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Taking Account of Time in Marketing Construct Validation: Theoretical and Methodological Problems

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ABSTRACT

In marketing research, the definitions of constructs often involve a temporal dimension, which make them either an ephemeral state or a lasting trait or a combination of the two. However, researchers do not always confirm the temporal hypothesis used. There are various ways of going about such verification, but their implementation is sometimes tricky. The purpose of this paper is to clarify these techniques and their use. A model decomposing the variance of a constuct into stable, scalable and situational temporal components is put foward. This model is then used in two different case studies, one to test the temporal validity of a marketing construct viewed as a trait, the other to test the temporal validity of a marketing construct viewed as a state.

Keywords : Trait, state, change of trait, temporal validity, construct validity.

INTRODUCTION

To study consumer behavior in various situations, researchers have developed a great many constructs. A construct, or an abstract variable, is defined by a set of "observable" manifestations, which the items comprising its measurement scale are intended to grasp (Nunnally, 1978). With the development of factorial statistical methods, those using this approach have adopted the term "trait" for their various constructs. Nevertheless, this generic term says nothing about the stability or instability of the phenomenon gras-

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ped. To avoid any confusion between the trait understood in the generic sense of the term and the trait defined as a stable individual difference, we will retain the distinction made by Baumgartner and Steenkamp (2006). We will use the word "trait" to refer to the stable component of a construct and the word "state" to denote its temporary component. Thus, we accept that the temporal structure of a construct may include several components, both stable and unstable. Although the dynamic nature of a marketing construct is a key element of its definition, researchers do not always check that the measures used for its implementation fully capture all the components of its temporal structure. The various protocols for the development of measurement scales proposed in the marketing literature are not conducive to this. Although their approach is empirical, Churchill (1979), Peter (1981), Fornell and Larcker (1981) and Gerbing and Anderson (1988) simply advise verifying the reliability, one-dimensionality, and convergent, discriminant and predictive validities of the tools used. Rossiter (2002), for his part, suggests focusing on the content validity or apparent validity, based on expert opinion. The researcher and his team ensure that items elaborated satisfactorily cover the field of the construct. They are expressed in such a way that they most faithfully reflect the hypothetical temporal structure of the construct. For example, the words "maintain" and "indefinitely" are intentionally used in the items of the attitudinal commitment measurement scale (Morgan and Hunt, 1994). These terms contribute to the semantic marking of temporal stability that the authors attribute to the construct. Nevertheless, despite the care taken, can we be sure that the formulation of the items is sufficient to ensure that their temporal structure will be as well interpreted by respondents as the authors imagine? In this regard, Cronbach and Meehl (1955) advise introducing measurement stability tests into the process of empirical validation of a construct. Checking this is crucial in marketing because the effects attributed to a construct may depend on its temporal dimension. Thus, Laurent and Kapferer (1986) note that involvement in a purchasing situation does not necessarily lead to enduring involvement in consumption. One may be very involved in the purchase of a bottle of champagne that one wants to give to a friend who enjoys it, without having an interest in this wine or even taking pleasure in its consumption. At a theoretical level, the temporal hypotheses elaborated around a construct therefore concern both its definition and its ability to predict other constructs. In this respect, they refer to the construct's validation process (Cronbach and Meehl, 1955). But this methodological requirement also has managerial implications. Suppose a company uses customer loyalty intention scores to segment its customers. If, as suggested by longitudinal studies, loyalty intention is more a temporary state than an enduring trait, then such segmentation should be regularly updated (Johnson, Herrmann and Huber, 2006). However, testing the hypothetical temporal structure of a construct raises a number of questions, as follows:

1) How is the temporal character of a construct to be conceptualized?
2) How can this hypothetical temporal dimension be evaluated and tested?
3) What method should be used to test the temporal status of a construct?
4) How are the results obtained to be interpreted?
5) What are the advantages and limitations of this validation process?

In marketing, these questions have already been partially addressed, either to check the stability of measurements of a purportedly stable construct (Richins and Bloch, 1986; Derbaix and Leheut, 2008; Capelli-Guizon and Helme, 2008) or to refine measurement instruments applied to panel data (Baumgartner and Steenkamp, 2006). However, in these studies, temporal validation is considered only incidentally. Our contribution is distinctive in focusing on this question, showing how a judicious choice of the methods used allows the various temporal aspects attributed to a construct to be validated. The aim of this paper is to provide readers with theoretical insights and methods, helping them formulate and test the temporal hypotheses that concern their constructs. In this way, we can go beyond the static perspective within which convergent, discriminant and predictive validities are envisaged and revisit them through a dynamic perspective. The first part of the paper consists of a literature review covering the theoretical and empirical foundations of the state-trait distinction, then re-situates this distinction in the specific context of marketing research. The second part offers a summary of the main methods put forward in the literature, to validate the various hypotheses formulated for defining the temporal structure of a construct. The third part is an illustration of the use of these methods, through case studies allowing us to test the temporal status of two constructs, one of them envisaged as a stable trait, the other as a situational state. We conclude the paper with a critical discussion with a view to finding new ways of improving the temporal validation process of constructs.

THE THEORETICAL QUESTION

How is the temporal nature of a construct to be conceptualized in marketing? This first question leads us to: i) clarify the theoretical and empirical bases of the distinction, prevalent in the literature, between a state and a trait, and ii) to show why, in marketing, this distinction should be conceived in terms of a continuum.

Theoretical foundations of the distinction between a trait and a state

The theoretical distinction made in psychology between state and trait has ancient roots. Eysenck (1983) locates its origins in Cicero, who clearly distinguished permanent anxiety felt by an individual (i.e., a trait) from the distress that someone experiences only occasionally (i.e., a state). Similarly, he distinguished chronic irritability (i.e., a trait) from passing anger (i.e., a state). Researchers in psychology have recognized the need to take into account the dynamic nature of constructs. They distinguish two opposed forms within the factorialists' "generic traits": the stable trait and the unstable state. By stable trait, psychologists understand a general predisposition (Bucky and Spielberger, 1972; Fridhandler, 1986; Hertzog and Nesselroade, 1987), specific to an individual (Schermelleh-Engel et al., 2004), which explains the consistency of that person's behavior over time and in different situations (Hamaker, Nesselroade and Molenaar, 2006). By unstable state, they understand instead a transient phenomenon (Bucky and Spielberger, 1972), an occurrence of short duration (Fridhandler, 1986), involving changes within the individual over time and from one situation to another (Hertzog and Nesselroade, 1987; Schermelleh-Engel et al., 2004). Although it is very often mentioned in the literature, this division between stable trait and unstable state is not accepted unanimously. Allen and Potkay (1981) strongly challenge it, arguing that there is no objective criterion for deciding whether someone's behavior expresses a trait or a state. Other authors go further, noting that this dichotomy leaves no room for phenomena that result from stable trends and temporary factors (Hertzog and Nesselroade, 1987; Chaplin, John and Goldberg, 1988; Mowen, 2000). It presupposes that traits are completely stable, something which applies only to a few specific biological characteristics (e.g., gender, skin color, blood type, DNA, etc.). Although deemed stable, personality traits are not necessarily regarded by psychologists as immutable throughout a person's life (Hertzog and Nesselroade, 1987). In this regard, Hampson and Goldberg (2006) and Hopwood et al. (2011) have shown that personality traits change during the transition from childhood to adulthood. The dichotomy that opposes state and trait on the basis of the criterion of stability thus seems to be too rigid and too reductive. Indeed, it implies that there are only two separate temporal structures and ignores the composite temporal structures that probably occur most frequently in marketing. By referring to the various types of variability that may characterize a hypothetical construct, the empirical approach broadens the spectrum of the construct's temporal dimension.

Empirical foundations of the trait-state distinction

Within an empirical perspective, traits and states are no longer defined on the basis of psychological, genetic or contextual considerations, but by the types of longitudinal and transverse variability that characterize them. When we say that the traits of individuals do not change, this means that their individual differences are invariant over time (Hamaker, Nesselroade and Molenaar, 2006). Their measures are then called stable if, irrespective of the variation in individual scores from one moment to another, each individual retains the same rank in successive evaluations he gives to the construct measures (Nesselroade, 1991; Kenny and Zautra, 2001). Eid and Diener (1999) and Hamaker, Nesselroade and Molenaar (2006) distinguish two kinds of inter-individual differences. The first concerns intra-individual change and is called trait change. Such change is slow, more or less reversible, and reflects complex processes such as learning. The second is intra-individual variability or state variation. This refers to short-term variations in the construct, expressing fluctuations around the trait. These variations are related to internal mental events (e.g., cognitive or affective) or external events (e.g., a physical or social situation). In summary, at time *t*, the differences between individuals, captured by a construct, are likely to depend on each of the following three sources of variation: i) stable individual differences (i.e., traits), ii) intra-individual changes (i.e., change or evolution of traits), and iii) intra-individual variability (i.e., states). Graphs a, b, c and d in Figure 1 illustrate these different kinds of variability.

