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ReliabilityandValidityinMarketingResearch:AStatistical Approach

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Introduction: Marketing research is the process of collecting data about the target market to improve the market share by making suitable modifications in the marketing mix. (4Ps). Usually marketing research will give a lot of valuable information about the underlying motives of consumers and helps in adjusting the promotional policies of the organization. There are various toolstocollectandanalyzedataforthispurpose.Butthefundamentalquestiontobeansweredin this case is how reliable and how valid are the data collected for this purpose? Unless the data collected becomes reliable & valid, the whole process of marketing research will become GIGO (Garbagein GarbageOut).Noneofthelatestsophisticatedstatisticalpackagesandtoolscanhelp onereplacetheauthenticdata.Thisarticlehelpstothrowlightuponthetwofundamentalconcepts of research namely reliability & validity.

Types of Marketing Research: Marketing research falls into two categories; primary & secondary. Primary research focuses on fresh data collected from market to draw conclusions about market whereas secondary research focuses on already collected data used for analysis. In boththecases,statisticalanalysisispossibletohelpinarrivingatreasonablylogicalconclusions. But before starting the statistical analysis we have to make sure that the data collected (primary/secondary) is amenableto reliability & validity. Primarydatais moresuitable fordoing apucca statistical analysis as it is devoid of any first-hand error. Generally secondary data is already baked once and re-baking it may not be that advisable. However, by making suitable adjustments in the data, we can use suitable tools for analysis.

Uses of Marketing Research: Marketing research can be done in five ways: observation, focus groups, surveys, behavioral data, and experiments. Marketing research is extremely useful in demand forecasting, understanding consumer insights, buyer behavior, product positioning and STP. Some times a product-preference test may also become critical in finding out the hidden motives of buyers. Closed ended questions like Dichotomous, Multiple Choice, Likert Scale, Semantic Differential, Importance Scale, Rating Scale & Intention-to-buy scale may reveal a lot of data about the market. Completely unstructured questions like word association, Sentence Completion, Story Completion, Picture& TAT can also be handy in revealing the psychological association of the consumer with the product.

Reliability: Reliabilityisoneofthemostbasicrequirementsforaresearch.Reliabilityisallabout consistency.Ifaresearcherdoestheexperiment3timesandcomesoutwith3differentanswers

then we can say that that research is not reliable. Reliability is all about being uniform in giving results. There are a number of measures of reliability.

Interraterreliability: Itisallaboutgivingtheinstrumenttodifferentrespondentsandmeasuring the results. Example can be a patient going to a doctor with stomach pain all doctors giving the same diagnosis.

Test-Retest Reliability: The instrument being administered to the same respondent more than once and the result being measured.

Inter-methodReliability: Thisisamethodoffindingoutthereliabilityofaninstrumentbyusing differentmethods.Exampletheweightofanindividualcanbemeasuredbybothnormalweighing machineandelectronicmachineandthedifferenceifanycanbeconsideredasameasureofinter- method Reliability.

Internal Consistency: The internal consistency of an instrument can be found by Cronbach's alpha. Alpha is a measure of internal consistency. Usually depending upon the construct, we are measuring, the acceptable value may vary, how-ever any value above 0.6 is considered as an acceptable value to authenticate the consistency of the instrument.

Differencebetween Reliability &Validity: Areliablemeasureneednot bevalid, in validitywe are measuring the true value of the construct being measured. A valid measure is always reliable butnotviceversa.Awall-clockrunning10minutesfastalwaysisreliable,butnotvalid.Validity is all about measuring what we intend to measure. Several basic types of validity exist, although oftendescribedwithsomewhatvaryingterminology.Inahighlyreadableandalmostlay-man-like presentation of the subject, Nunally writes of three basic types: (1) content validity which is generally irrelevant in consumer research. (2) predictive validity, (3) construct validity. Face validity, a non-psychometric variety, refers to whether a measure looks like it is measuring what it is supposed to be measuring. Examination of the core consumer behavior journals and conference proceedings since 1970-a body of literature reveals the following:

Face Validity: First, there are numerous examples of face validity. The measures used almost alwayslooklike they are measuring that whichthey aresupposed to be measuring.However, the overwhelmingmajoritystudiesgonofurther,i.e.,providenoempiricalsupport.Thus,facevalidity is often used as a substitute for construct validity.

