TEMPORAL DISSONANCE IN IT WORKERS

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Abstract

IT projects continue to fail too frequently. One reason for these failures is interpersonal and motivational issues in IT workers. One possible cause for these issues is increased temporal dissonance, which causes stress and the ill effects associated with that stress. In this study, we develop a measure of temporal dissonance, and place it in the nomological net. With this measure, temporal dissonance and its possible remedies can be quantified.

Keywords: temporal dissonance, temporal congruity, stress, IT workers
1. Introduction

Failure of IT projects continues to be a significant problem in the business world. In 1995, The Standish Group report estimated that over 30% of IT development projects would be canceled, and more than half would cost nearly twice the original estimate (The Standish Group 1995). The picture has not improved much: failures are currently estimated at 24%, and cost over-runs exceed $6 trillion (Sessions 2009). In a study of 99 failed projects, undermined motivation and poor working relationships among team members affected 37% of those failed projects (Nelson 2007). Reducing these personnel driven failures would provide significant returns to business.

One possible source of IT worker stress may be found in their temporal characteristics, which may not match more traditional white collar worker profiles. For instance, people whose cortisol levels rise later in the day ("owls") seem to be somewhat more creative than their morning ("lark") counterparts (Giampietro and Cavallera 2007). This increase in creativity would be an advantage in creative work such as IT project implementation, but is less present in the stereotypical manager, who is a lark. Some attention has been paid to temporal characteristics at the organizational level, detailing the potentially devastating effects of a lack of temporal congruity (Bluedorn and Denhardt 1988; Ryan 2008; Standifer and Bluedorn 2006). Suggestions for improving congruence include entrainment and time management techniques, with the expectation that these would also improve individual performance. Individuals with time structures incongruent with those of their organization suffer stress, leading to health effects and poor performance (Cotte et al. 2004; Kaufman et al. 1991; Slocombe and Bluedorn 1999). These problems are even more likely to be found in distributed teams, as individuals from different areas with different ways of using time and differing physical time are brought together (M. P. E. Cunha and R. C. E. Cunha 2004; O'Leary and Cummings 2007). While the cited works consider several different notions of time, such as polychronicity, temporal focus, and time urgency, the complexity of time itself suggests that many more temporal characteristics might be important (Ancona et al. 2001). One area that this prior work neglects is an understanding of the underlying psychological or social mechanisms by which this congruence affects performance. Existing models of time management have also thus far failed to solve congruence issues (Claessens et al. 2007; Macan 1994).

One possible explanation for the effect that a lack of temporal congruity may have on performance is the concept of temporal dissonance. Temporal dissonance is the affective reaction an individual has to a salient lack of temporal congruity (Conway and Limayem 2010). Distributed teams are at a higher risk of developing temporal dissonance due to both cultural differences (Geert Hofstede and Gert Jan Hofstede 2004) and physical time differences (O'Leary and Cummings 2007) – in addition to the individual differences that are already known to be a problem in teams. Detecting temporal dissonance in a distributed team would allow the manager an opportunity to address the temporal challenges to the team, and thus improve the team's functioning. However, no method for detecting temporal dissonance currently exists.

Our research questions, then, are: can we detect temporal dissonance? And, does temporal dissonance mediate the effect of temporal congruence on individual stress? We answer this by developing a measure for temporal dissonance. We create an instrument and document its psychometric properties. We show that temporal dissonance is created from the interaction of temporal congruity and salience, and that increased temporal dissonance increases stress.

Our paper follows a standard model. We first examine the prior work in more depth in the "background" section. We then develop the theory of temporal dissonance in the individual in the "model" section. We describe the instrument we designed and the method for its testing in the "method" section. The results of the study are presented in the "results" section. Finally, we note implications for theory and for practice, and point toward avenues for future research in the "conclusion" section.
2. Background

Most research views time as an immutable and objective measure of distance between two states. This view, however, is relatively new, and was created largely through the industrialization of the Western world, as a tool for turning labor into a commodity (Sorokin and Merton 1937). Prior to that, time was viewed more fluidly: years from an event, seasons, recurring markets. In recent years, researchers have realized that time is a more important, and more complex, element of research, which requires a careful analysis of the assumptions underlying its use. To many business people, time is a real object which can be manipulated or used in various ways. In one study, researchers were observed in many activities related to manipulating time, including making time, exchanging time, exploiting time, investing time, spending time, extending time, and documenting time (Yli-Kauhaluoma 2009).