These graphs trace the imaginary measures of an item, evaluated by individuals A, B and C, at five successive times. Individual A's responses do not change and are equal to 1. They reveal a stable trait in this individual and the measurements coincide with the trend parallel to the time axis (Figure 1a). Individual B's responses are characterized by intra-individual variability, manifesting itself at each moment "*t*" by a deviation from the trend representing the trait (Figure 1b). His responses fluctuate around this stable trend which is equal to 6 and parallel to the time axis (e.g., trait). In this individual, the measurement instrument simultaneously captures the

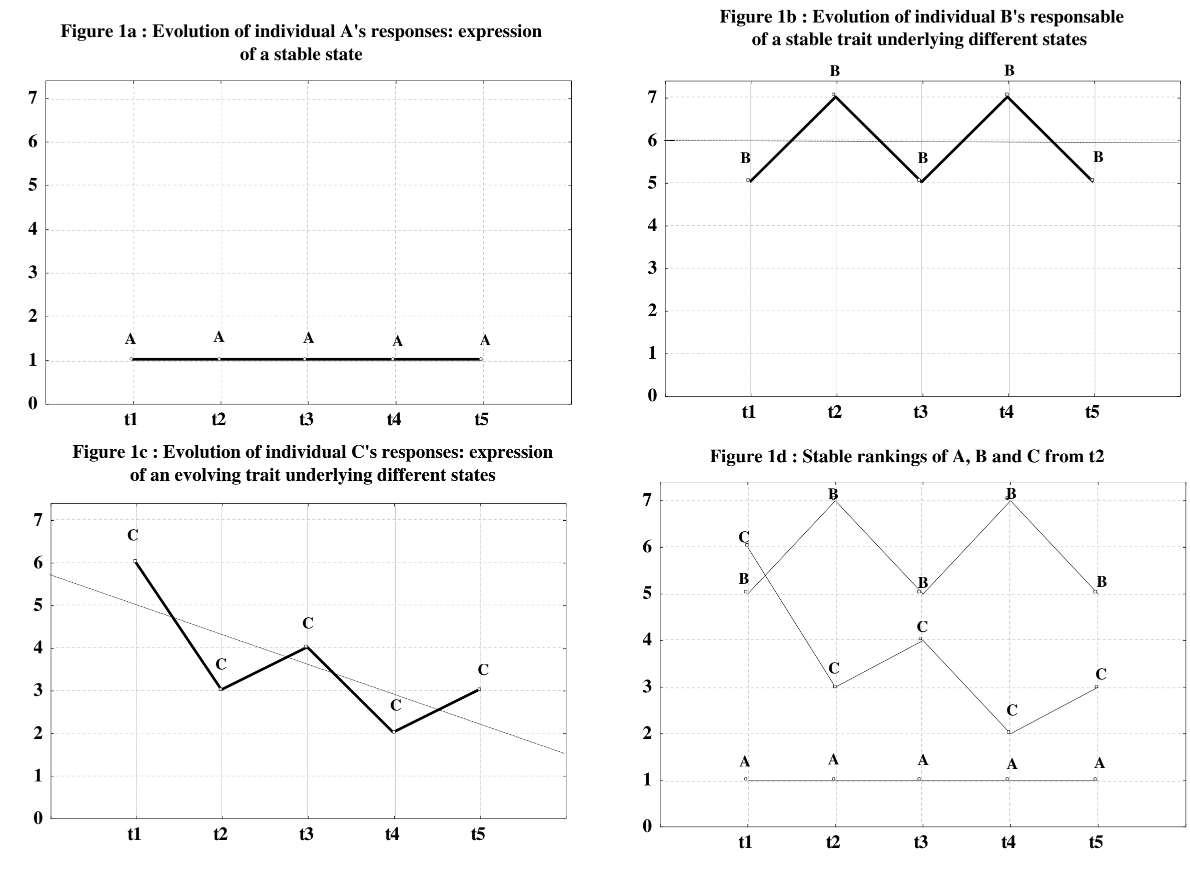

Figure 1. – Variability, intra-individual change and inter-individual differences

enduring component (i.e., the trait) and the unstable component (i.e., the state). Individual C's responses are also characterized by strong intra-individual variability. This is shown by a deviation from the trend at each moment "t" and by a change in the trait that decreases over time (Figure 1c). Figure 1d summarizes these three cases on a single graph. At $t = 1$, the order of individuals is $C > B > A$. From $t = 2$, a new order occurs and remains unchanged until $t = 5$, which suggests that the measurement of this construct indicates a trait rather than a state (e.g., $B > C > A$).

The temporality of marketing constructs

The marketing literature provides examples of hypothetical constructs which may be either stable traits or unstable states. The propensity for brand loyalty has been defined as a stable personality trait, giving rise to consistent answers from the purchaser that transcend brands and purchasing situations (Bennett and Rundle-Thiele, 2002). The same applies to temperament, which is thought to produce stable behavior under the influence of biological characteristics that change little over time (Capelli and Helme-Guizon, 2008). In contrast, marketing constructs considered to be unstable states capture phenomena resulting from the consumer's interactions with brief purchasing situations or consumption. Immersion in a consumption experience is considered to be a non-enduring and already superseded state when it is evaluated (Fornerino, Helme-Guizon and Gotteland, 2008). Consumer resistance has also been described as a motivational state in opposition to market practices, principles or discourses viewed as unacceptable (Roux, 2007). This, too, is therefore transitory and unstable, since it occurs only in certain situations, as a reaction to specific factors. Nevertheless, archetypal traits and states do not seem to be the rule in marketing. Marketing constructs most often concern phenomena whose temporal structure is associated with composite forms. For example, "commitment in a relationship", defined by Moorman, Zaltman and Deshpande (1992) as an enduring desire to maintain a valued relationship, can be seen as an evolving trait. A trait will intensify over time in individuals for whom the relationship is a positive experience. Conversely, a trait undergoes erosion among those for whom the relationship is disappointing (See Figure 1c). In the particular context of those taking medication, the construct "trust in the drugs" probably has a stable component and an unstable component. The first is a personal trait, resulting from the competence that the person attributes to the health professions that are responsible for finding effective drugs, prescribing

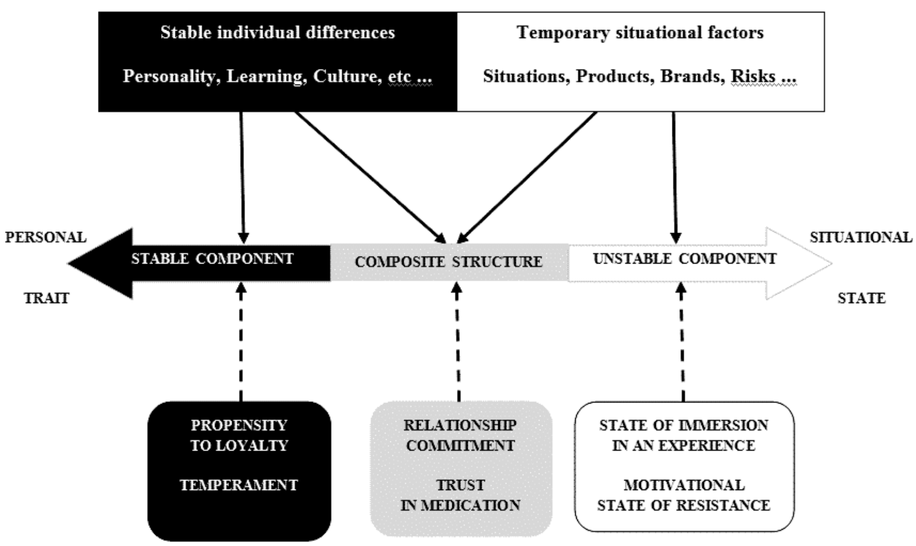

Figure 2. – State-trait continuum in marketing

them and monitoring their effects (e.g., laboratories, doctors, monitoring agencies, etc.). The second is a situational state, sensitive to events linked to the use of the medicines (e.g., allergies, therapeutic failure, effective new treatments, withdrawal of defective medicines, etc.) (See Figure 1b). The dichotomy between stable state and unstable trait thus overly simplifies the temporal structure of marketing constructs. In all probability, it would be better represented by a continuum, since some constructs are closer to a stable trait than to an unstable state and other constructs are closer to an unstable state than to a stable trait. In Figure 2, we indicate such a continuum and, very provisionally, situate certain constructs along it. Ultimately, the crucial question that arises is not so much knowing whether a construct is an unalterable stable trait or an unstable state, but knowing the relative proportion of stable components (i.e., traits), evolutionary components (i.e., changing traits) and unstable components (i.e., states) that it contains.

METHODOLOGICAL APPROACHES

How is the hypothetical temporal dimension of a construct to be evaluated and tested? In the literature, we find two types of method whose approaches complement each other. The first tackles the question by evaluating the degree of stability of the construct measures, the second by focusing on the breakdown of the construction into different kinds of temporal components.

