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Abstract

Are people sensitive to the level of compatibility in everyday settings? We manipulated via scenario both a specified goal and a setting typically associated with a given goal. Settings were either typically compatible with the specified goal or not. Different participants rated either compatibility (as a direct indicator of sensitivity to manipulated compatibility) or preference for being in the setting (as an indirect indicator of sensitivity). For both measures, mean ratings were significantly greater in the high-compatibility conditions than in the low-compatibility conditions. We conclude that people are indeed sensitive to the level of compatibility in everyday settings. These findings indicate that a core concept of Attention Restoration Theory (ART), compatibility, has psychological reality in everyday settings and thus support the construct validity and external validity of the compatibility concept.

Keywords

compatibility, mental fatigue, directed attention, restoration, ART

The purpose of this study was to explore the construct validity of a core concept of Attention Restoration Theory (ART). Specifically, we wanted to see if people are sensitive to the level of compatibility in a realistic setting. Compatibility refers to the fit between what a person wants to do or is inclined to

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do and the kinds of activities supported by a setting. A good fit implies compatibility and a bad fit implies incompatibility. As described below, ART specifies compatibility as a necessary feature of a restorative setting. Although not demanded by the theory, it seems likely that people would be sensitive at some level (not necessarily consciously) to the degree of compatibility in a setting. Our purpose was to see if such sensitivity could be demonstrated in realistic settings. Such a demonstration would contribute to the construct validity of the compatibility concept by showing that it has psychological reality in everyday settings. It would thus speak to what Aronson, Brewer, and Carlsmith (1985) referred to as the "mundane realism" of the compatibility construct. Below, we first provide an overview of ART and its empirical support. This is followed by a discussion of its application to the variables under investigation. Finally, we derive specific predictions for the set of situations tested.

Theoretical Background

As described by the Kaplans (Kaplan, 1995, 2001; Kaplan & Kaplan, 1989), ART holds that directed attention, the kind that requires an effort, can become fatigued from prolonged use, leading to the inability to focus attention voluntarily. Directed attention fatigue (known colloquially as mental fatigue) has several unfortunate consequences, including performance errors, inability to plan, social incivility, and irritability. Restoration of directed attention capacity requires a setting that is different from the ones that led to fatigue (being away), has sufficient scope and organization to occupy one's mind (extent), holds attention without requiring an effort (fascination), and supports one's inclinations or purposes (compatibility). All four of these properties are essential for a successful restorative experience. ART notes that ordinary natural settings are likely to be well endowed with all of the features necessary for a restorative experience.

The concept of compatibility has been explored in detail by Kaplan (1983, 2001). To help illuminate the concept, both articles deal at some length with its opposite, incompatibility. The general conclusion is that if a good fit between a person's inclinations or goals and what the setting facilitates or encourages (compatibility) is necessary for restoring fatigued directed attention, it follows that a bad fit (incompatibility) will exacerbate the problem. Further use of directed attention is required to deal with an incompatibility. Thus, one avenue for avoiding mental fatigue is to avoid incompatibility. For this reason, various generic situations involving incompatibility are reviewed and classified. Kaplan (2001) distinguished six categories of incompatibility:

deficit of information, distraction, duty, deception, difficulty, and danger. These categories of incompatibility all involve either problems in achieving clarity (the first two), a conflict between thought and action (the next two), or a mismatch between what the situation demands and one's skills or abilities (the last two). Given the costs of incompatibility, it seemed likely to us that people would show some sensitivity to the level of incompatibility in every-day settings.