Predictive Validity: There are also a sizeable number of studies which suggest the existence of predictive validity, that is, the measure in question seems to correlate, as predicted, with the measure of other variables. Unfortunately, many investigators do not seem to recognize that predictive validity provides little, if any understanding of the relationship. One can have a predictivevaliditycoefficientof0.99andstillknowwhyorwhatitmeans-otherthanthefactthat thescoresononevariablearehighlypredictiveofscoresonsecondvariable.Therelationshipmay even be meaningless. Obviously high predictive validity doesn't necessarily have to be meaningful.

Cross Validity: One type of predictive validity, however, receives too little attention, namely cross-validity."Whereaspredictivevalidityisconcernedwithsinglesample,cross-validity

requires that the effectiveness of the predictor composite be tested on a separate independent sample from the sample population". It should be obvious that unless we can cross-validate our findings, we may really have no findings at all. Again, examination of the literature reveals few cross-validation studies.

ConstructValidity: Themostnecessarytypeofvalidityinscientificresearchis construct validity.

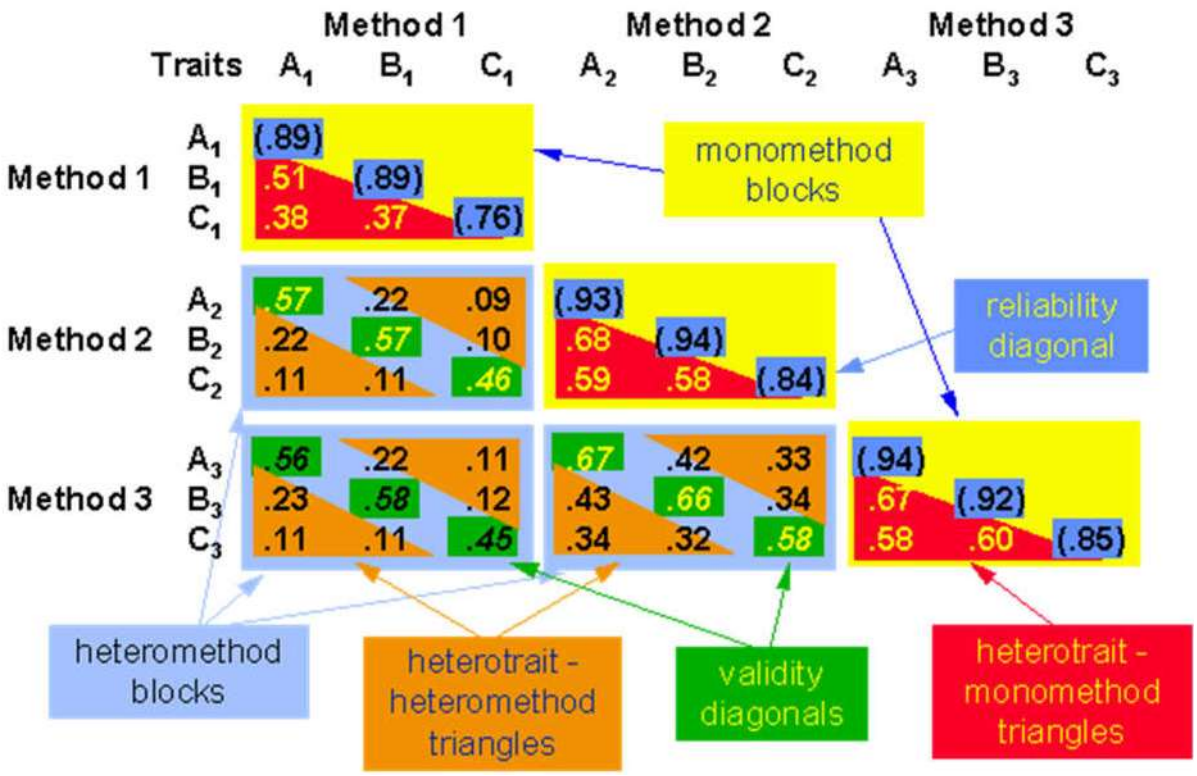
Examination of the recent literature indicates that a negligible proportion of our productivity has been directed toward determining construct validity. A large part of the problem lies in the fact that many researchers appear to be naively believe that scientific research is a game played by creating measures and applying them directly to reality. Although guided by some implicit conceptualization of what it is by trying to measure, the consumer researcher rarely makes his implicit concepts sufficiently or uses them as a basis for developing operational measures. Yet virtually all contemporary scholars of science generally agree that the concept must precede the measure.