Methods based on the stability of construct measures

These methods apply to the scores observed and are therefore exclusively concerned with the empirical level of the measurement model. Collected under the general term "test-retest" method, these practices allow variations that are described in the literature. The basic principle is simple. It involves calculating the correlation coefficient r between two measurements of each item, one taken at "t", the other after a time lapse Δt, at "$t + \Delta t$".

$$r(y_t, y_{t+\Delta t}) = \frac{\mathrm{Cov}(y_t, y_{t+\Delta t})}{[\mathrm{Var}(y_t) \cdot \mathrm{Var}(y_{t+\Delta t})]^{1/2}}$$

Although the method looks straightforward, in practice it is ambiguous and calls for precautions to be taken during its implementation. Its ambiguity stems from the fact that researchers use the method to test the reliability of measures as well as their temporal stability. In a sample of 192 studies from the literature, Baumgartner and Steenkamp (2006) find that in 23% of cases this coefficient is calculated without it being clear whether the aim of the researcher is to measure stability or reliability. This test-retest correlation coefficient also raises some problems in evaluating reliability measures. Its interpretation in terms of the proportion of "true" variance is possible only under two conditions: 1) that the numerator $\mathrm{Cov}(y_t,\ y_{t+\Delta t})$ be equal to $\mathrm{Var}(\tau_t)$, which implies that $\tau_t = \tau_{t+\Delta_t}$ (τ_t being the true score at time t) and 2) that its denominator be equal to $\mathrm{Var}(y_t)$, which implies that $\mathrm{Var}(y_t) = \mathrm{Var}(y_{t+\Delta t})$. Yet, these assumptions are not very realistic, since the change of situation between two implementations of the same test can alter the distribution of "true" and "observed" responses (Bollen, 1989). Nunnally (1978) and Churchill (1979) also advise against using this coefficient to evaluate reliability because of the hindsight bias that the dual implementation of the test can create in respondents. When the test-retest method is used to check the stability of measures, it must be used carefully. The measures of a construct are in fact deemed stable if, despite possible variation of individual scores from one moment to another, this does not change the rank-order of individuals in successive evaluations they give to the items of this construct (Nesselroade, 1991; Kenny and Zautra, 2001). To check the stability of measures, researchers often use the test-retest correlation coefficient calculated via Pearson's formula, which concerns the value of the scores (i.e., r). This index provides information on a possible variation of scores over time, but not on the stability of measures, defined in terms of individual rankings. Spearman's rank correlation coefficient, ρ, is recommended for this purpose (Spencer, Bornholt and Ouvrier, 2003).

An *ad hoc* numerical example serves to show why this is so. Using the data in Table 1, assume that a

Table 1. – Test-retest and measurement stability correlation coefficients

	Test at t = 1		Re-test A at t = 2		Re-test B at t = 2	
individuals (1)	scores (2)	ranks (3)	scores (4)	ranks (5)	scores (6)	ranks (7)
1	7	1	5	1	7	1
2	7	1	5	1	6	2
3	7	1	5	1	6	2
4	7	1	5	1	7	1
5	4	2	4	2	4	3
6	4	2	4	2	4	3
7	4	2	4	2	4	3
8	3	3	1	3	4	3
9	3	3	1	3	4	3
10	3	3	1	3	4	3
Pearson's correlation of scores			$r_{12A} = 0.859$		$r_{12B} = 0.944$	
Spearman's rank order correlation			$\rho_{12A} = 1.000$		$\rho_{12B} = 0.874$	

first collection of the measurement of an item carried out at time $t = 1$, gives the scores shown in column 2, and that at $t = 2$ the second collection provides two possible responses – either response A (column 4) or response B (column 6). In response A, the scores change but the rank-order of the individuals does not change, thus testifying to the stability of the measure. In response B, both the scores and the ranks change, indicating that the measure is unstable. If we use the Pearson coefficients calculated on the value of the score, response A shows less stability than that given by response B ($r_{A.1/2} = 0.859$ *vs* $r_{B.1/2} = 0.944$), whereas the opposite result was expected. Spearman's correlation coefficient of the ranks turns out to be more suitable to express the stability of the measures of a hypothetical trait ($\rho_{A.1/2} = 1$ *vs* $\rho_{B.1/2} = 0.874$). In summary, the test-retest performed with the Spearman coefficient ρ, is suitable for detecting the stability of the measures, but the results are tainted by measurement error (Nunnally, 1978). In addition, they show whether the construct measures refer to a trait or a state, but say nothing about the respective proportions of traits or states that the construct measures contain. Yet, this information is important because the construct validity directly reflects the correspondence between the constructs and their measures (Crié, 2005). Methods that split the construct into stable, evolutionary and situational components can situate the constructs on the state-trait continuum, test their components, evaluate their respective weights and measure their relative effects on other constructs.

Methods based on the decomposition of the construct

Research on the dynamics of constructs was first conducted in psychology, and more recently in marketing (Baumgartner and Steenkamp, 2006). The idea of breaking down the "true" score of a construct into more detailed components is not new. Generalizability theory used it first (Gleser, Cronbach and Rajaratnam, 1965; Shavelson, Noreen and Webb, 1989). In this theory, the scores of an item are attributed to several causes (e.g., individual, item, situation, individual x situation, etc.) that determine its variance. The idea of decomposing the variance of items is the same. However, while generalizability theory interprets the situation variance merely as one source of variation among others, the authors of the models we will present view it as a manifestation of the dynamic properties of the construct (Steyer and Schmitt, 1990; Steyer, Schmitt and Eid, 1999). Several models have been created for decomposing the true score. Here we present the three main models.

1) The Latent State Trait Method (LSTM), first, has been applied by psychologists to the concepts of social desirability (Schmitt and Steyer, 1993) and mood (Eid et al., 1994). Estimation in this model requires repeated measurement of k items in which the construct is reflected. These measurements are made at times t ($t = 0, 2, ...T$), during which the same items are given to the same individuals. This method of data collection justifies introducing a "stable item-specific error" ν_k (Baumgartner and Steenkamp, 2006). This error, which persists over time, arises from respondents' idiosyncratic reactions to the way an item is formulated. The observed score of item k ($k = 1, 2, 3$) at time t ($t = 0, 1, 2, ...T$), written as y_{kt}, is determined by the factor η_t expressing the transient component or "state" of the construct, the stable error ν_k specific to item k, a constant π_{kt} and a temporary item-specific error ε_{kt} (Equation 1). Moreover, each "state" factor (i.e., η_t) at each instant t ($t = 0, 1, 2$) is determined by a unique higher order "trait" factor ξ and by a situational residue ζ_t (Equation 2). Transferring the expression η_t taken from (2) into (1), we obtain the decomposition of the score y_{kt} into its trait (ξ), state (ζ_t), stable item-specific error (ν_k) and measurement error (ε_{kt}) components (Equation 3).

$$y_{kt} = \lambda_{kt} \cdot \eta_t + \nu_k + \pi_{kt} + \varepsilon_{kt} \tag{1}$$
$$\eta_t = \gamma_t \cdot \xi + \zeta_t \tag{2}$$
$$\underbrace{y_{kt}}_{\text{score}} = \underbrace{\lambda_{kt} \cdot \gamma_t \cdot \xi}_{\text{trait}} + \underbrace{\lambda_{kt} \cdot \zeta_t}_{\text{state}} + \underbrace{\kappa_{kt} \nu_k}_{\text{stable item error}} + \pi_{kt} + \underbrace{\varepsilon_{kt}}_{\text{temporary item error}} \tag{3}$$

2) The STARTS (Stable trait, autoregressive trait and state) model, developed by Kenny and Zautra (2001), is based on a rather different specification than that of the LSTM model. The STARTS model only involves a single item y_t, determined by a stable trait ξ, an autoregressive trait ξ_t that changes over time, and a measurement error ε_t (Equation 4). The autoregressive trait ξ_t depends on its value at $t - 1$ and a situational factor δ_t (Equation 5). Transferring the expression of ξ_t taken from (4) into (5), we obtain the decomposition of the score yt into its stable and labile components (Equation 6).

$$y_t = \xi + \xi_t + \varepsilon_t \tag{4}$$
$$\xi_t = \alpha \xi_{t-1} + \delta_t \tag{5}$$
$$\underbrace{y_t}_{\text{score}} = \underbrace{\xi}_{\text{trait}} + \underbrace{\xi_{t-1}}_{\text{autoregressive trait}} + \underbrace{\delta_t}_{\text{state}} + \underbrace{\varepsilon_t}_{\text{error}} \tag{6}$$

Although the STARTS model calls for only one time, its identification requires at least four repeated measurements and its estimation may sometimes encounter problems (Cole, Martin and Steiger, 2005). Indeed, when the coefficients α tend toward 0, autoregressive trait factors ξ_t becomes independent variables that are difficult to distinguish from residual terms δ_t. Conversely, when the coefficients α tend toward 1, the factors ξ_t combine into a single latent variable that is hard to distinguish from the enduring trait factor (Cole, Martin and Steiger, 2005).