Successful innovators view time as something which exists and can be used, enacted and affected in many ways; in fact, this may be a source of their success in innovation (T. Hellström and C. Hellström 2002). It seems clear that, rather than a simple yardstick, time is a complex and essential element when examining business processes.

Time can mean many different things, depending on the context. An early framework differentiates between social time, astronomical time, and economic time (Sorokin and Merton 1937). A newer framework divides time into social time, mathematical time, or economic time (Bluedorn and Denhardt 1988). Yet another framework subdivides the Bluedorn and Denhardt “social time” into three primary categories: conceptions of time, socially constructed time, and actors relating to time (Ancona et al. 2001). These frameworks are by no means exhaustive; none of them include (for example) biological time, rooted in the physical body. In order to understand why time is so complex, let us briefly examine several types of time.

Biological time is rooted in biological processes such as circadian rhythms, seasonal variation, and life stages. Circadian rhythms affect chronotype: how individuals structure their day, including waking and sleeping hours. Owls (an evening chronotype) prefer to start work later in the day, and work into the evening, while larks (a morning chronotype) are "early birds" who try to start work as early as possible. These differences are physiological, and can be measured by cortisol levels. Peak cortisol levels have implications for when individuals perform best (Horne et al. 1980). Larks tend to have a high early morning peak in cortisol levels, with production dropping fairly quickly in the afternoon. Owls tend to have a later, and flatter, peak, with production continuing at moderate levels into the evening (Kudielka et al. 2006). Seasonal variation is not limited to deciduous trees; illnesses such as Seasonal Affective Disorder are caused by differences in the seasons (Mayo Clinic Staff 2009). Life stages can be as obvious as insect development from egg to larva to nymph to adult, or as subtle as the development of humans from infancy through youth to maturity and old age.

Psychological time deals with the subjective nature of time which is unique to an individual. The Type A personality exhibits a characteristic of time urgency (Landy et al. 1991; Waller et al. 2001). Time perspective or focus deals with the propensity of an individual to focus on the future, the present, or the past (Zimbardo and Boyd 1999). Polychronicity refers to a preference for undertaking multiple tasks at once; monochronicity is a focus on one task at a time (Kaufman-Scarborough and Lindquist 1999). These are only a few of the most commonly used psychological models of time; there are many others which can be applied when circumstances warrant (Ancona et al. 2001). While these psychological constructs are created through the interaction of social time structures and biological time structures, eventually they take on a life of their own in the individual.

Biological and psychological times are individual traits. These traits interact with other individuals' traits to create social time. Social time structures an individual's interactions with the social groups surrounding her. Social time is both created from, and is input into, psychological time, in a feedback loop. Thus, social time is constructed as a shared model of time between two or more people (Ancona et al. 2001; Sorokin 1964). These structures are created by incorporating psychological time with the
temporal requirements of the social groups, organizations, or institutions in which the individual finds herself (Blount and Leroy 2007). Different groups may have different social time characteristics; for instance, family social time may be organized around birthdays, anniversaries, or important holidays, while work social time may revolve around quarters, years, or busy seasons (Bluedorn and Denhardt 1988). All these social times may be in effect at any point in time, depending on which is salient. Conflicts between them can set up stress and may trigger affective reactions in the individuals involved (Ryan 2008), which may also have implications for the organization itself (Slocombe and Bluedorn 1999). Cultures, too, have models of time, such as long-term outlook (Geert Hofstede and Gert Jan Hofstede 2004). Cultural outlooks on time have an impact on social time as conceived by both individuals and the groups, organizations, and institutions embedded within the culture.

Physical time is based upon the underlying physical world. It is seen as objective reality which does not arise out of an organism's biological nature. The current definition of a physical time second as 9,192,631,770 wavelengths of a caesium atom (NIST 2009) is an example of this kind of time. Physical time interacts with other types of time: for instance, jet lag occurs when circadian rhythms (biological time) are disrupted as a traveler changes her position in physical time (Arendt and Marks 1982).