ConvergentValidity:A basicandrelativelyeasy-to-establishcomponentofconstructvalidityis convergentvalidity.Thisreferstothedegreetowhichattemptstomeasurethesameconceptusing the same concept using two or more different measures yield the same results. Even if few construct validity investigations are available, it seems reasonable to expect that, since many of our core concept are characterized by numerous and varied operationalizations, we should find many studies to demonstrate convergent validity.

TheMultitrait-MultimethodMatrixapproachforvalidity

What is the Multitrait-Multimethod Matrix?

TheMultitrait-Multimethod Matrix (hereafter labeled MTMM) is an approach to assessing the constructvalidityofasetofmeasuresinastudy.Itwasdevelopedin1959byCampbellandFiske (Campbell, D. and Fiske, D. (1959). Convergent and discriminant validation by the Multitrait-multimethod matrix. 56,2, 81-105.) in part as an attempt to provide a practical methodology that researchers could actually use (as opposed to the**nomological network**idea which was theoretically useful but did not include a methodology). Along with the MTMM, Campbell and Fiske introduced two new types of validity –**convergent and discriminant**– as subcategoriesof**constructvalidity**.**Convergentvalidity**isthedegreetowhichconceptsthatshouldber elated theoreticallyareinterrelatedinreality.**Discriminantvalidity**isthedegreetowhichconceptsthat should*not*be related theoretically are, in fact,*not*interrelated in reality. You can assess both convergent and discriminant validity using the MTMM. In order to be able to claim that your measures have construct validity, you have to demonstrate both convergence and discrimination.



The MTMM is simply a matrix or table of correlations arranged to facilitate the interpretation of the assessment of construct validity. The MTMM assumes that you measure each of several concepts (called*traits*by Campbell and Fiske) by each of several methods (e.g., a paper-and-pencil test, a direct observation, a performance measure). The MTMM is a very restrictive methodology – ideally you should measure *each* concept by *each* method.

To construct an MTMM, you need to arrangethe correlation matrix by concepts within methods. ThefigureshowsanMTMMforthreeconcepts(traitsA,BandC)eachofwhichismeasuredwith three different methods (1, 2 and 3) Note that you lay the matrix out in blocks by*method*. Essentially,theMTMM is just acorrelationmatrixbetween yourmeasures, withoneexception – insteadof1'salongthediagonal(asinthetypicalcorrelationmatrix)wesubstituteanestimateof the reliability of each measure as the diagonal.

BeforeyoucaninterpretanMTMM,youhavetounderstandhowtoidentifythedifferentpartsof the matrix. First, you should note that the matrix is consists of nothing but correlations. It is a square,symmetricmatrix,soweonlyneedtolookathalfofit(thefigureshowsthelowertriangle). Second, these correlations can be grouped into three kinds of shapes: diagonals, triangles, and blocks. The specific shapes are:

TheReliabilityDiagonal(monotrait-monomethod)

Estimatesofthereliability ofeach measurein the matrix.You can estimate reliabilitiesanumber of different ways (e.g., test-retest, internal consistency). There are as many correlations in the reliability diagonal as there are measures – in this example there are nine measures and nine reliabilities.ThefirstreliabilityintheexampleisthecorrelationofTraitA,Method1withTrait

A,Method1 (hereafter, I'll abbreviatethis relationshipA1-A1).Notice that this is essentiallythe correlation of the measure with itself. In fact such a correlation would always be perfect (i.e., r=1.0).Instead,wesubstituteanestimateofreliability.Youcouldalsoconsiderthesevaluestobe monotrait-monomethod correlations.

TheValidityDiagonals(monotrait-heteromethod)

Correlations between measures of the same trait measured using different methods. Since the MTMMisorganizedintomethodblocks,thereisonevaliditydiagonalineachmethodblock.For example,lookattheA1-A2correlationof.57.Thisisthecorrelationbetweentwomeasuresofthe same trait (A) measured with two different measures (1 and 2). Because the two measures are of thesametraitorconcept,wewouldexpectthemtobestronglycorrelated.Youcouldalsoconsider these values to be monotrait-heteromethod correlations.

TheHeterotrait-MonomethodTriangles

These are the correlations among measures that share the same method of measurement. For instance, A1-B1 = .51 in the upper left Heterotrait-monomethod triangle. Note that what these correlations share is method, not trait or concept. If these correlations are high, it is because measuring different things with the same method results in correlated measures. Or, in more straightforward terms, you've got a strong "methods" factor.