Empirical Background

Much of the research on ART has supported its prediction of a positive relation between restorative experiences, particularly those involving nature, and various measures of effective functioning (e.g., Berman, Jonides, & Kaplan, 2008; Berto, 2005; Canin, 1992; Cimprich, 1993, 1999; Felsten, 2009; Hartig, Evans, Jamner, Davis, & Garling, 2003; Hartig, Mang, & Evans, 1991; Kuo, 2001; Kuo & Sullivan, 2001; R. Kaplan, 2001; Taylor, Kuo, & Sullivan, 2001, 2002; Tennessen & Cimprich, 1995; Wells, 2000). Some research has also investigated other possibilities for restorative settings such as museums (Kaplan, Bardwell, & Slakter, 1993), favorite places (Korpella, Hartig, Kaiser, & Fuhrer, 2001), and spiritual settings (Herzog, Ouellette, Rolens, & Koenigs, IN PRESS; Ouellette, Kaplan, & Kaplan, 2005). There has also been research directed at distinguishing among the benefits of restorative experiences, such as restoration of fatigued attention versus reflection (Herzog, Black, Fountaine, & Knotts, 1997).

Research on ART's four necessary features of a restorative setting has generally involved attempting to measure them and then showing that they are positively related to behavioral or self-report measures of restoration. Several researchers have pursued this strategy by developing self-report measures of the four necessary features (Hartig, Korpella, Evans, & Garling, 1997; Herzog, Maguire, & Nebel, 2003; Laumann, Gärling, & Stormark, 2001). A common approach to validation for such measures has been to show that they yield higher scores for natural settings than for urban settings and/ or that they are sensitive to the actual or imagined state of mental fatigue (e.g., Hartig & Staats, 2006; Staats, Kieviet, & Hartig, 2003). Empirical relations between both measures of the necessary features or composites of such measures and independent behavioral measures of restoration are rare. Hartig et al. (1991), showed that a composite score based on self-report measures of the four necessary features was positively correlated with a proofreading measure of restoration.

Manipulating Compatibility

Encouraged by the modest success described above in exploring compatibility as one of the necessary features of a restorative experience, we felt that a useful next step in furthering the construct validity of the concept would be to manipulate compatibility in realistic everyday situations. Given that the concept involves both internal variables (goals, inclinations, purposes) and external variables (what the setting affords or supports), a full manipulation would involve manipulating both types of variables so as to create good and bad fits between them. It can be argued that these conditions have been approximated implicitly in previous research. For example, when Berman et al. (2008) manipulated the directional congruency of flanking arrows and a central target arrow in their Attentional Network Task, this can be seen as contrasting supportive or compatible contexts (congruent trials) with incompatible contexts (incongruent trials). Such an interpretation requires the assumption that participants had the goal of doing well on the task. Although the assumption is quite reasonable, it is nonetheless an assumption. We wished to manipulate both the internal and external components of compatibility explicitly and to do so in realistic everyday settings.

Although manipulating both goals and setting supportiveness in actual real-world settings would be ideal, such an approach would likely be daunting in terms of procedural complexity, resources, and quite possible for ethical reasons as well. We opted instead for a scenario approach. Scenario manipulations have been used successfully in several studies on restoration (e.g., Hartig & Staats, 2006; Herzog, Chen, & Primeau, 2002; Herzog et al., 1997; Herzog & Rector, 2009; Staats et al., 2003; Staats & Hartig, 2004). Given that our participants were college students, we selected both goals and settings that we felt confident would be familiar to them. The goals were entertainment and reflection (thinking things over), and the settings were those typically affording entertainment and those typically affording a quiet atmosphere for reflection. We used two exemplars of each type of setting to reduce the possibility that our results might be influenced by any peculiarities of a single exemplar. The typical entertainment settings were a lively club and a rock concert, whereas the typical reflective settings were a quiet coffeehouse and a library. We used all four combinations of goal and setting type in a between-subjects design to reduce the likelihood of demand characteristics.

Given that we were asking participants to imagine that they had a certain goal and that they were in a certain setting type, a special concern was the credibility of the incompatible conditions in which the goal did not match the

setting type. We addressed this problem by specifying in the scenario that the participant and his or her best friend take turns deciding what to do on Friday evenings. On the Friday evening in question, it is the best friend's turn to choose. Thus, the friend could choose a setting that either matched or did not match the participant's goal, and the choice would seem credible. We assumed that this sort of peer arrangement would seem familiar and reasonable to college students.

