguishable factors of Impulsivity, Simple Tasks, Risk Seeking, Physical Activities, Self-Centered, and

Temper. The indices for the pseudo-factor and a single-factor model indicate that they cannot account for the data yielded by Grasmick's low self-control scale.

The statistical analyses presented in this study are important for several reasons. Previously, the dimensionality of low self-control scale has been subjected only to exploratory factor analysis. We attempt to confirm the structure of self-control scale through confirmatory factor analysis.

More importantly, research on low self-control has made it clear that many questions remain about measures of self-control. In this study, it was hypothesized that six factors are based on the content of low self-control using 24 items, but these first-order factors could be explained in terms of a single second-order factor that corresponds to unidimensionality of low self-control. A variety of assessment tools and techniques will be required to unveil the operational concept of low self-control.

Analysis provided supports for the construct validity of the six constructs of the low self-control. Risk-Seeking, Simple Tasks, Temper, Impulsivity, and Self-Centered are robust constructs, but Physical Activity is very not robust consistent with earlier findings from Grasmick's(1993). Our results support the construct validity of the six factors to varying degrees. The shared variance among the indicators of Risk-Seeking factor was higher than any other construct. Conversely, the proportion of shared variance among individual indicators of Physical Activity is comparatively low. The construct validity for this factor is less than desirable. Many indicators for this construct had high loading on indicators of other constructs.

Although our analysis found Grasmick's low self-control scale valid and reliable, the Physical Activities items are the weakest component of the scale, hence further research developing alternative items is needed to establish the instrument's construct validity. Future studies should use larger samples to give researchers the luxury of analyzing a random half of the sample and then replicating those findings using the other random half. Measurement analysis done in this way provides more confidence when confirming the construct validity of the low self-control scale.

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