Measurement in Marketing: A Study On Construct Validation With Special Reference To Multitrait-Multimethod (MTMM) Matrix

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Construct validation is a significant step towards formulation of justified measurement instruments for abstract marketing conceptualisations e.g. materialism, ethnocentrism, consumption innovativeness, attitude towards television advertising and many more. The marketing researchers have been operationalising abstract concepts through measurement instruments in the form of questionnaires carrying relevant statements. However, these instruments need to go through a statistically appropriate process to determine their ability to capture the construct in totality. The attempt should be towards determining if the measuring instrument is able to represent the construct, the whole of the construct, and nothing but the construct. The present study provides a detailed discussion on the conceptual underpinnings of construct validity. This is followed by an in-depth review of the marketing research literature on the construct validation process. The process involves determination of reliability, convergent validity and discriminant validity of the measuring instrument. The measures of reliability of a scale viz. Cronbach coefficient alpha and item-to-total correlation are discussed in the succeeding sections. The assessment of convergent and discriminant validity through Campbell and Fiske's (1959) multitrait-multimethod (MTMM) matrix has been profoundly delved upon, followed by an exhaustive evaluation of a modified, but more practical version of multitrait-multimethod (MTMM) matrix, as put to application by Ruekert and Churchill (1984).

CONSTRUCT VALIDITY

Validity may be defined as the extent to which a measure or set of measures correctly represents the concept of study, or in other words, the degree to which it is free from any systematic error (Hair *et. al.*, 5th ed., p 3). Validity is an important criterion in measurement of constructs.

A construct may be defined as a concept that the researcher can define in conceptual terms but cannot be directly measured or measured without error (Hair *et. al.*, 5th ed., p. 579). Philosophically, constructs have been viewed as non-observable, non-real entities (Cronbach and Meehl, 1955; Nagel, 1961; Cronbach, 1971). On the other hand, scientifically, construct is the term used to organise knowledge and direct research towards explaining some aspect of nature (Peter, 1981). However, construct cannot be a metaphysical term. Kaplan (1964) explains that a construct can have a systematic and observational meaning. The systematic meaning ensures that the interpretation of a construct depends upon the theoretical underpinnings of the construct whereas observational meaning conveys that a construct must be capable of being directly or indirectly operationalised (see Torgerson, 1958). For example, the construct "materialism" has a systematic meaning in the sense that it can be interpreted either as a "personality trait" or as a "value". "Materialism" has an observational meaning as well since it reflects in the behaviour of the consumers and therefore, can be indirectly measured by eliciting responses from consumers through indicators or statements on a valid scale. Since a construct cannot be directly measured but has to be approximately evaluated through indicators, every attempt has to be made to enhance the construct validity of the operationalisation or measuring scale.

The process of construct validation, and justifiably so, starts with a specific explication of the domain of the construct by categorically delineating what is included in and what is excluded from the definition of construct (Churchill, 1979). Once the construct has been defined, the researcher needs to operationalise it. The operationalisation involves the "rules for assigning numbers to objects to represent quantities of attributes" (Nunnally, 1967, p2). In other words, operationalisation requires translating a construct into a functioning and operating reality by manifesting it into a series of statements which should reflect the construct under consideration. However, the dilemma is that post-operationalisation, the instrument comprising of a series of statements, not only reflects the construct but also the measurement error. This measurement error can have confusing repercussions on empirical research and may lead the researcher to misleading conclusions (Campbell and Fiske, 1959; Fiske, 1982). Since measurement errors (i.e. random and systematic error) influence research findings, it is pertinent to determine the construct validity of the measure.