Special care also went into the selection of dependent variables. We opted for two dependent variables, one a direct measure of compatibility and the other an indirect indicator based on preference for being in the setting. The direct measure was an eight-item Likert-type scale assessing the participant's judgment of the fit between the setting and the specified goal. Regarding the indirect indicator, we noted that traditionally preference has been interpreted as an intuitive guide to effective functioning (e.g., Kaplan & Kaplan, 1982), and that preference ratings have been accepted as reliable and valid measures of environmental evaluation for more than 40 years (e.g., Kaplan & Kaplan, 1989; Kaplan, Kaplan, & Ryan, 1998). The bridge to compatibility is provided by the architect Alexander (1979) who referred to settings which allow us to resolve our conflicts as having the "quality without a name" (p. 297). The test for the presence of this quality is simple liking for a setting, unembellished by conscious rationalization. This sounds remarkably like an assertion that preference reflects an intuitive assessment of compatibility. Thus, we selected preference as our indirect indicator of sensitivity to compatibility, and we also measured it with a simple eight-item Likert-type scale.

Predictions

With two settings and two goals, one appropriate to each setting, we expected a cross-over interaction between settings and goals. For each setting, both compatibility and preference should be greater when the specified goal fits the setting than when it does not. This prediction is based on the assumption that preference reactions can be sensitive to the degree of compatibility between a goal and a setting.

Method

Participants

The sample consisted of 594 undergraduate students at a university in the MidWestern United States. Participation fulfilled a course requirement for

introductory psychology. A total of 25 sessions were run, with the number of participants per session ranging from 6 to 34. The sample was young (80% less than 20 years old), single (86%), and predominantly female (66%).

Stimuli and Measures

Each participant received a six-page booklet consisting of a cover page of instructions, followed by three pages of scales unrelated to this study, then a page containing one of the scenarios followed by items to measure one of the dependent variables, and finally a page eliciting personal information (gender, age, marital status, religious affiliation, and perceived health). The scenario page began with these instructions: "Please read the following account carefully and then respond to the items below." This was followed immediately by one of the scenarios. The basic kernel of the scenario was as follows:

> You and your best friend have a long-standing tradition of meeting every Friday evening and doing something together. To make things fair, you take turns each week deciding on the activity for the evening. This week it is your friend's turn to decide what you will be doing. You have had a long week and really would like to spend some time [description of goal here]. Your friend decides that the two of you will go to a [description of setting here].

There were two generic goals, entertainment and reflection, and two generic setting types, one supporting each goal. We used two different scenario sets. In one, the settings were a club (entertainment) and a coffeehouse (reflection). In the other, the two settings were a rock concert (entertainment) and a library (reflection). Wording for the goals was tailored to each scenario set. Wordings for both goals and settings for each scenario set are given in Table 1. These wordings appeared in the appropriate brackets in the above scenario kernel.

There were two dependent variables, compatibility and preference. Each was measured via an eight-item Likert-type scale. The items for each scale are given in the appendix. Responses to all items were made using a seven-point step scale for agreement ranging from *strongly agree* through *neutral* to *strongly disagree*. The instructions for compatibility were "Given your goal, please indicate how well you think the setting chosen by your friend would fit or match or support your goal." The instructions for preference were "Given your goal, please indicate how much you would like to be in the

Table 1. Wording for Goals and Settings for Each Scenario Set

Scenario Set	Goal	Setting
1	Entertainment: "partying."	Entertainment: "nearby club. The club is packed. There are bright lights and loud music."
	Reflection: "sorting through your thoughts and thinking about things."	Reflection: "nearby coffeehouse. The coffeehouse is practically empty. It is dimly lit and quiet."
2	Entertainment: "have a good time."	Entertainment: "rock concert. The concert is packed. There are bright lights and loud music."
	Reflection: "thinking through a personal problem you have had."	Reflection: "library. The library is practically empty. It is dimly lit and quiet."

setting chosen by your friend." Scoring for positive items on each scale was *strongly disagree* = 1 through *strongly agree* = 7. Negative items were reverse scored. The final scale score for each dependent variable was the average of the eight item scores.