3) Finally, LC-LSTM (Latent curve - Latent State Trait Method) model, developed by Tisak and Tisak (2000), also takes into account the possibility of a change of trait. But it grasps this change through the individual trajectories that follow the trait (i.e., permanence of the phenomenon) and not through an autoregressive trait factor. It is specified as follows. A first equation (7) links the measurement of item k, observed at time t, termed y_{kt}, to the state η_t. A second equation (8) describes the change of the "state" factor (η_t) over time in accordance with C latent curves. In practice, a linear change of trait is generally assumed and two latent curves are sufficient (i.e., $c = 0,1$).

$$y_{kt} = \pi_{kt} + \lambda_{kt} \cdot [\eta_t] + \nu_k + \varepsilon_{kt}$$
$$\forall k = 1,2...K \text{ and } \forall t = 0,1,2...T \tag{7}$$

$$\eta_t = \sum_{c=0}^{1} \gamma_{ct \cdot \xi_c \zeta_t} \; \gamma_{0t} = 1 \; \forall t = 0,1,2...T$$
$$\text{and } \gamma_{1t} = t = 0,1,2,3...T \tag{8}$$

ξ_0 is a constant linear curve (i.e., latent ordinate) and $\xi_1 \cdot \gamma_{1t} = \xi_1 \cdot t$. t is an increasing, decreasing or constant linear curve, the effect of which is added to ξ_0. The raw factor weights γ_{0t} are all set at 1 and the raw factor weights γ_{1t} follow the arithmetic progression 0, 1, 2, 3, ...T. ξ_0 is the stable trait. In other words, individual rankings, defined from their score ξ_{i0}, retain the same order in each period t. ξ_1 expresses the linear change in the trait over time, such that the linear combination $\xi_{i0} + \gamma_{1t} \cdot \xi_{i1}$ represents, for each individual and at every moment t, that individual's score on the latent trajectory of the trait. Transferring the expression η_t taken from (8) into (7), and developing the terms, we obtain the general expression y_{kt} (Equation 9).

$$\underset{\text{stable trait}}{y_{kt} = \lambda_{kt} \cdot \gamma_{0t} \cdot \xi_0} + \underset{\text{change of trait}}{\lambda_{kt} \cdot \gamma_{1t} \cdot \xi_1} + \underset{\text{state}}{\lambda_{kt} \cdot \zeta_t} + \underset{\text{stable item error}}{\nu_k + \pi_{kt}} + \underset{\text{temporary item error}}{\varepsilon_{kt}}$$

$$\forall k = 1,2,...K \forall t = 0,1,2,...T \quad (9)$$

These methods for decomposing the constructs have two advantages. The first is being able to evaluate the fit of the measurement scale to the temporal structure ascribed to the construct without this evaluation being flawed by measurement error. The second is that they give an expression of the estimated variance of measurement variables y_{kt} according to the variances of the dynamic components. For example, in the last model, taking into account the independence of errors and the factors between them, as well as the value of the fixed coefficients γ, we obtain the following decomposition (Equation 10).

$$\underset{\text{Var (item)}}{\mathrm{Var}(y_{kt})} = \underset{\text{Var (trait)}}{\lambda_{kt}^2 \cdot \mathrm{Var}(\xi_0)} + \underset{\text{Var (change of trait)}}{\lambda_{kt}^2 \cdot \gamma_{1t}^2 \cdot \mathrm{Var}(\xi_1)} + \underset{\text{Var (state)}}{\lambda_{kt}^2 \cdot \mathrm{Var}(\zeta_t)}$$

$$+ \underset{\text{Var (state item error)}}{\mathrm{Var}(\nu_k)} + \underset{\text{Var (temporary item error)}}{\mathrm{Var}(\varepsilon_{kt})} \quad (10)$$

This decomposition allows us to test empirically the significance of each hypothetical temporal component of the construct. To do this, we simply test the nullity of the variance and the mean of the component(s) concerned. Temporal reliability indices, comparable to Jöreskog's (1971) static index ρ, as well as the proportions of variance extracted by each component, similar to Fornell and Larcker's (1981) static index ρ_{vc}, can be calculated (Eid et al., 1994; Tisak and Tisak, 2000). One can then retain the significant components that are compatible with an acceptable level of convergent and discriminant validity. Another advantage of these methods is to provide a much richer assessment of predictive validity. Predictive validity is a form of criterion validity, which corresponds to the degree of correspondence between a measure and a criterion variable occurring in the future (Cronbach and Meehl, 1955; Bollen, 1989). In the temporal validation of a construct, this evaluation covers all the hypothetical components of the construct, whether stable, evolving and unstable or situational.

PRACTICAL ILLUSTRATION

How, in practice, is the temporal dimension of a hypothetical construct evaluated and tested? To provide a more didactic answer to this question, we will apply the procedures outlined in the second part to two typical cases quite often encountered in marketing. After presenting the measurement model used, we will report on its contributions to various aspects of temporal validation.

A dynamic general measurement model

Which method should be used to test temporal status of a construct? The measurement model that we propose is based on the models presented in the second part. However, it differs from them by the introduction of an additional construct η', which is assumed to be predicted by the construct studied. This model for analyzing the temporal structure of the construct will be designated by the acronym ASTC. It is specified by equations (11), (12) and (13). Its simplified causal diagram is shown in Figure 3. To enhance readability, we have not represented the regression constants of the indicators (e.g., π_{kt}) and the means of the latent factors. In this model, $K = 4$ (i.e., 4 indicators) and $T = 2$ (i.e., 3 periods = 0, 1, 2).

$$X_{kt} = \pi_{kt} + \lambda_{kt} \cdot [\eta_t] + \nu_k + \varepsilon_{kt}$$
$$\forall k = 1...K \;\; \forall t = 0,1...T \quad (11)$$

$$\eta_t = \sum_{c=0}^{1} \gamma_{ct} \cdot \xi_c + \zeta_t \; (\gamma_{0t} = 1 \; \forall t = 0,1...T \; ;$$
$$\gamma_{10} = 0, \gamma_{11} = 1, \gamma_{12} = 2) \quad (12)$$

$$\eta' = (\sum_{t=0}^{2} \beta_t \cdot \eta_t) + \zeta \quad (13)$$

Each variable in this model is defined in the key to Figure 3. To keep the same measurement scales over time, a stationarity condition is added (Tisak and Tisak, 2000). For each item k, at three moments t (i.e., t = 0, 1, 2), this makes the saturations equal (i.e., $\lambda_{k0} = \lambda_{k1} = \lambda_{k2}$). It also makes the constants equal (i.e., $\pi_{k0} = \pi_{k1} = \pi_{k2}$). In addition, the mean of