This underscores the need to consider time as an essential element when examining business processes. Because of the implied manipulability of time, there is a tendency among individuals to make value judgments about competing time structures, perceiving them as evidence of personality flaws (Ryan 2008). American society values morning people. Contemporary media is biased towards the polychronic individual. Being aware of time complexities can improve a leader's ability to drive organizational innovation and creativity (Halbesleben et al. 2003).

Individuals create complex mental models of time (called temporal structures) out of all these temporal characteristics, which help them to order and organize their lives. Temporal structures take trait-based and environmental information as inputs, and instantiate them as a state in the individual. Individuals may have multiple temporal structures to deal with different aspects of the world (Orlikowski and Yates 2002). For instance, one can have one temporal structure for organizing one's interaction with family, and a different one for organizing interactions with the workplace. These temporal structures may sometimes conflict with each other in ways that can cause individual stress – thus the concern with "work-life balance" (Orlikowski and Yates 2002). This stress can lead to reduced individual health and performance (Bluedorn and Denhardt 1988; Slocombe and Bluedorn 1999). Individuals' temporal structures are created through interaction between their environment (including culture, organizational ties, institutional memberships, and familial ties) and their own personal psychological and physiological characteristics (Blount and Leroy 2007; Clark 1985; Saunders et al. 2004). Being a state, temporal structures are malleable, but will have a tendency to return to values supported by the underlying traits.

Temporal congruity can be defined as the degree to which two temporal characteristics match (Kaufman et al. 1991). Similarity in polychronicity of the individual and the organization, for instance, can improve both individual and organizational outcomes (Kaufman-Scarborough and Lindquist 1999). Other studies have similarly showed the value of temporal congruity for other time dimensions, both in terms of the positive value of congruity (Standifer and Bluedorn 2006) and the negative impact of lack of congruity (M. P. E. Cunha and R. C. E. Cunha 2004). Why does this congruity matter? Surely the simple congruence of time dimensions does not, in and of itself, improve outcomes. However, no mechanism for temporal congruity's effects have been identified. What happens when two time structures are incongruent? How do they become congruent? And does lack of congruence on multiple dimensions lead to more trouble than a difference on only one dimension? Several of these studies give a couple of useful clues as the mechanisms behind the problems. First, individuals seem to feel distress when they have conflicting time structures, and perform actions to reduce that distress (Cotte et al. 2004). Second, conflict seems to emerge when temporal structures are not congruent (Ryan 2008) (M. P. E. Cunha and R. C. E. Cunha 2004) (Labianca et al. 2005) (Gersick 1988).
The actions taken to reduce the stress of competing time structures in Cotte et al. (2004) included emphasizing certain time characteristics, and downplaying others. In organizations, individuals often force themselves to cope with competing temporal structures when they do not have the power to alter them, or negotiating changes when they can (Mcgrath 1991). These behaviors are very similar to the coping behaviors associated with the reduction of cognitive dissonance. Cognitive dissonance (Festinger 1957) is the discomfort felt when an individual holds two conflicting psychological models. The classic example of cognitive dissonance is the person who smokes, even though she knows that it increases the likelihood of early death. Individuals will attempt to reduce this discomfort by reducing the salience of beliefs that are dissonant to desired attitude; adding consonant beliefs to strengthen the desired attitude; or attempting to change the dissonant beliefs to remove the dissonance (Aronson 1969).

The behavior of individuals with salient incongruent temporal structures is similar to that of individuals suffering from cognitive dissonance, and the concept of incongruent temporal structures itself is similar to the causes of cognitive dissonance. Therefore, we call the psychological discomfort felt when an individual internalizes two or more temporal structures that lack congruity temporal dissonance. Temporal dissonance may be created from differences in physical, biological, social, or psychological time, or any combination of those, when those differences are made salient. Temporal dissonance requires an affective reaction to the temporal incongruity. The concept is similar to the difference between psychological contract breach, and psychological contract violation. The former is the simple fact of a broken psychological contract, while the latter is the affective reaction to the breach (Morrison and Robinson 1997).