Procedure

After obtaining informed consent and going over instructions for how to fill out the survey, the researcher passed out booklets and allowed participants in each session to work at their own pace. Responses were entered on computer forms for scanning into a data file. The 2 (Generic Goal) × 2 (Generic Setting Category) × 2 (Scenario Set) between-subjects design required eight booklets to achieve one complete replication for each dependent variable. We created a set of 40 booklets that represented three complete replications for preference and two complete replications for compatibility. We wanted a larger sample size for the indirect indicator, preference, to guard against the possibility of greater variation for that variable. The booklets were arranged in a random order and were passed out within each session by dealing off the top of the pile, always starting each session at the point in the random sequence where the previous session had terminated. The purpose was to obtain approximately equal sample sizes within each condition of the experimental design. With three different experimenters running the sessions, there were inevitably a few errors in implementing this strategy. Final sample sizes for

the eight conditions of the factorial design ranged from 28 to 32 for compatibility and from 43 to 45 for preference.

Results

Internal consistency for the eight-item scale measuring each of the two dependent variables was assessed by computing coefficient alpha. Reliability coefficients were computed separately within each of the eight conditions of the factorial design. For preference, the coefficients ranged from .92 to .96. For compatibility, the coefficients ranged from .88 to .98 in seven of the conditions, and in one condition (scenario set: club-coffeehouse; setting: entertainment = club; goal: reflection) the coefficient was .68. There was no apparent reason for the one discrepant reliability coefficient.

The mean ratings for measured compatibility and preference, averaged over both scenario sets, are presented in Tables 2 and 3. It is clear from inspection that the predicted cross-over interaction between generic setting category and generic goal occurred. For each setting category, rated preference was greater when the goal fit the setting category than when it did not.

For purposes of analysis, we treated the experiment as a $2 \times 2 \times 2$ (Scenario Set $\times$ Generic Setting Category $\times$ Generic Goal) factorial design, with separate analyses for each dependent variable. Given the number of tests of inference, we adjusted alpha to .001 to avoid Type I errors of inference. The most important of the tests of inference was the two-way interaction between setting category and goal. That interaction yielded the strongest result for both dependent variables [$F(1, 230) = 157.58, p < .001$, MS Error = 1.64, eta^2 (effect size) = .41 for compatibility; $F(1, 346) = 46.28, p < .001$, MS Error = 2.12, eta^2 = .12 for preference]. To document the cross-over interaction, we tested the simple main effect of goal within each setting separately for each dependent variable. All four of those tests were significant at $p < .001$. Thus, for both dependent variables, the rating was greater when the goal fit the setting than when it did not. Inspection of Tables 2 and 3 as well as comparison of the effect sizes for the interaction suggest that it was stronger for rated compatibility than for preference.

The analyses yielded two other significant results. For rated compatibility, the main effect of generic setting category was significant [$F(1, 230) = 16.33, p < .001$, MS Error = 1.64, eta^2 = .07], with the reflection category rated higher than the entertainment category (means of 4.31 and 3.67, respectively). For preference, the interaction of scenario set and generic setting category was significant [$F(1, 346) = 19.77, p < .001$, MS Error = 2.12, eta^2 = .05]. The interaction is illustrated in Table 4. It appears that the ratings

Table 2. Means for Rated Compatibility as a Function of Generic Setting Category and Generic Goal

	Generic Goal		
Generic Setting Category	Reflection	Entertainment	Mean
Reflection			
M	5.14$_a$	3.45$_b$	4.31
SD	1.22	1.32	
Entertainment			
M	2.38$_c$	4.87$_d$	3.67
SD	.92	1.58	
Mean	3.78	4.19	

Note: Means with different subscripts within each row differ significantly at $p < .001$ in tests of simple main effects.