Heterotrait-HeteromethodTriangles

These are correlations that differ in both trait and method. For instance, A1-B2 is .22 in the example. Generally, because these correlations share neither trait nor method we expect them to be the lowest in the matrix.

TheMonomethodBlocks

These consist of all of the correlations that share the same method of measurement. There are as many blocks as there are methods of measurement.

TheHeteromethodBlocks

These consist of all correlations that do*not*share the same methods. There are (K(K-1))/2 such blocks, where K = the number of methods. In the example, there are 3 methods and so there are (3(3-1))/2 = (3(2))/2 = 6/2 = 3 such blocks.

PrinciplesofInterpretation

NowthatyoucanidentifythedifferentpartsoftheMTMM,youcanbegintounderstandtherules for interpreting it. You should realize that MTMM interpretation requires the researcher to use judgment. Even thoughsomeoftheprinciplesmay beviolatedin an MTMM, youmay still wind upconcludingthatyouhavefairlystrongconstructvalidity.Inotherwords,youwon'tnecessarily get*perfect*adherencetotheseprinciplesinappliedresearchsettings,evenwhenyoudohave

evidence to support construct validity. To me, interpreting an MTMM is a lot like a physician's reading of an x-ray. A practiced eye can often spot things that the neophyte misses! A researcher who is experienced with MTMM can useit to identifyweaknesses in measurement as well as for assessing construct validity.

		P&P			Teacher			Parent		
	Traits	SE_1	SD_1	LC_1	SE_2	SD_2	LC_2	SE_3	SD_3	LC_3
P&P	SE_1	(.89)								
	SD_1	.51	(.89)							
	LC_1	.38	.37	(.76)						
Teacher	SE_2	.57	.22	.09	(.93)					
	SD_2	.22	.57	.10	.68	(.94)				
	LC_2	.11	.11	.46	.59	.58	(.84)			
Parent	SE_3	.56	.22	.11	.67	.42	.33	(.94)		
	SD_3	.23	.58	.12	.43	.66	.34	.67	(.92)	
	LC_3	.11	.11	.45	.34	.32	.58	.58	.60	(.85)

To help make the principles more concrete, let's make the example a bit more realistic. We'll imaginethat wearegoingto conduct astudyofsixth gradestudents andthat wewant to measure three traits or concepts: Self Esteem (SE), Self Disclosure (SD) and Locus of Control (LC). Furthermore,let'smeasureeachofthesethreedifferentways:aPaper-and-Pencil(P&P)measure, aTeacherrating,and aParent rating.Theresultsarearrayedin theMTMM.Astheprinciples are presented,trytoidentifytheappropriatecoefficientsintheMTMMandmakeajudgementyourself about the strength of construct validity claims.

ThebasicprinciplesorrulesfortheMTMMare:

Coefficients in the reliability diagonal should consistently be the highest in the matrix. That is, a trait should be more highly correlated with itself than with anything else! This is uniformly true in our example.

Coefficients in the validity diagonals should be significantly different from zero and high enoughtowarrantfurtherinvestigation. Thisisessentiallyevidenceofconvergentvalidity.All of the correlations in our example meet this criterion.

A validity coefficient should be higher than values lying in its column and row in the same heteromethod block. In other words, (SE P&P)-(SE Teacher) should be greater than (SE P&P)-(SD Teacher), (SE P&P)-(LC Teacher), (SE Teacher)-(SD P&P) and (SE Teacher)-(LC P&P). This is true in all cases in our example.

A validity coefficient should be higher than all coefficients in the heterotrait-monomethod triangles. This essentially emphasizes that trait factors should be stronger than methods factors. Note that this is*not*true in all cases in our example. For instance, the (LC P&P)-(LC Teacher) correlationof.46islessthan(SETeacher)-(SDTeacher),(SETeacher)-(LCTeacher),and(SD

Teacher)-(LCTeacher)–evidencethattheremightmeamethodsfactor,especiallyontheTeacher observation method.