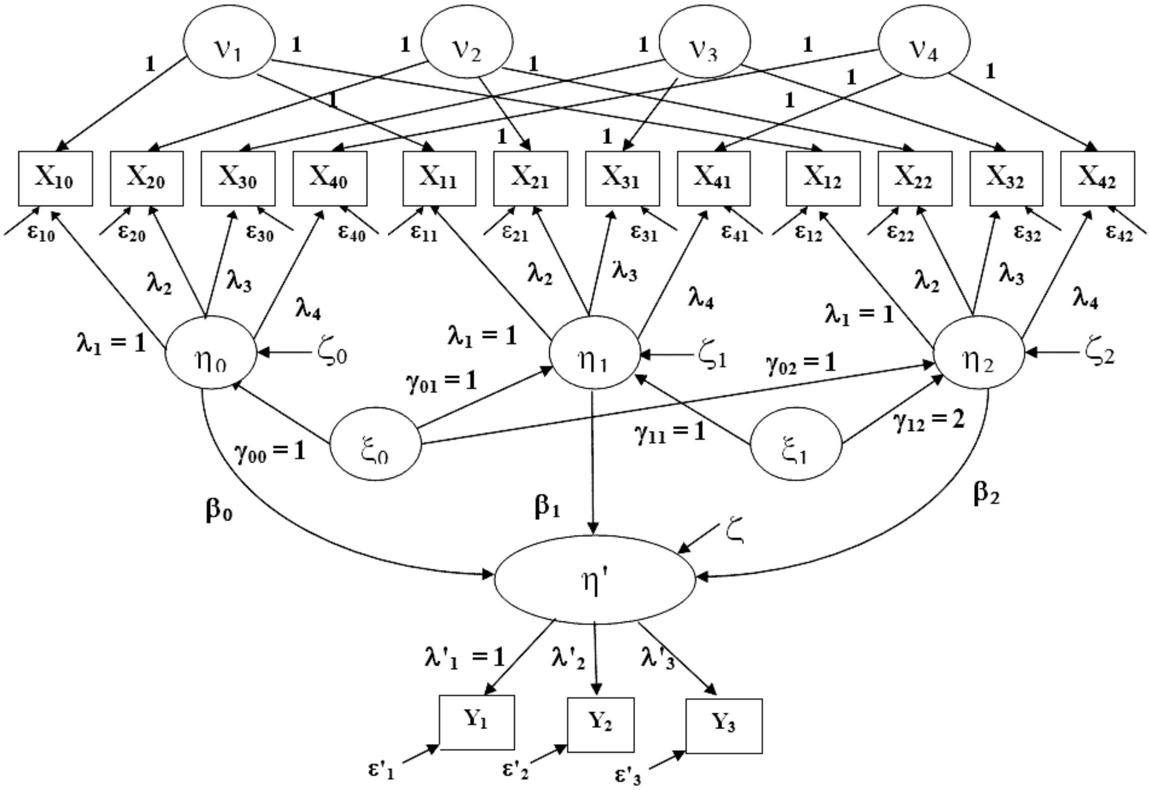

Figure 3. – ASTC model causality diagram

Key :
X_{kt} : item k measured at t of the construct whose temporal dimensions are tested, k =1,2,3,4; t = 0,1,2
Y_j : item j of the construct η' due to be predicted by the construct tested
η_t : "state" component at t of the construct tested; t = 0,1,2
ξ_0 : stable, "trait" or "enduring predisposition" component of the construct tested
ξ_1 : evolutionary component of the construct tested or "change of trait"
ζ_t : "state" situational component at t; t = 0,1,2
ν_k : stable error made on item k measuring the construct tested; k =1,2,3,4
ε_{kt} : temporary error at t made on item k measuring the construct tested; k =1,2,3,4 ; t = 0,1,2
η' : construct due to be predicted by the construct tested
β_t : standardized effect of the component η_t of the construct tested, on the construct η'
ζ : residual variable of the regression of η' on η_0 η_1 η_2
ε'_j : measurement error made item j of the construct η'

trait (0 should be set arbitrarily, at value zero in this case, as recommended by Muthén and Muthén (2004).

This model is dynamic because it measures the construct repeatedly over time and not at one particular moment. It is, on the other hand, general, because the temporal structure that it describes incorporates the stable, evolutionary, and situational components of a hypothetical construct. Hence, it can test all the instances identified in the state-trait continuum (Figure 2). Before considering the practical aspects of the test, it seems important to recall the specific role of each of these temporal components in the model. Indeed, all three have a direct effect on the states captured in the three instants "t" (e.g., η_t $\forall t = 0, 1, 2$) and have an indirect effect on the repeated measurements of the indicators X_{kt}. But these effects are not the same. Although the stable component ξ_0 (e.g., trait) has the same direct effect at each of the three moments "*t*" (i.e., 1), the evolutionary variable ξ_1 only has a direct effect on the states measured at $t = 1$ and $t = 2$. The amplitude of these effects follows an arithmetic progression (i.e., 0, 1, 2) because we make the assumption of a linear change over time (i.e., $\eta_t = \xi_0 + \xi_1 \cdot t + \zeta_t$). Furthermore, each situational variable ζ_t has a direct effect only on state η_t. The individual scores of the stable component ξ_0 retain the same order over time. The product ($\xi_1 \cdot t$) measures the underlying change in the stable component ξ_0. It strengthens or weakens this when "*t*" increases, depending on the sign of ξ_1. In addition, ξ_0 has an indirect effect on each of the indicators measured at three times "*t*", whereas ξ_1 has an indirect effect on these indicators only at times 1 and 2.

Two case studies

How should the results be interpreted? To answer this question, we have chosen to apply the general model to the treatment of two case studies, where the hypotheses and results encompass the full spectrum of the state-trait continuum. In the first, the researcher attempts to confirm the hypothesis that the construct "propensity to be brand loyal" is a stable trait (Bennett and Rundle-Thiele, 2002). The predictive validity of this construct will be tested on its capacity to predict the construct "willingness to pay more for brands", measured six months later. In the second case study, the researcher attempts to confirm the hypothesis that "consumer resistance to the provision of a loyalty card", regularly offered by large retailers, is a situational motivational state. Analysis of the temporal structure of this construct is relevant, since resistance is seen both as situational resistance, i.e., a variously active or reactive response, and as a psychological tendency (Roux, 2007). The predictive validity of this construct will be tested on its capacity to predict the construct "negative word of mouth" in relation to this loyalty card, measured six months later. The data used in these two cases are fictional and were designed to highlight the different contributions of the model. In both cases, the researcher has 400 observations for the three consecutive series of measurements. Variances, covariances and means of these data are given in Appendix A1. The temporal validation of the construct logically takes place in step (7) of Churchill's (1979) procedure. Temporal validity is not, in fact, independent of the other forms of validity (i.e., convergent, discriminant and predictive validity). It is not enough that the temporal dimensions exist; they must also satisfy the conditions of convergent and discriminant validity. The researcher thus has to answer three key questions:

1) Are the hypothetical temporal dimensions of the construct proven?
2) If so, with what degree of convergent and discriminant validity?
3) What, then, is the effect of each temporal dimension of the construct on the construct it is supposed to predict?

Tests of the temporal dimensions

Before testing the temporal dimensions of the constructs, it is advisable to check the fit of the estimated models to the data. The results reported in Appendix A2 reveal a satisfactory fit of the estimated models to the data in both case studies. The probabilities associated with the chi square statistics are below the 0.05 threshold, above which it is considered that the model does not have a perfect fit in the population (i.e., $p_1 = 0.074$ and $p_2 = 0.220$). The TLI and CFI indices are above the 0.95 threshold adopted in the literature, and the estimated RMSEA indices are below 0.05 and include the value 0 in their respective confidence intervals ($p = 0.90$) (Hu and Bentler, 1998).

In the first case study, the researcher attempts to verify that the propensity to be brand loyal is a stable trait. A significant variance for ξ_0 (i.e., trait) is expected, and non-significant variances for ξ_1 (i.e., change of trait) and ζ_0, ζ_1 and ζ_2 (i.e., situational differences) are also assumed. The results do not confirm all these expectations. Variance ξ_0 is clearly significant and variance ξ_1 is not. However, contrary to what was expected, the variances of ζ_0, ζ_1 and ζ_2 are significant (See Appendix A2). Three tests are carried out to complement these results (Eid et al., 1994). In the first, a nested model constraining the variance and the mean of ξ_1 to the value 0 is compared to the same model estimated without this constraint.

The chi square difference obtained is 6.812 with 2 degrees of freedom and a probability $p = 0.033$. This chi-square difference is significant at the 0.05 threshold, but not at the 0.01 threshold, similarly to the estimated mean and variance of ξ_1. It therefore seems prudent to reject the hypothesis of an evolutionary component. A second test, comparing the nested model (i.e., $\text{var}(\xi_0) = 0$) to the unconstrained model, produces a highly significant chi square difference (i.e., 168.98, with 1 degree of freedom, $p = 0.0000$), which justifies retaining the hypothesis of a trait component. A third test comparing a nested model eliminating the situational components (i.e., $\text{var}(\zeta_0) = \text{var}(\zeta_1) = \text{var}(\zeta_2) = 0$) to the unconstrained model leads to the rejection of the hypothesis eliminating the situational component (i.e., 926.77, 3 degrees of freedom, $p = 0.0000$). Researchers therefore need to think further about the propensity for brand loyalty. Indeed, analysis of its temporal structure in this test shows that it is perhaps not the stable trait it is supposed to be.

In the second case study, the researcher verifies that consumer resistance to the offer of a loyalty card is a situational state. He is expecting non-significant variances for ξ_0 and ξ_1 and significant variances for ζ_0, ζ_1 and ζ_2. The results confirm these expectations. The test comparing a nested model, neutralizing the stable and evolutionary factors ξ_0 and ξ_1 to the unconstrained (i.e., $\text{Var}(\xi_0) = \text{Var}(\xi_1) = E(\xi_1) = 0$), produces a non-significant chi square difference (i.e., 1.62, 3 degrees of freedom, $p = 0.6540$). However, the test comparing the model in which the three situational variances are set at zero to the unconstrained model produces a highly significant chi square difference (i.e., 1556.94, 3 degrees of freedom, $p = 0.0000$). The tests here corroborate the hypothesis, according to which consumer resistance to the offer of a loyalty card is a situational state.