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Construct validity has been acknowledged as a major issue in organisational research (e.g. Webb and Weick, 1979; Schwab, 1980; Mitchell, 1985). Peter (1981) *defines construct validity as the "vertical correspondence between a construct which is at an unobservable, conceptual level and a purported measure of it which is at an operational level".* The definition may be interpreted to understand that the measure of the construct developed should be able to assess exclusively and exhaustively, the characteristics of the construct under study. Statistically, what it means is that the observed variance in a measure represents in totality the variance in the characteristics of the construct only. Ideally, this should lead to "epistemic correlation" (Blalock, 1968), i.e. a hypothetical correlation of +1 between a construct and its measure for an instrument with full construct validity. However, practically, a systematic measurement error in the form of method variance also influences results while operationalising a construct. *Method variance refers to "the variance attributable to the measurement method rather than to the construct of interest, and examples include archival biases, key-informant prejudices or limitations, halo effect, social desirability, and acquiescence"* (Bagozzi, Yi and Philips, 1991). Therefore, a more realistic definition of construct validity could be that it is *"the degree to which a measure assesses the construct it is purported to access"* (Peter, 1981) or *"the extent to which an operationalisation measures the concept it is supposed to measure"* (Cook and Campbell, 1979). Construct validity is the approximate truth of the conclusion that the operationalisation achieved, comprising of a series of statements, reflecting its construct. The better mirror image a measure is of its construct, the greater is the degree of construct validity it has been able to attain.

Over the years, construct validation has grown in stature in marketing research (e.g. Campbell and Fiske, 1959; Jacoby, 1978; Churchill, 1979; Peter, 1981; Bagozzi, Yi and Phillips, 1991). Marketing being a Social Science has to investigate and offer theoretical explanations, backed by empirical evidence, for the behaviour of consumers. This requires development of measuring instruments which can unequivocally assess the abstract nature of constructs relevant to marketing e.g. personality, attitude, consumer satisfaction, materialism etc. However, the scenario is more dull than dynamic. Heeler and Ray (1972, p369) have reviewed the marketing literature on construct validation studies up to 1972 and conclude that there have been "sporadic thrusts into various measurement areas, without continuing effort and pullout." Peter (1981) investigated construct validation practices through a review of articles in Journal of Marketing Research (JMR) for the period 1973-1979. He found out that out of more than 450 articles and notes published in JMR during the above mentioned period, only 12 had construct validation as a major objective. This led Peter (1981) to conclude that "though encouraging signs of interest in construct validation are found in the review, the results suggest that there are few if any measures in marketing that could fully meet rigorous construct validation criteria in a series of studies." The situation demands that more validation studies be carried out to eradicate invalid measures and consolidate the valid ones through assessment of the construct they intend to measure. Cronbach (1971) suggests that construct validation is an ever extending process of investigation and development.

Construct validation, as a process, cannot be carried out in isolation. The profound impact of theory on a given construct demands that construct validity should be preceded by content validity. Peter (1981) contends that unless a measure has high degree of content validity, determined primarily through logical analysis, it cannot be expected to have a high degree of construct validity. *Content validity requires an assessment of the operationalisation against the relevant content domain for the construct*. For example, an assessment of the content validity of the construct "materialism" requires laying down all the criteria that should be met for an instrument that claims to measure the construct "materialism". As mentioned by Churchill (1979), "the literature should indicate how the variable has been defined previously and how many dimensions or components it has."

Further, the analysis of construct validity is a multifaceted endeavour which has to overcome a number of pitfalls (Bagozzi, Yi and Phillips, 1991). The inference in a construct validation process is based upon the empirical data generated which indicates that the variance in the score is explicable only by the construct and it is not explained by any phenomenon other than the construct under study. Therefore, the data generated becomes the lynchpin in the validation process. However, the type of data collected depends upon the type of scale used to measure the construct (Churchill, 1979). This is where the statements constituting a measuring scale come under the scanner for their precision and lucidity.

There are two pertinent issues which need to be brought up over here for discussion. The present author believes that a researcher ought to be careful while considering construct validation as the ultimate test of a measurement instrument's credibility. Firstly, even as construct validity reflects the degree of correspondence between a construct and its measure, its reasons and ramifications have much broader contours. Construct validity is contingent not just upon the measurement instrument but also on the entire measurement procedure and interpretation of data generated (Cronbach, 1971; Cook and Campbell, 1976, 1979). To elaborate further, construct validation is an attempt at giving empirical certification to the physical avatar (the measurement instrument) of an abstract concept. However, the subjectivity inherent in the tool to assess construct validity demand that validation be concerned with generalisability of results across conditions of measurement (Cronbach et. al., 1972) and not just instrument of measurement.