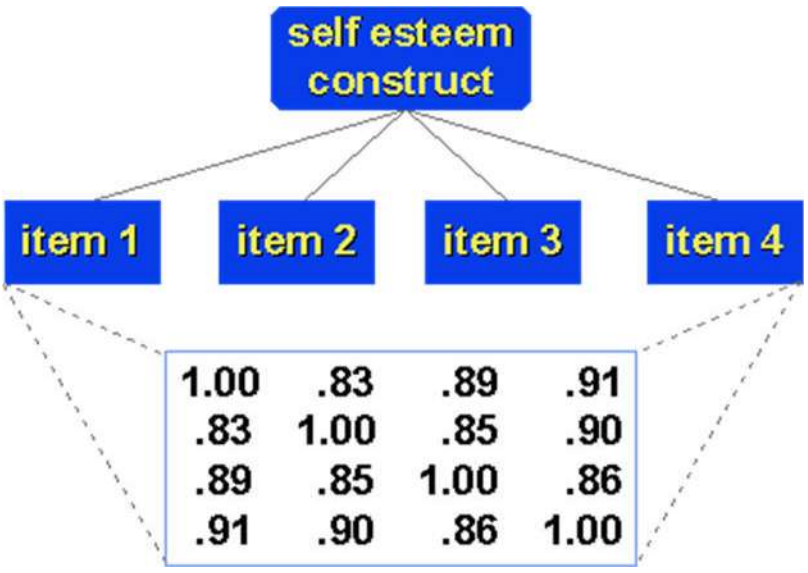
Thesame*pattern***oftraitinterrelationshipshouldbeseeninalltriangles.**Theexampleclearly meets this criterion. Notice that in all triangles the SE-SD relationship is approximately twice as large as the relationships that involve LC.

AdvantagesandDisadvantagesofMTMM

TheMTMMideaprovidedanoperationalmethodologyforassessingconstructvalidity.Intheone matrix it was possible to examine both convergent and discriminant validity simultaneously. By its inclusion of methods on an equal footing with traits, Campbell and Fiske stressed the importance of looking for the effects of how we measure in addition to what we measure. And, MTMM provided a rigorous framework for assessing construct validity.

Despitetheseadvantages,MTMMhas received littleusesinceitsintroductionin1959.Thereare several reasons. First, in its purest form, MTMM requires that you have a fully-crossed measurement design – each of several traits is measured by each of several methods. While CampbellandFiskeexplicitlyrecognizedthatonecouldhaveanincompletedesign,theystressed the importance of multiple replication of the same trait across method. In some applied research contexts, it just isn't possible to measure all traits with all desired methods (would you use an "observation"ofweight?).Inmostappliedsocialresearch,itjustwasn'tfeasibletomakemethods an explicit part of the research design. Second, the judgmental nature of the MTMM may have worked against its wider adoption (although it should actually be perceived as a strength). many researchers wanted a test for construct validity that would result in a single statistical coefficient that couldbetested–theequivalent ofareliability coefficient. It was impossiblewithMTMMto quantify the*degree*of construct validity in a study. Finally, the judgmental nature of MTMM meant that different researchers could legitimately arrive at different conclusions.

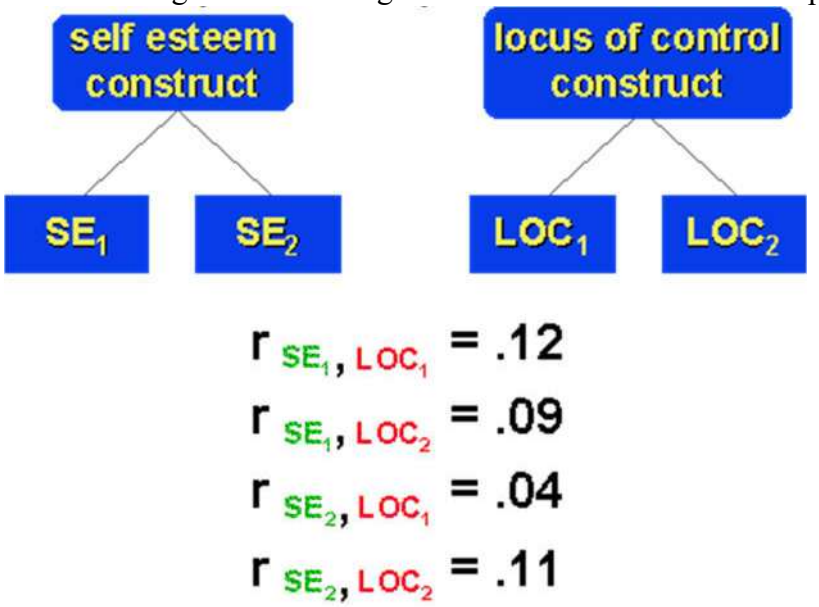
AModifiedMTMM–LeavingouttheMethods Factor



As mentioned above, one of the most difficult aspects of MTMM from an implementation point of view is that it required a design that included all combinations of both traits and methods. But the ideas of convergent and discriminant validity do not require the methods factor. To see this, we have to reconsider what Campbell and Fiske meant by convergent and discriminant validity.