This discussion has provided the background we need to begin to construct our model of what temporal dissonance is and how it works.

3. Model

3.1. The Effect of Temporal Congruity and Internalization Requirements on Temporal Dissonance

Past work has shown that, for individual temporal characteristics, differences between an individual's characteristic and that of their workplace can increase stress on the individual. This happens because the individual has a natural way of working (Saunders et al. 2004). When they work within that natural rhythm, they do not experience any particular difficulties. When they are required to work outside their normal desires, they experience stress and its consequences. This is clear in studies of shift work. Second or third shift workers suffer from more stress, leading to poorer health, higher accident rates, and lower productivity (Folkard et al. 2006).

However, it seems unlikely that it is simple congruity that causes the problem. Consider two IT working groups at the same company, with the same manager. Without loss of generality, assume that all the IT workers are owls, and that the manager is a lark. The manager (Larry) tells the first group: "I need you to work the same hours that I do. I'm a morning person, so I'll expect you to be here, in your seat, and working, from 7am until 4pm, just like I am." Larry tells the second group: “I need you to keep a time card. I don't care what time you work, but I need to see eight hours of work time every work day on your time card.”

The second group will be under considerably less stress. They are still under orders to work their eight hours, and have a small incremental nuisance in keeping a time card, but they will be able to work at the time that they feel the best. They do not suffer the stress due to working at times that do not match their chronotype. This is why simple lack of congruity does not explain stress differences. Both groups of workers have exactly the same temporal congruity with respect to chronotype (and the other factors will vary randomly, or be controlled since they have the same manager). The first group, however,
suffers much more stress, as they are working at hours during which they are not at their peak performance level.

The difference between the temporal structures is not enough to create stress on its own. The difference has to be made salient. The worker must be under some requirement to internalize a temporal structure which differs from their own. When this happens, they feel discomfort because of the clash between the structures. In the case of our example, the first group wants to work later in the day, but is being forced to work early in the morning. They have to observe the temporal structure of their manager, and feel uncomfortable because that makes them work at hours they’d rather not. The second group, while they are aware of the differences between their chronotype and Larry’s, are not forced to adapt to Larry’s chronotype. They lack congruity with him, but do not feel discomfort, since they can still work later in the day.

For simplicity's sake, this example has been purely about chronotype, but we expect that other temporal characteristics can present similar difficulties. Further, it may be that slight differences on any particular characteristic may not cause difficulty, but when combined with slight differences on other temporal characteristics, the aggregate can create difficulties. Thus, it makes sense to consider congruity in the totality of a person's temporal structure with the temporal structures that the individual may encounter, and consider the salience of those external structures. When the congruity is high, the salience should not matter: the individual feels no discomfort in complying with temporal structures that match her own. Similarly, when the salience is low, the differences do not matter, so no discomfort results. When the congruity between the structures is low, and the salience is high, we would expect the person to experience considerable discomfort. As we defined previously, this discomfort, when felt, is temporal dissonance. Thus, we arrive at our hypotheses that lack of temporal congruity combines with internalization requirements to create temporal dissonance. The interaction hypotheses are summarized in Table 1.

H1A: When the temporal congruity between an individual's temporal structure and an internalized external temporal structure is low, in a situation with high internalization requirements (salience), temporal dissonance will be high in the individual.

H1B: When the temporal congruity is high between an individual's temporal structure and an external temporal structure, that external temporal structure will not cause temporal dissonance in the individual, regardless of the internalization requirement (salience) for the external temporal structure.

H1C: When the internalization requirement (salience) for an external temporal structure is low, the individual's temporal dissonance will be low, regardless of the congruity of the temporal structures.