Secondly, whether empirical evidence approves or disapproves a measure depends upon the nature of the construct and the hypothesised relationship between it and other variables (Peter, 1981). This emphasises upon the paramount role of theory in construct validation. Peter (1981) contends that, "it is the theory and nature of construct which not only specify what empirical relationships are worth investigating but also determine whether empirical results support or invalidate a measure." The significance of theory in the construct validation process can be stressed upon by considering it as the fountainhead decision. Construct validation is directly related to the question of "what" the instrument is actually measuring and this "what" (the construct, trait or concept) needs to be precisely, specifically and categorically stated so as to give an unambiguous indication of domain included and domain excluded in the definition.

Peter (1981) has identified reliability, convergent validity and discriminant validity as significant components of construct validation process. Any acceptance of construct validity of a measure should be preceded by a series of reliability and validity studies.

RELIABILITY

Reliability is an assessment of the degree of consistency between multiple measurements of a variable (Hair *et. al.*, 5th ed., p 117). It differs from validity in the sense that it is not about what is to be measured but about how it is to be measured. A measure can be considered reliable if it would give us the same result over and over again, assuming that the object of measurement is not changing.

Peter (1981) defines reliability as the *"correlation between a measure and itself"*. The higher is this correlation; more is the internal consistency of the measuring instrument. The rational behind this internal consistency is that the individual items in an instrument would all be measuring the same construct and therefore, should be highly inter-correlated (Churchill, 1979; Nunnally, 1979). However, since an entire measure cannot be simultaneously correlated with itself, part of a multi-item operationalisation is correlated with other part to arrive at the correlation. If all the items constituting a measure reflect a single construct, then the responses would be highly inter-correlated whereas a low correlation would denote that some items are not authentic representatives of the construct and therefore, are leading to unreliability (Churchill, 1979). Reliability is an essential part of construct validation process since a "valid measure must be composed primarily of systematic variance" and if most of the variance in a measure is systematic; it leads to higher correlation reflecting greater internal consistency (Peter, 1981). This assertion here needs a little elaboration.

Systematic variance is caused by factors that systematically affect of measurement of the variable across the sample whereas random variance is caused by factors that randomly affect measurement of the variable across the sample. While random variance weakens the observed relationships among variables, systematic variance tends to inflate the observed relationships between variables (Bagozzi, Yi and Phillips, 1991). This is the reason why systematic variance leads to high correlations, which is construed as greater internal consistency, and therefore, more reliability of the measure. Some of the recommended measures of reliability include Cronbach coefficient alpha and item-to-total correlations.

Churchill (1979) suggests that coefficient alpha should be the first to assess reliability of a construct measuring instrument. It is the most widely used measure and determines the consistency of the entire scale (Hair *et. al*, 5th ed., p. 118). Cronbach's coefficient alpha is the mathematical equivalent of the average of all possible split-half reliability estimates. In split half reliability, all items in a measure are randomly divided into two sets. The measuring instrument is administered to a sample and total score is calculated for each set. The correlation between these two total scores gives the split half reliability estimate. A high value of Cronbach coefficient alpha indicates greater reliability of the measure based on its internal consistency whereas a low value conveys that the items have failed to capture the construct comprehensively (Churchill, 1979). The generally agreed upon lower limit for Cronbach coefficient alpha is 0.70 (Robinson and Shaver, 1973; Robinson, Shaver and Wrightsman, 1991), although it may be acceptable at 0.60 in case of exploratory research (Robinson, Shaver and Wrightsman, 1991).

If the value of Cronbach coefficient alpha is below the acceptable level, the researcher can resort to calculation of item-to-total correlation figure. It would facilitate elimination of items with a lower item-to-total correlation. The process involves calculation of the correlation of each item with the total score which is then plotted in a decreasing order of magnitude (see http://www.socialresearchmethods.net). Items with correlation near zero and items which produce a substantial or sudden drop in item-to-total correlations are likely candidates for rejection.

The reliability estimate is a significant constituent in the construct validation process. In fact, before proceeding onto determination of convergent or discriminant validity, the measure should "first be shown to have high (and similar) reliabilities (Peter, 1981).