Whatisconvergentvalidity?

It is the principle that*measures of theoretically similar constructs should be highly intercorrelated*. We can extendthis ideafurtherby thinkingofameasurethat has multipleitems, forinstance, afour-itemscaledesigned to measure self-esteem. If eachoftheitemsactually does reflecttheconstructofself-esteem,thenwewouldexpecttheitemstobehighlyintercorrelatedas showninthefigure.Thesestrongintercorrelationsareevidenceinsupportofconvergentvalidity.

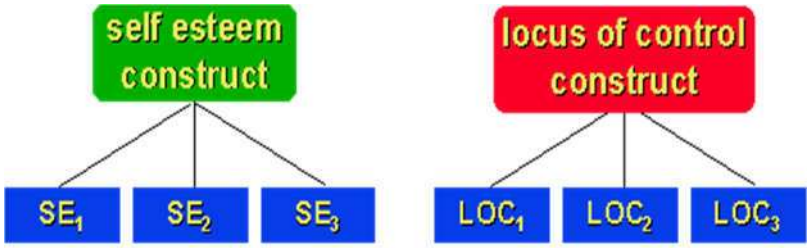


Andwhatisdiscriminant validity?

It is the principle that*measures of theoretically different constructs should not correlate highly witheachother*.Wecanseethatintheexamplethatshowstwoconstructs–self-esteemandlocus ofcontrol–eachmeasuredintwoinstruments.Wewouldexpectthat,becausethesearemeasures ofdifferentconstructs,thecross-constructcorrelationswouldbelow,asshowninthefigure.These low correlations are evidence for validity. Finally, we can put this all together to see how we can address both convergent and discriminant validity simultaneously. Here, we have two constructs – self-esteem and locus of control – each measured with three instruments. The red and green correlations arewithin-construct ones. They are a reflection of convergent validity and should be strong.Thebluecorrelationsarecross-constructandreflectdiscriminantvalidity.Theyshouldbe uniformly lower than the convergent coefficients.

The important thing to notice about this matrix is that*it does not explicitly include a methods factor*as a true MTMM would. The matrix examines both convergent and discriminant validity (liketheMTMM)butitonlyexplicitlylooksatconstructintra-andinterrelationships.Wecansee inthisexamplethattheMTMMideareallyhadtwomajorthemes.Thefirstwastheideaoflooking

simultaneouslyatthepatternofconvergenceanddiscrimination.Thisideaissimilarinpurposeto the notions implicit in the**nomological network**– we are looking at the pattern of interrelationships based upon our theory of the nomological net. The second idea in MTMM was the emphasis on methods as a potential **confounding factor**.



	SE1	SE2	SE3	LOC1	LOC2	LOC3
SE1	1.00	.83	.89	.02	.12	.09
SE2	.83	1.00	.85	.05	.11	.03
SE3	.89	.85	1.00	.04	.00	.06
LOC1	.02	.05	.04	1.00	.84	.93
LOC2	.12	.11	.00	.84	1.00	.91
LOC3	.09	.03	.06	.93	.91	1.00

While methods may confound the results, they won't necessarily do so in any given study. And, whileweneedtoexamineourresultsforthepotentialformethodsfactors,itmaybethatcombining this desire to assess the confound with the need to assess construct validity is more than one methodology can feasibly handle. Perhaps if we split the two agendas, we will find that the possibility that we can examine convergent and discriminant validity is greater. But what do we do about methods factors? One way to deal with them is through replication of research projects, rather than trying to incorporate a methods test into a single research study. Thus, if we find a particular outcome in a study using several measures, we might see if that same outcome is obtained when we replicate the study using different measures and methods of measurement for the same constructs. The methods issue is considered more as an issue of generalizability (across measurement methods) rather than one of construct validity.

Whenviewedthisway,wehavemovedfromtheideaofaMTMMtothatoftheMultitraitmatrix that enables us to examine**convergent and discriminant validity**, and hence construct validity. We will see that when we move away from the explicit consideration of methods and when we begin to see convergence and discrimination as differences of degree, we essentially have the foundation for the **pattern matching** approach to assessing construct validity.

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