<table>
<thead>
<tr>
<th>Internalization Requirement</th>
<th>Temporal Congruity</th>
<th>Temporal Dissonance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>Low</td>
<td>Low (H1C)</td>
</tr>
<tr>
<td>High</td>
<td>Low</td>
<td>High (H1A)</td>
</tr>
<tr>
<td>Low</td>
<td>High</td>
<td>Low (H1B and H1C)</td>
</tr>
<tr>
<td>High</td>
<td>High</td>
<td>Low (H1B)</td>
</tr>
</tbody>
</table>

Table 1: Hypothesis 1 Summary

3.2. The Effect of Temporal Dissonance on Stress

When an individual has the affective reaction of temporal dissonance, they feel uncomfortable. They are being forced to try to resolve conflicts between their own temporal structure and those that have been imposed on them from without. When Larry insists that Mary (who is monochronic) work on
multiple projects simultaneously, she will be required to work in a way which is sub-optimal for her. If she switches tasks frequently, she loses the focus she needs, and proceeds much more slowly on all the tasks. If she focuses on one task at a time, she may have to explain to Larry that she has only worked on one task. Either option upsets Mary, and having to make this choice causes her stress. This stress can be physical (due to contravening a physical tendency toward a temporal characteristic), psychological (due to violation of preferred working methods or fear of reprimand), or both. Either choice will produce the physiological effect of stress. Thus, we see that higher levels of temporal dissonance lead to higher levels of stress. Stress is well-known in the literature to cause reduction in motivation, an increase in neuroticism and turnover intention, and to have a negative impact on the individual's health.

H2: An increase in temporal dissonance in an individual increases the stress felt by the individual.

Figure 1 shows the proposed model graphically.

Figure 1: Proposed Model

4. Method

We took several steps in the development of the scales for temporal dissonance, temporal congruity, and salience of temporal congruity, in accordance with the accepted scale development procedure (DeVellis 2003). In the first step, we created a pool of items by brainstorming with subject matter experts. We then subjected this pool of items, along with some similar items which should not be part of these measures, to a card sort by PhD students. Their sort generally agreed with the pool items, eliminating two weak items. This left nine items for temporal dissonance, five for temporal congruity, and three for salience. We then had two panels complete a survey including those items and previously developed items for measuring stress (Cohen et al. 1983). The first panel taking the survey were student volunteers offered extra credit in class at a large southern university. The second panel were paid volunteers solicited on Amazon.com's Mechanical Turk. The data were analyzed utilizing the R statistical package.

5. Results

We initially had 721 responses to the survey. After removing responses in which the new items and the stress items were not completed, we had 636 complete responses. Four of those responses was missing a response to the gender question, and 44 to the age question. We replaced those NA
responses with median values, as the demographic responses are intended for use as controls, and are not the focus of the study. Of those responses, 54 were from students, and 582 were from the Amazon Mechanical Turk.

For the next step, we removed data points which were outside the distribution of a $\chi^2$ test for multivariate normality using all data that was collected. This was done in an iterative manner; first, the Mahalanobis distances of all the current data set were calculated, and then the expected distances from a $\chi^2$ distribution. The furthest outlying point was compared to the largest expected distance, and deleted if it was larger. The process then continued by recalculating the Mahalanobis distances, and repeating this procedure, until the most extreme point was within the expected distribution. This left a total of 509 data points to continue the analysis. Of these, 35 were student responses, and the remainder were Mechanical Turk responses.

We then constructed a measurement model for SEM analysis, using R version 2.11.1 and the SEM package. Items were loaded onto their appropriate constructs, and the constructs were allowed to covary. We created two method variables, one for positive, and one for negative items, which were allowed to covary with each other. We did this because several of the stress scale items are reverse coded, and there is some concern that scales with reverse coding may suffer from instrument-related artifacts. (Roszkowski and Soven 2010). Our initial run indicated that that fear was well-grounded. The reverse-coded stress items loaded strongly onto the negative method factor, and only weakly on the stress factor. Because of this, we removed all the reverse coded stress items, and reduced the method variables to a single common method variable. This resulted in a model with good fit criteria. Good criteria for measurement model fit are CFI greater than 0.95, SRMR less than 0.08, and RMSEA less than 0.06 (Hu and Bentler 1999). For the unreduced model, we had an RMSEA of 0.0396, SRMR of 0.0316, and CFI of 0.967, indicating an acceptable fit.