CONVERGENT AND DISCRIMINANT VALIDITY

Campbell and Fiske (1959) proposed convergent and discriminant validity as two significant aspects of construct validity. *Convergent validity is the degree to which multiple attempts to measure the same construct are in agreement* (Bagozzi, Yi and Phillips, 1991). The concept of convergent validity of a measuring instrument is based on the premise that different measures of a construct should have a high degree of correspondence or convergence with each other, if they are valid measures of a construct. This convergence is inferred through determination of correlation between responses obtained using different methods of measuring the same construct. The extent to which a measure correlates highly with other measures designed to investigate the same construct acts as evidence of convergent validity (Churchill, 1979). Hence, convergent validity assesses the degree to which two measures of the same construct are correlated (Hair *et. al.*, 5th ed., p 118).

Convergent validity does not work alone in the construct validation process. It is complimented and supplemented by discriminant validity, since neither one alone is sufficient for concluding construct validity. *Discriminant validity is the degree to which measures of different constructs are distinct* (Bagozzi, Yi and Phillips, 1991). It is based on the premise that if two or more constructs are unique and distinct from each other, then the valid measures should have low correlation with each other. Therefore, discriminant validity is ascertained by demonstrating that a measure does not correlate very highly with other measures from which it should differ (Campbell, 1969). Heeler and Ray (1972) believe that "predictably low correlations between the measure of interest and other measures that are supposedly not measuring the same variable or concept," signify discriminant validity. Campbell and Fiske (1959) put forward very strong views on discriminant validity when they state that, "tests can be invalidated by too high correlations with other tests from which they were intended to differ." It is logically acceptable since a measuring instrument should distinctly reflect a particular construct and if it correlates highly with another measure representing a different construct, then its exclusivity with respect to the given construct is low. A high correlation, therefore, is indicative of the inability of the measure to discriminate between dissimilar constructs, leading to lower construct validity.

Convergent and discriminant validity work as a pair towards establishing construct validity by ensuring that correlations between measures of similar constructs is high while correlations between measures of dissimilar constructs is low.

Again, convergent and discriminant validation processes cannot be carried out in isolation of reliability of the measure. For example, a low correlation between two measures may lead the researcher to conclude that the measures represent different constructs. However, this low correlation may be due to unreliability of one or both the measures examined. On the other hand, even if two measures reflect same construct, the calculated correlation may not be high if any of the measures has low reliability, since no two measures can correlate any higher than the square root of the smaller reliability (Lord and Novick, 1968).

Any of the above mentioned situations may lead the researcher into incorrect conclusions. Hence, prior to analysis of convergent and discriminant validity, it is pertinent to ensure that the measures show "high (and similar) reliabilities" (Peter, 1981). On the basis of an investigation of 12 research papers on construct validation in the Journal of Marketing Research between the periods 1973-1979, Peter (1981) contends that, "unless measures have high and similar reliabilities, the interpretation of results becomes even more ambiguous." Therefore, in order to be able to propose for construct validity, the researcher needs to ascertain greater reliability and follow it up with higher convergent correlations in comparison to discriminant correlations.

MULTITRAIT-MULTIMETHOD (MTMM) MATRIX

Campbell and Fiske (1959) suggested an operational method to assess convergent and discriminant validity through multitrait-multimethod matrix (see Table 1). It is a matrix or table comprising of zero order correlations between different traits such that each trait is measured by different methods (Churchill, 1979). In order to construct the multitrait-multimethod matrix, researcher needs to arrange the correlation matrix such that the traits lie within the methods. Thereafter, the entire matrix can be interpreted through analysis of four essential elements (see http://www.socialresearchmethods.net; Bagozzi, Yi and Phillips, 1991) –

1. The reliability diagonal (monotrait-monomethod diagonal) - These correlations give the estimates of reliability of each measure in the matrix. Reliability can be assessed using Cronbach coefficient alpha (Churchill, 1979) or item-to-total correlation. The number of correlations in the reliability diagonal is always equal to the total number of measures which can be obtained by multiplying the number of methods with the number of traits.
2. The validity diagonal (monotrait-heteromethod diagonal) - It gives the correlations between measures of the same trait, measured using different methods. Since the same trait is being measured using different methods, the correlations are expected to be high.
3. The heterotrait-monomethod triangle- These are correlations among measures that use the same method of measurement. High correlations indicate a strong method factor, i.e. use of same method leading to higher than expected correlations between different traits.
4.Hetertrait-heteromethod triangles- These are correlations between measures that are different in terms of both trait and method. These correlations are expected to be lowest in the multitrait-multimethod matrix since they share neither the trait nor the method.