Table 3. Means for Rated Preference as a Function of Generic Setting Category and Generic Goal

	Generic Goal		
Generic Setting Category	Reflection	Entertainment	Mean
Reflection			
M	5.14$_a$	3.88$_b$	4.51
SD	1.55	1.54	
Entertainment			
M	3.92$_c$	4.77$_d$	4.35
SD	1.62	1.29	
Mean	4.54	4.33	

Note: Means with different subscripts within each row differ significantly at $p < .001$ in tests of simple main effects.

for the reflection setting in scenario set #1, the coffeehouse, were greater than those for the comparable setting in scenario set #2, the library. At the same time, there was little difference in the ratings for the two entertainment settings (club vs. rock concert). These impressions are confirmed by a test of the simple main effect of scenario set for each generic setting category. The simple main effect of scenario set was significant for the reflection setting category ($p < .001$) but not for the entertainment setting category ($p = .163$).

Table 4. Means for Rated Preference as a Function of Generic Setting Category and Scenario Set

Generic Setting Category	Scenario Set		
	Set #1 (Coffeehouse, Club)	Set #2 (Library, Rock Concert)	Mean
Reflection			
M	5.03$_a$	3.98$_b$	4.51
SD	1.44	1.72	
Entertainment			
M	4.19$_c$	4.52$_c$	4.36
SD	1.48	1.54	
Mean	4.61	4.25	

Note: Means with different subscripts within each row differ significantly at $p < .001$ in tests of simple main effects.

Discussion

The results indicate that college students are sensitive to the degree of compatibility in a situation as indicated by their reactions to an explicit manipulation of compatibility. Two kinds of reactions yielded the same pattern of results. One was a direct rating of compatibility, the other an indirect indicator of compatibility in the form of a preference rating. In both cases, the ratings were greater when there was a good fit between a specified goal and the kind of goal typically supported by a setting than when there was not a good fit. The results were obtained with a between-subjects experimental design featuring random assignment to conditions. Moreover, we obtained the predicted pattern of results for two different scenario sets, reducing the likelihood that the results might be peculiar to a particular set of situations. As far as we know, this is the first time that compatibility has been fully manipulated (that is, both generic setting and generic goal were manipulated) in realistic settings. The results were strongly supportive of the utility of the compatibility construct as articulated in ART.

We regard these results as mildly supportive of ART. They attest to the psychological or mundane realism of the compatibility concept and thus support both its construct validity and its external validity. We note that the study tested no predicted relations between compatibility and other constructs as specified in ART. The study simply speaks to the psychological reality of the compatibility construct. This is a very modest contribution, but a contribution nonetheless. It can be seen as a first step in delineating a construct about

which there has been very little empirical research. We noted earlier that ART does not demand that people must be consciously aware of the degree of compatibility in a setting. Thus, a negative finding would have had no bearing on the theory. The positive finding implies that at least in some situations people are consciously aware of compatibility issues. Although not demanded by the theory, the positive finding is supportive in the sense discussed above.

An issue for future research is the generality of conscious awareness about compatibility. As this was a first attempt to manipulate compatibility in realistic situations, we followed standard practice and used a strong manipulation in the form of very obvious compatibility matches and mismatches. Future research could explore what kinds of situations facilitate an awareness of compatibility issues and whether people would be aware of subtler manipulations.

It is important to note that our use of the term *realism* refers to the situation being rated by the participant and not the setting of the study. We are assuming that people can project themselves into common situations with which they are likely to have a high degree of familiarity and to react accordingly. This is a standard assumption of scenario manipulation. The realism or external validity of the study setting is a separate issue. We are also assuming that with an effective scenario manipulation, the study setting is not a serious impediment to the external validity of the findings. Leff and Gordon (1979) provided some reassurance for both of our assumptions. We noted earlier that it would be very difficult to study compatibility with staged manipulations in realistic settings. Nonetheless, if an enterprising researcher could devise an ethically palatable way of accomplishing that feat, it would certainly be a welcome supplement to the current study.