Convergent and discriminant validities

The convergent validity requirement must also guide the researcher in the choice of the temporal components that should be retained. In a static confirmatory factor analysis, initial evidence of convergent validity is provided by Jöreskog's ρ (1971). In the dynamic model proposed here, Jöreskog's ρ is expressed in three indices measured at each time t (Schmitt and Steyer, 1993; Eid et al., 1994; Tisak and Tisak, 2000). The most restrictive index, ρ_t^{DYN}, limits the variance of the true score to the variances of the stable (ξ_0) and evolutionary (ξ_1) components. The least restrictive index, ρ_t^{STA}, excludes from the variance of the true score only the variances of the stable item-related error and of the measurement error. Finally, the index ρ_t^{SYS} includes in the variance of the true score all sources of variability, except for measurement error. As the results reproduced in Appendix A3 show, the convergent validity of the propensity for brand loyalty is obtained only at the static level, i.e., when the variances of the stable, evolutionary and situational components are taken into account in the true score ($\rho_0^{\text{STA}} = 0.873$; $\rho_1^{\text{STA}} = 0.913$; $\rho_2^{\text{STA}} = 0.913$). The same goes for the convergent validity of consumer resistance to the offer of a loyalty card ($\rho_0^{\text{STA}} = 0.884$; $\rho_1^{\text{STA}} = 0.896$; $\rho_2^{\text{STA}} = 0.912$). The proportion of variance extracted (AVE) by each component allows further examination of convergent validity. A minimum of 50% of variance extracted by the construct is needed to establish its convergent validity (Fornell and Larcker, 1981). Although at a static level the temporal indices ρ show that convergent validity is obtained in both case studies, the AVE indices themselves are very different (Appendix A4). Whereas in the case of the propensity for brand loyalty, the proportion of variance extracted by the stable and evolutionary components of the construct is 36.9%, it is only 0.4% in the case of resistance to the loyalty card offer. Conversely, the proportion of situational variance in the propensity to brand loyalty is estimated at 36.7%, while that of resistance to the loyalty card offer is estimated at 68.5%. At the static level, the two constructs extract, respectively, 72.6% and 68.9% of the variance of the measurement indicators. In addition, the discriminant validity of the two constructs is established, since greatest variance shared between the states η_0, η_1, η_2 and the construct η' to be predicted is less than the smallest variance shared between the constructs concerned and their measurements (e.g., $\beta_{1std}^2 = 0{,}752^2 = 0{,}566$ *vs* $\rho_{vc}^{\eta'} = 0{,}656$ in the first case study and $\beta_{1std}^2 = 0{,}636^2 = 0{,}404$ *vs* $\rho_{vc}^{\eta'} = 0{,}686$ in the second). These results support the view of the researcher, who sees “resistance to the offer of a loyalty card” as a situational state. On the other hand, they suggest that he should either reconsider the stable trait status that he attributes to the propensity for brand loyalty or review the measurement scale associated with it.

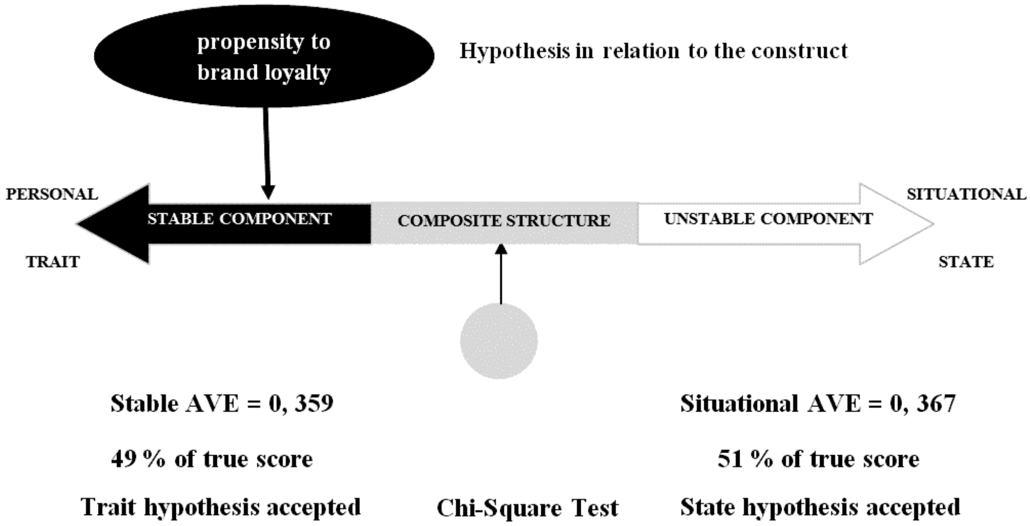

Figure 4.1 – First case study

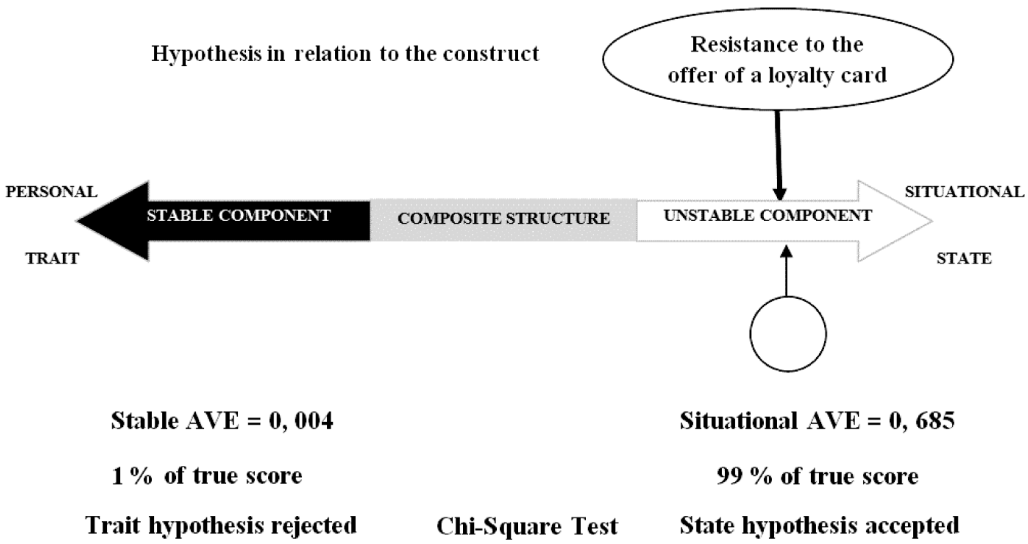

Figure 4.2 – Second case study

Figure 4. – Graph summarizing the results obtained in the two case studies.

Temporal aspects of predictive validity

Taking into account the temporal dimensions of a construct can also help refine the study of predictive validity. In this phase of validation, it is a question of showing that the construct predicts another construct viewed as an external criterion. When the construct is a typical trait or a state, this predictive effect is wholly attributed to the trait or the state that it is supposed to be. However, when the construct is a heterogeneous temporal structure, it is worthwhile distinguishing the contribution of the various stable, transient or progressive components to the expected effect. The proposed model allows the decomposition. Putting the expression of η_t given in (12) into equation (13), then expanding the variances of the terms, gives equation (14). From (14) it is easy to establish the relative shares of each component of the construct as a percentage of Var (η') (See Appendix A5).

$$\mathrm{Var}(\eta') = (\sum_{t=0}^{2} \beta_t)^2 \cdot \mathrm{Var}(\xi_0) + (\beta_1 + 2 \cdot \beta_2)^2 \cdot \mathrm{Var}(\xi_1) + \sum_{t=0}^{2} \beta^2 \cdot \mathrm{Var}(\zeta_t) + \mathrm{Var}(\zeta) \qquad (14)$$

In the first case study, the researcher attempts to verify that the propensity for brand loyalty has a positive effect on the willingness to pay more for brands (i.e., η'). This relationship is verified at $t = 0$, since the effect of η_0 on η' is positive and significant (0.929), but not at $t = 1$ or $t = 2$, since the effects of η_1 and η_2 on η' are negative (– 0.026 and – 0.170). These results should be treated with caution. The high correlations between the factors η_t, lying between 0.420 and 0.529, probably contribute to biases in the estimates of these parameters. In terms of percentage of explained variance, the situational component of the propensity for brand loyalty is a better predictor than the stable component of the propensity to pay more for brands, i.e., 25.6%, or 52.4% of the total effect of the construct, against 23.2%, or 47.6% of the total effect of the construct (See Appendix 5a). This result should encourage the researcher to reconsider the hypothetical stability of the propensity to loyalty and/or the scale that measures it.

In the second case study, consumer resistance to the loyalty card offer (η_0, η_1, η_2) has a significant positive effect on negative word of mouth (η') at the three times considered (0.711; 0.298; 0.221). Although this positive effect was expected, the variations in its amplitude over time can be explained by situations that are different. Has the pressure exerted by the retailer on consumers to take the card diminished over time? The resistance construct as a whole explains 54% of negative word of mouth ($R^2 = 0.54$), and the situational component contributes 99% of this effect (See Appendix A5).

DISCUSSION AND CONCLUSION

In this research, we have offered a general model designed to test various temporal hypotheses in relation to a construct. The examples chosen are simply illustrative. Our goal is not to establish these methods as absolute rules, but rather to show how they can be usefully applied in marketing. Anticipating some of the possible objections, we therefore willingly subject these methods to criticism. We then discuss ways of improving them.