On analysis of the diagonals and triangles in a multitrait-multimethod matrix, Bagozzi, Yi and Phillips (1991) suggest that the interpretation depends upon "four desiderata based on the inspection of MTMM matrix" -
1. Convergent validity may be inferred if the validity diagonal values consisting of monotrait-heteromethod correlations are, significantly different from zero and sufficiently large" (Campbell and Fiske, 1959).
2. Discriminant validity may be established if the following three criteria are satisfied-
(i) The monotrait-heteromethod correlations should be greater than the heterotrait-heteromethod correlations. In other words, the correlation coefficients in the validity diagonal should be greater than the correlation values lying in its row or column. It is an essential requirement for discriminant validity since the correlation within the same trait measured using different methods ought to be higher than the correlations "between that variable and any other variable which has neither trait nor method in common" (Campbell and Fiske, 1959).
(ii) The monotrait-heteromethod correlations in the validity diagonal should be greater than the correlations in the heterotrait-monomethod triangles. It indicates that the correlations within the same trait measured by different methods is greater than correlations between different traits but measured using same method, or in other words, that trait factor should be stronger than method factors.
(iii) The pattern of trait correlations should be same in heterotrait-monomethod triangles as well as heterotrait-heteromethod triangles. It indicates a genuine correlation between traits. On the other hand, "a failure to meet this criterion implies that the observed correlation between traits measured by a given method is due to a method bias" (Bagozzi, Yi and Phillips, 1991). The pattern of correlations in all the heterotrait triangles may be compared by using a rank order correlation coefficient, such as Kendall's coefficient of concordance (Churchill, 1979; Bagozzi, Yi and Phillips, 1991).

MULTITRAIT-MULTIMETHOD (MTMM) MATRIX- A CRITIQUE

The principles of Campbell and Fiske's (1959) criteria for determination of convergent and discriminant validity are based on the assumptions that, "there are no correlations between trait and method factors; ……. all traits are equally influenced by method factors; …… method factors are uncorrelated" (Schmitt and Stults, 1986). Bagozzi, Yi and Phillips (1991) believe that the first assumption may not be unreasonable but the rest of the assumptions are unlikely to be appropriate. This puts a question mark over the very procedure itself. Further, it is a big practical problem to select "maximally different methods" (Peter, 1981) to measure the same construct, so as to reduce method variance. A high method variance may inflate monotrait-heteromethod correlations, thereby enhancing the probability of a given multitrait-multimethod matrix meeting the criteria for convergent and discriminant validity.

Campbell and Fiske's (1959) procedure is also silent regarding specific standards to ascertain how well the criteria are met. It is impossible to quantify the degree of construct validity and therefore, the entire procedure becomes subjective and judgmental. The biggest drawback, however, is that "application of Campbell and Fiske's procedure can result in Type I and Type II errors" (Bagozzi, Yi and Phillips, 1991).

MODIFIED MULTITRAIT-MULTIMETHOD MATRIX

Notwithstanding its implementation handicaps, Campbell and Fiske's (1959) multitrait-multimethod matrix did provide an operational methodology for assessment of construct validity by simultaneous examination of reliability, convergent validity and discriminant validity in a single matrix. A critical evaluation of multitrait-multimethod matrix procedure reveals that the matrix requires a design that includes a combination of both traits as well as methods. Multitrait-multimethod matrix expects the researcher to measure multiple similar yet dissimilar traits using multiple and maximally different methods, thereby giving equal importance to traits and methods.

Peter (1981) observes that the methods selected should be independent of each other while the traits should be conceptually similar. This is mandatory since, in order to assess convergence and discriminant validity, multitrait-multimethod matrix takes into consideration the effect of not only "what we measure", but also "how we measure" (http://www.socialresearchmethods.net). From the implementation point of view, while trying to derive multitrait-multimethod matrix, the researcher is troubled by the inability to find different justifiable and credible methods to measure all the traits, which are part of the study. Campbell and Fiske (1959) suggest that the traits and methods that are part of a multitrait-multimethod matrix should be as independent as possible. However, at times, the nature of the trait itself makes it inappropriate for measurement using different methods, thereby leading to method variance (Churchill, 1979). For example, measuring the construct "intelligence" by using the method of observation would be absurd.