Some other potential limitations of the study should be noted. First, we used college students, raising the issue of whether the results might apply to other demographic groups. This issue is best settled by future research, but there are meta-analytic data that provide grounds for optimism (Stamps, 1999). A second issue is whether self-report measures are valid indicators of what might be found with behavioral or performance measures. We noted earlier that when the self-report measure involves preferences, as in our study, this controversy is usually circumvented. Herzog and Rector (2009) have argued that for strong manipulations like danger, it is likely that self-report results would mirror behavioral results. We would suggest that our compatibility manipulation is another example of a strong manipulation in this sense. Again, however, the only way to find out for sure is to devise a compatibility experiment with a behavioral reaction in a realistic situation. Finally, we would emphasize that we used preference as an indirect indicator

of compatibility. We make no claims about any relation between preference and restoration, actual or perceived.

Assuming that our results are valid, they may have some practical implications. For designers and planners, when a setting is meant to have a single purpose, it is important to communicate that purpose clearly to potential users so that they can make informed choices and avoid embroiling themselves in nonsupportive settings. This might be achieved by the kind of transparent design envisioned by Wurman (1971) that allows people to readily see what is going on in a setting. According to ART, incompatible settings contribute to the fatigue of directed attention, and directed attention is a global resource. Thus, its fatigue is felt far beyond the situations in which the fatigue occurred. Anything that can help people avoid mental fatigue will have pervasive consequences. On the other hand, it is also important to plan for settings which can support many different goals and purposes and for settings that can easily be altered to accommodate purposes that may not have been envisioned in advance. Incompleteness in design which allows users to tailor the setting to their purposes and provide opportunities for personalization are two ways to address this issue.

The other side of the coin is that people need to become aware of potential sources of incompatibility. The analysis of incompatibility offered by Kaplan (2001) provides a user-friendly portable mental model for such awareness. It has structure (three categories of incompatibility: clarity-based, thought vs. action, and task-based) and six specific types of incompatibility, all beginning with the letter "d" (distraction, deficit of information, duty, deception, difficulty, and danger). A handy model of sources of incompatibility can allow a person to recognize generic situations in which incompatibility is likely to be a problem and to take appropriate actions to conserve directed attention as much as possible. In order of preference, these actions might include avoiding the situation (if possible), preparing in advance to acquire the resources needed to reduce or overcome the incompatibility, and at least having realistic expectations regarding the costs and consequences involved in the situation.

Besides future research already suggested, future research on compatibility might proceed in two directions. One is to manipulate the specific types of incompatibility suggested by Kaplan (2001). One could find out whether each type works and perhaps even make some relative comparisons. Once again, this might be difficult to do with staged manipulations, but it could be readily accomplished with scenarios. A second line of research would involve measuring the specific types of incompatibility with a view toward testing an obvious prediction from ART: The level of incompatibility in a person's life

should be positively correlated with that person's level of mental fatigue. Here too one could find out if the specific types of incompatibility differ in their relation to mental fatigue. One could also explore whether different incompatibility profiles are related to different classic personality types. From a research perspective, compatibility is a relatively untapped concept from ART. As such, it offers intriguing opportunities for empirical exploration.

Appendix

Likert-Type Scale Items for Measuring Preference and Compatibility

Preference
1.	This setting sounds appealing.
2.	I would enjoy being in this setting.
3.	I would be unhappy in this setting.
4.	I would find this setting pleasant.
5.	This setting would be annoying.
6.	I would be miserable in this setting.
7.	This setting would be attractive.
8.	I would find this setting irritating.

Compatibility
1.	This setting would help me reach my goal.
2.	I would be able to achieve my goal in this setting.
3.	I would be frustrated in trying to reach my goal in this setting.
4.	I would find this setting supportive of my goal.
5.	This setting would make it difficult to achieve my goal.
6.	I would be unable to reach my goal in this setting.
7.	This setting would fit nicely with my goal.
8.	This setting would hold me back from reaching my goal.

Note: Items 3, 5, 6, and 8 in each scale were negative items and were reverse scored.

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Bios

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