Legitimate questions

Some readers may well question the relevance of these methods, which have been used very little in marketing. In cases where the researcher does not specify the temporal status of the constructs being developed, the methods described here do not apply. The temporal status of the constructs is then simply indeterminate. We nevertheless recommend the use of the tools presented here when the researcher explicitly specifies the temporal structure of a construct. The test-retest method applied with a Spearman correlation coefficient will certainly give useful indications as to the stability or instability of the measurements, but it will not say anything about the relative shares of the construct's enduring component and the situational component. Knowing this proportion and its effects is essential because it is easier for a company to act on purchasing situations than on the customer's personality or enduring predispositions.

A more fundamental question is whether it is really important to empirically distinguish trait and state, since the definition of a construct is clear. This question touches on Rossiter's (2002) arguments for the validity of appearance. This author makes a distinction between "abstract" constructs, in which researchers are often different things, and "concrete" constructs, the definition of which is unanimously agreed on by experts. The former, which are the more debatable, would be amenable to the methods presented here. The latter, where there is more consensus, would not be. The methods we have presented here are not intended to challenge the results of previous research, but to deepen and enrich the knowledge they have already established. In particular, great caution should be exercised in regard to the conclusions that one might be tempted to draw from the use of these methods. Two important points seem to us to be relevant here. The first concerns the degree of corroboration of the method, the second the interpretation of the results. The force of temporal validation depends on three things: i) the time between data collections, ii) the temporal hypothesis elaborated in regard to the constructs, and iii) the result of testing the hypothesis, which may be either accepted or rejected. These cases are analyzed in Table 4. We will comment on just two of them, leaving the reader to discover the others.

In the practical illustrations we have given, we did not specify the time intervals between the three consecutive measurements of the constructs. Consider, for example, the second case study, where the hypothesis of a situational state is tested. We concluded that the construct was very likely a state. This corroboration would be that much more conclusive were the time intervals between observations short. Over a short period, the situations have little opportunity to change and reveal fluctuating states. Conversely, in the first case study, we did not reject the hypothesis of the presence of a stable component. For the same reasons, this corroboration would be that much less convincing if the duration under consideration to obtain this result were short.

The second case study leads us to clarify what is meant by theoretical validation. The latent variable associated with the trait never corresponds exactly to the theoretical trait. For it to do so, it would have to be measured by considering its effect on all states occurring during the lifetime of the relationship between the consumer and the brand or the company. In practice, the researcher will consider three or four arbitrary points in time. If the hypothesis making the construct a trait is rejected, this conclusion should be viewed as tentative. The same measurement scale applied to a longer time period might yield a very different result, thereby possibly substantiating the well-foundedness of the trait dimension attributed to the theoretical construct.

Contributions and the need for further research

Temporal validation methods based on the decomposition of constructs have generated more interest in psychology than in marketing (Baumgartner and Steenkamp, 2006). They neverthe-

Table 2. – Degree of corroboration in the temporal validation of a construct

Time between measurements / **Hypothesis and result of test**		**Short** (a few weeks)	**Long** (several months or years)
Presence of a trait in the construct	Hypothesis of a trait trajectory **rejected**	It is shown that in a short period where situations vary little, there is no persistent trait **STRONG CORROBORATION**	It is shown that in a long period where situations vary more, there is no persistent trait **WEAK CORROBORATION**
	Hypothesis of a trait trajectory **accepted**	A trait is revealed in the short term but it is not shown that it will persist **WEAK CORROBORATION**	A trait is revealed in the long term which persists **STRONG CORROBORATION**
Presence of states in the construct	Hypothesis of a succession of states **rejected**	It is shown that in a short period where situations vary little, no states are distinguishable **WEAK CORROBORATION**	It is shown that in a long period where situations vary more, no states are distinguishable **STRONG CORROBORATION**
	Hypothesis of a succession of states **accepted**	It is shown that in a short period where situations vary little, there is a succession of different states **STRONG CORROBORATION**	It is shown that in a long period where situations vary more, there is a succession of different states **WEAK CORROBORATION**

less usefully complement conventional test-retest techniques. While these are useful for verifying the stability of measurements, methods based on disaggregation of the construct produce a better understanding of the temporal structure of constructs and enable the effects of each of their components to be evaluated. There are numerous applications for these methods in marketing – first, to revisit measurement scales that are already widely used (e.g., loyalty, involvement, etc.). This work is particularly important in that researchers often use existing scales (Chandon and Bartikowski, 2004) whose temporal validity has not always been verified. But the use of these methods also addresses newer concepts such as resistance (Roux, 2007), reactance (Wendlandt and Schrader, 2007) and nostalgia (Vignolles, 2011; Kessous and Roux, 2010), whose temporal status is still open to debate. Other avenues of research concern possible improvements to these methods. For example, the model we have proposed is, like traditional factor analysis, based on an implicit assumption according to which the factor structure is identical for all individuals. This assumption is not always legitimate and improved temporal models would be in a position to dispense with it (Hamaker, Nesselroade and Molenaar, 2006).

In this paper, we have tried to show the importance of validating temporal constructs, both from a theoretical and a methodological perspective. We put forward a model (ASTC) to analyze the temporal structure of a construct and test each of its hypothetical components. While test-retest methods indicate the degree of stability of measurements, the ASTC model usefully complements these by specifying the structure of the stable and unstable components of the construct. The use of tests allows them to be fully or partially corroborated or to be rejected. The illustration of this model, through two different case studies, showed that the temporal validity of a construct is not independent of other forms of validity, whether convergent, discriminant or predictive. Quite the reverse in fact, for temporal validity increases in conformity with them. These case studies also showed that the testing of temporal hypotheses is sometimes difficult to implement and that the results must be interpreted with caution. However, this model improves our understanding of the degree of agreement between constructs and their measurement scales. This match is one of the bridges connecting the world of concepts devised by researchers to the world of realities vital for managers.

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APPENDICES

A1.– Matrices of variances-covariances and means in cases 1 and 2 (trait and state)

	x10	x20	x30	x40	x11	x21	x31	x41	x12	x22	x32	x42	y1	y2	y3
averages	3.981	3.977	3.996	3.998	3.976	3.971	3.990	3.992	3.970	3.965	3.984	3.986	3.720	3.622	3.653
x10	0.478														
x20	0.370	0.497													
x30	0.366	0.397	0.725												
x40	0.385	0.418	0.414	0.787											
x11	0.213	0.224	0.222	0.234	0.608										
x21	0.224	0.243	0.241	0.254	0.487	0.602									
x31	0.222	0.241	0.241	0.251	0.482	0.523	0.780								
x41	0.234	0.254	0.251	0.264	0.508	0.551	0.546	0.869							
x12	0.213	0.224	0.222	0.234	0.213	0.224	0.222	0.234	0.597						
x22	0.224	0.243	0.241	0.254	0.224	0.243	0.241	0.254	0.505	0.626					
x32	0.222	0.241	0.241	0.251	0.222	0.241	0.241	0.251	0.500	0.542	0.807				
x42	0.234	0.254	0.251	0.264	0.234	0.254	0.251	0.264	0.526	0.571	0.565	0.931			
y1	0.287	0.332	0.381	0.374	0.215	0.144	0.148	0.155	0.104	0.113	0.112	0.118	0.826		
y2	0.245	0.312	0.396	0.345	0.221	0.171	0.181	0.190	0.128	0.138	0.137	0.144	0.548	0.961	
y3	0.336	0.327	0.384	0.348	0.245	0.135	0.177	0.187	0.125	0.136	0.135	0.142	0.539	0.659	0.895

Mean variances and covariances of data in case 1

	x10	x20	x30	x40	x11	x21	x31	x41	x12	x22	x32	x42	y1	y2	y3
averages	4.075	4.092	4.091	4.086	4.037	3.962	4.021	4.055	4.022	4.031	4.021	4.015	3.831	3.735	3.766
x10	0.468														
x20	0.420	0.498													
x30	0.401	0.421	0.774												
x40	0.404	0.418	0.428	0.814											
x11	0.002	0.001	0.001	0.001	0.645										
x21	0.001	0.001	0.001	0.001	0.484	0.686									
x31	0.001	0.008	0.003	0.003	0.464	0.513	0.769								
x41	0.002	0.001	0.001	0.001	0.493	0.534	0.522	0.840							
x12	0.001	0.001	0.007	0.001	0.001	0.001	0.001	0.001	0.605						
x22	0.001	0.003	0.001	0.001	0.002	0.001	0.001	0.004	0.512	0.618					
x32	0.004	0.001	0.001	0.002	0.001	0.001	0.005	0.001	0.523	0.535	0.804				
x42	0.001	0.002	0.001	0.001	0.001	0.002	0.001	0.001	0.515	0.557	0.545	0.914			
y1	0.287	0.332	0.381	0.374	0.132	0.143	0.140	0.146	0.104	0.112	0.110	0.114	0.828		
y2	0.245	0.312	0.396	0.345	0.161	0.174	0.170	0.177	0.126	0.137	0.133	0.139	0.556	0.964	
y3	0.336	0.327	0.384	0.348	0.157	0.170	0.166	0.173	0.123	0.133	0.130	0.135	0.547	0.658	0.898