As per the multitrait-multimethod matrix procedure, the conclusion regarding convergent and discriminant validity is contingent upon multiple iteration of the same trait across several distinct methods. However, the idea of convergent and discriminant validity, as envisaged by Campbell and Fiske (1959) need not necessarily require a method factor. Convergence validity requires that measures of theoretically similar constructs should have high correlations whereas discriminant validity requires that measures of constructs which are theoretically different, should not have high correlation with each other. Therefore, convergence and discriminant validity of a measure can be inferred by examining respectively, "the pair-wise correlations between the measure and other supposedly similar and dissimilar measures" (Ruekert and Churchill, 1984). The pair-wise correlations obtained in the matrix should be high for similar measures and low for dissimilar measures, thereby indicating convergent and discriminant validity, respectively. The matrix can be obtained by using multiple measuring instruments to measure multiple similar and dissimilar constructs. For construct validation, within-construct correlations are expected to be high and indicate convergent validity, whereas cross-construct correlations are expected to be relatively lower, in order to indicate discriminant validity.

The obvious drawback of this amended procedure is that it does not take into consideration the confounding impact of method factor. However, this lacuna can be overcome by separating "assessment of convergent and discriminant validity" from the need to "examine the impact of method factor" on measuring instrument. Method factor can be considered to be an issue of generalisability. The impact of method factor can be determined through replication of research project using "different methods of measurement" for the same construct (see http://www.socialresearchmethods.net). On replication, if the outcome remains unchanged, it would be an indication of lower impact of method factor, leading to greater generalisability across methods.

Hence, the present author would like to conclude that construct validation of measuring scales is an essential requirement for credible exploration of concepts in Marketing. However, the essence of construct validity can be determined even by using a modified and more practically applicable variant of multitrait-multimethod matrix rather than the originally suggested method.

Table 1: Multitrait-multimethod (MTMM) matrix

		Method 1			Method 2			Method 3		
	Traits	A1	B1	C1	A2	B2	C2	A3	B3	C3
Method 1	A1	$\mathbf{r_{A1A1}}$								
	B1	r_{B1A1}	$\mathbf{r_{B1B1}}$							
	C1	r_{C1A1}	r_{C1B1}	$\mathbf{r_{C1C1}}$						
Method 2	A2	$\mathbf{r_{A2A1}}$	r_{A2B1}	r_{A2C1}	$\mathbf{r_{A2A2}}$					
	B2	r_{B2A1}	$\mathbf{r_{B2B1}}$	r_{B2C1}	r_{B2A2}	$\mathbf{r_{B2B2}}$				
	C2	r_{C2A1}	r_{C2B1}	$\mathbf{r_{C2C1}}$	r_{C2A2}	r_{C2B2}	$\mathbf{r_{C2C2}}$			
Method 3	A3	$\mathbf{r_{A3A1}}$	r_{A3B1}	r_{A3C1}	$\mathbf{r_{A3A2}}$	r_{A3B2}	r_{A3C2}	$\mathbf{r_{A3A3}}$		
	B3	r_{B3A1}	$\mathbf{r_{B3B1}}$	r_{B3C1}	r_{B3A2}	$\mathbf{r_{B3B2}}$	r_{B3C2}	r_{B3A3}	$\mathbf{r_{B3B3}}$	
	C3	r_{C3A1}	r_{C3B1}	$\mathbf{r_{C3C1}}$	r_{C3A2}	r_{C3B2}	$\mathbf{r_{C3C2}}$	r_{C3A3}	r_{C3B3}	$\mathbf{r_{C3C3}}$

MONOMETHOD BLOCKS

RELIABILITY

VALIDITY DIAGONALS

HETEROMETHOD

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(Cont. from page 8)

marketing where customer is in constant touch with the supplier, personal service is very much significant. Organizations need a good personal-selling effort to compete in today's market place. Salespeople help make companies successful. The purpose of all marketing effort is to create a satisfied customer and the sales rep is ultimately responsible for the degree of customer satisfaction. From any viewpoint, in our total economy or in an individual organization, personal selling and consequently its management is tremendously important. As Red Motley, a noted sales trainer and writer once said, "Nothing happens until somebody sells something".

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