We then proceeded to examine residuals and loadings. We eliminated items with high residuals, high cross-loadings, and / or low loadings on the construct of interest. This process was done one item at a time; after eliminating an item, the model was reevaluated for the next candidate for removal. As a result, items sal00, diss07, diss05, and diss04 were eliminated. The final model fit very well: CFI is 0.981, RMSEA is 0.0333, and SRMR is 0.0294. The loadings were acceptable: all were greater than 0.4, and all were significant with $p < 0.001$. We then calculated the composite reliability and AVE for each of the variables. These are presented in tables 2 (reliability) and 3 (correlations). This measure has adequate reliability and convergent validity, as all variables had a composite reliability greater than 0.7, and AVE greater than 0.5. Discriminant validity is acceptable using the Fornell-Larcker test (Fornell and Larcker 1981). The correlation table, which has the square root of the AVE on the diagonal, shows that the square root of the AVE is greater than than the latent variable correlations for each variable.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Composite Reliability</th>
<th>Cronbach's $\alpha$</th>
<th>AVE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temporal Congruity</td>
<td>0.832</td>
<td>0.747</td>
<td>0.500</td>
</tr>
<tr>
<td>Salience of Temporal Congruity</td>
<td>0.784</td>
<td>0.471</td>
<td>0.647</td>
</tr>
<tr>
<td>Temporal Dissonance</td>
<td>0.775</td>
<td>0.872</td>
<td>0.541</td>
</tr>
<tr>
<td>Stress</td>
<td>0.904</td>
<td>0.849</td>
<td>0.611</td>
</tr>
</tbody>
</table>

Table 2: Reliability and Convergent Validity

Having shown the measurement model was adequate, we then proceeded to the structural model. We residual-centered the proposed interaction term, and ran the model. The resulting model had excellent fit (CFI 0.96, SRMR 0.03, RMSEA 0.04). A $\chi^2$ difference test indicated that the proposed model was not significantly different from the fully saturated model, which indicates that the proposed model adequately models the covariance matrix. The path coefficients were all significant, supporting all our hypotheses. The results of the structural model are shown in Figure 2.
Diagonal is $\sqrt{AVE}$

<table>
<thead>
<tr>
<th></th>
<th>Temporal Congruity</th>
<th>Salience of Temporal Congruity</th>
<th>Temporal Dissonance</th>
<th>Stress</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temporal Congruity</td>
<td>0.732</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Salience of Temporal</td>
<td>0.315</td>
<td>0.772</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Congruity</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Temporal Dissonance</td>
<td>0.472</td>
<td>0.472</td>
<td>0.834</td>
<td></td>
</tr>
<tr>
<td>Stress</td>
<td>0.444</td>
<td>0.401</td>
<td>0.741</td>
<td>0.867</td>
</tr>
</tbody>
</table>

*Table 3: Correlations*

![Figure 2: Model Results](image)

**6. Conclusion**

We have shown that our proposed scale for individual temporal dissonance has good psychometric properties. We have been able to differentiate it from similar constructs such as temporal congruity and stress, and have been able to demonstrate that it fits into the nomological network as hypothesized.

As with any work, this study has limitations. It is possible that the use of the Mechanical Turk did not result in selection of subjects that were both random enough and motivated enough to take the survey seriously. Repetition with different groups would strengthen the validity of the measure. Also, we only investigated a small portion of the nomological net. A more comprehensive model, with more thorough grounding in antecedents and consequences, will improve the usefulness of this measure. Finally, this is a cross-sectional survey study. Conclusions about causality should be considered with caution, as other models with differing causality will fit the data as well as the proposed model.

This scale makes it possible to investigate temporal dissonance in the workplace. If we are able to detect temporal dissonance, we will be able to better understand when management may need to intervene to reduce it. It opens the door to investigate whether temporal dissonance is inherent in the IT workforce, and thus a cause for excessive levels of stress and cynicism in the IT worker. With proper adaptation, this scale could also be used to detect temporal dissonance in teams and organizations.
From a scientific standpoint, we have provided the first empirical validation of the existence of temporal dissonance. We have explained how it provides a first step in showing how temporal characteristics and temporal congruity affect individual performance. Our model also provides a frame for understanding why time management techniques do not always work, and a possible pointer to their most effective use.

References