Mean variances and covariances of data in case 2

A2.– Estimated parameters in the two case studies

Variances of construct components		
Components	**Propensity to be loyal to brands**	**Resistance to the offer of a loyalty card**
durable (ξ_0)	Var (ξ_0) = 0.206 t = 9.550 E (ξ_0) = 0.000 (set parameter)	Var (ξ_0) = 0.002 t = 0.092 (ns) E (ξ_0) = 0.000 (set parameter)
evolving (ξ_1)	Var (ξ_1) = 0.000 t = 0.000 (ns) E (ξ_1) = -0.005 t = -0.327 (ns)	Var (ξ_1) = 0.000 t = 0.020 (ns) E (ξ_1) = -0.031 t = -1.273 (ns)
situational (ξ_0)	Var (ζ_0) = 0.133 t = 6.994	Var (ζ_0) = 0.388 t = 11.110
situational (ζ_1)	Var (ζ_1) = 0.256 t = 9.279	Var (ζ_1) = 0.460 t = 11.065
situational (ζ_2)	Var (ζ_2) = 0.245 t = 9.552	Var (ζ_2) = 0.485 t = 7.283
Parameters of the structural model		
	Propensity to be loyal to brands	**Resistance to the offer of a loyalty card**
β_0 non-standardized β_0 standardized	β_0 = 0.929 t = 11.054 β_0 = 0.752 t = 15.660	β_0 = 0.711 t = 12.627 β_0 = 0.636 t = 18.143
β_1 non-standardized β_1 standardized	β_1 = -0.026 t = -0.447 β_1 = -0.025 t = -0.448	β_1 = 0.298 t = 6.464 β_1 = 0.290 t = 6.855
β_2 non-standardized β_2 standardized	β_2 = -0.170 t = -2.985 β_2 = -0.167 t = -3.034	β_2 = 0.221 t = 5.097 β_2 = 0.220 t = 5.261

A3.– The model's goodness of fit in the two case studies

Evaluation indices of the model's goodness of fit applied to the two case studies	Case 1 **Construct concerned is assumed to be a trait**	Case 2 **Construct concerned is assumed to be a state**
χ^2 (maximum likelihood estimator) **degrees of freedom** **associated probability** **χ^2/degrees of freedom**	**117.875** **97** **0.074** **1.215**	**107.433** **97** **0.220** **1.108**
CFI **TLI**	**0.995** **0.994**	**0.997** **0.997**
RMSEA **Confidence interval (90%)** **Probability (RMSEA) < 0.05**	**0.023** **0.000 0.037** **1.000**	**0.016** **0.000 0.032** **1.000**
SRMR	**0.023**	**0.023**

A4.– Indices of convergent validity in the two case studies

Instruments for evaluating convergent and discriminant validities	Case study 1 Construct concerned is assumed to be a trait			Case study 2 Construct concerned is assumed to be a state		
Temporal decomposition of Jöreskog's (1970) rho	t_0	t_1	t_2	t_0	t_1	t_2
Dynamic reliability index ρ^{DYN} of the construct tested $\rho_t^{DYN} = \frac{\sum_{k=1}^{4}\sum_{k'=1}^{4}[\lambda_k\lambda_{k'}\sum_{c=0}^{1}\sum_{c'=0}^{1}\gamma_{ct}\gamma_{c't}.Covar(\xi_c\xi_{c'})]}{Var(\sum_{k=1}^{4} y_{kt})}$	0.531	0.421	0.405	0.005	0.004	0.004
Static reliability index ρ^{STA} of the construct tested $\rho_t^{STA} = \frac{\sum_{k=1}^{4}\sum_{k'=1}^{4}[\lambda_k\lambda_{k'}\sum_{c=0}^{1}\sum_{c'=0}^{1}\gamma_{ct}\gamma_{c't}.Covar(\xi_c.\xi_{c'}) + \lambda_k.\lambda_{k'}.Var(\zeta_t)]}{Var(\sum_{k=1}^{4} y_{kt})}$	0.873	0.913	0.913	0.884	0.896	0.912
Systematic reliability index ρ^{SYS} of the construct tested $\rho_t^{SYS} = \frac{\sum_{k=1}^{4}\sum_{k'=1}^{4}[\lambda_k\lambda_{k'}\sum_{c=0}^{1}\sum_{c'=0}^{1}\gamma_{ct}\gamma_{c't}.Covar(\xi_c\xi_{c'}) + \lambda_k.\lambda_{k'}.Var(\zeta_t) + \frac{1}{4}Var(\upsilon_k)]}{Var(\sum_{k=1}^{4} y_{kt})}$	0.874	0.914	0.914	0.884	0.896	0.912
Jöreskog's (1971) ρ of the static construct η' $\rho_{\eta'} = \frac{(\sum_{j=1}^{3}\lambda_j)^2.Var(\eta')}{(\sum_{j=1}^{3}\lambda_j)^2 + \sum_{j=1}^{3}Var(\varepsilon'_j)}$		0.851			0.852	
Temporal composition of Fornell and Larcker's AVE (1981)	AVE (1)	Accumulated AVE (2)		AVE (3)	Accumulated AVE (4)	
% of variance of the hypothetical stable component (ξ_0) $AVE\ stab = \frac{\sum_{k=1}^{4}\sum_{t=0}^{2}\lambda^2_k.\gamma^2_{0t}Var(\xi_0)}{\sum_{k=1}^{4}\sum_{t=0}^{2}Var(y_{kt})}$	0.359	0.359		0.002	0.002	
% of variance of the hypothetical evolutionary component of the trait (ξ_1) $AVE\ évol = \frac{\sum_{k=1}^{4}\sum_{t=0}^{2}\lambda^2_k.\gamma^2_{1t}Var(\xi_1)}{\sum_{k=1}^{4}\sum_{t=0}^{2}Var(y_{kt})}$	0.000	0.359		0.002	0.004	
% of variance of the hypothetical situational component (ζ_t) $AVE\ situ = \frac{\sum_{k=1}^{4}\sum_{t=0}^{2}Var(\zeta_t)}{\sum_{k=1}^{4}\sum_{t=0}^{2}Var(y_{kt})}$	0.367	0.726		0.685	0.689	
% of variance due to stable item-related error (ν_k) $AVE\ erreur\ stable\ d'item = \frac{\sum_{k=1}^{4}\sum_{t=0}^{2}Var(\upsilon_t)}{\sum_{k=1}^{4}\sum_{t=0}^{2}Var(y_{kt})}$	0.003	0.729		0.000	0.689	
% of variance due to measurement error (ε_{kt}) $AVE\ erreur = \frac{\sum_{k=1}^{4}\sum_{t=0}^{2}Var(\varepsilon_{kt})}{\sum_{k=1}^{4}\sum_{t=0}^{2}Var(y_{kt})}$	0.271	1.000		0.311	1.000	
AVE of the static construct η'						
$\rho_{vc(\eta')} = \frac{(\sum_{j=1}^{3}\lambda_j^2).Var(\eta')}{\sum_{j=1}^{3}\lambda_j^2 + \sum_{j=1}^{3}Var(\varepsilon_{j'})}$		0.657			0.659	
AVE of factors η_t						
η_0		0.656			0.698	
η_1		0.739			0.686	
η_2		0.742			0.739	

A5.– Temporal decomposition of the construct's predictive effect in the two case studies

Instruments for evaluating predictive validity				
	Case study 1 (trait)		**Case study 2 (state)**	
Proportion of variance of η' explained by each hypothetical component to the construct	**AVE (1)**	**Contribution to the effect (2)**	**AVE (3)**	**Contribution to the effect (4)**
a) by the stable component of the trait (ξ_0) $\frac{(\sum_{t=0}^{2}\beta_t)^2.\mathrm{Var}(\xi_0)}{\mathrm{Var}(\eta')}$	**0.232 (a)**	**0.476 = a/(a+b+c)**	**0.006 (a)**	**0.012 = a/(a+b+c)**
b) by the evolutionary component of the trait (ξ_1) $\frac{(\beta 1+2\beta 2)^2\,\mathrm{Var}(\xi 1)}{\mathrm{Var}(\eta')}$	**0.000 (b)**	**0.000 = b/(a+b+c)**	**0.000 (b)**	**0.000 = b/(a+b+c)**
c) by the situational component ($\zeta_0.\zeta_1.\zeta_2.$) $\frac{\sum_{t=0}^{2}(\beta_t^2.\mathrm{Var}(\varsigma_t)}{\mathrm{Var}(\eta')}$	**0.255 (c)**	**0.524 = c/(a+b+c)**	**0.534 (c)**	**0.988 = c/(a+b+c)**
d) by the residual component (ζ) $\frac{\mathrm{Var}(\zeta)}{\mathrm{Var}(\eta')}$	**0.513 (d)**		**0.460 (d)**	
R^2 = (a+b+c) / (a+b+c+d)	**0.487**		**0.540**	