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SOCIAL PSYCHOLOGY | NEW PERSPECTIVE

The sufficiency assumption of the reasoned approach to action

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Abstract: The reasoned action approach to understanding and predicting behavior includes the sufficiency assumption. Although variables not included in the theory may influence behavior, these variables work through the variables in the theory. Once the reasoned action variables are included in an analysis, the inclusion of other variables will not increase the variance accounted for in behavioral intentions or behavior. Reasoned action researchers are very concerned with testing if new variables account for variance (or how much traditional variables account for variance), to see whether they are important, in general or with respect to specific behaviors under investigation. But this approach tacitly assumes that accounting for variance is highly relevant to understanding the production of variance, which is what really is at issue. Based on the variance law, I question this assumption.

Subjects: Social Sciences; Behavioral Sciences; Communication Studies

Keywords: theory of reasoned action; theory of planned behavior; reasoned approach to action; sufficiency assumption; variance law

1. Introduction

The reasoned action approach to understanding and predicting behavior has been prominent for a long time and continues to generate much research (e.g. Ajzen, 1988; Ajzen & Fishbein, 1980; Fishbein, 1980; Fishbein & Ajzen, 1975, 2010). Much of the appeal of this approach is empirical; it is



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PUBLIC INTEREST STATEMENT

The article, "The sufficiency assumption of the reasoned approach to action," provides a critical examination of an implication of the assumption that the reasoned action variables are sufficient to explain all behavior that is explainable. Although other variables might matter, their effects on behavior are mediated through reasoned action variables. Arguments on both sides have depended on analyses of how well reasoned action variables and outside variables account for variance in behavior; but this article describes the perils of such analyses. Among other points, the article shows that in a multiple regression context, correlations among component variables decrease the variance in behavior that predictor variables account for, but increase the variance in behavior that is produced. Because variance accounted for and variance produced go in opposite directions, it is clear that the former provides a poor basis for drawing conclusions about the latter.

a well-documented fact that using the approach results in larger correlations than can be obtained when the approach is not used (see Fishbein & Ajzen, 2010 for a recent review). However, the popularity of the approach also is due largely to the *sufficiency* assumption. Before explaining the sufficiency assumption, it is necessary first to explain some reasoned action details.

The reasoned action approach was designed to enable researchers to understand and predict behavior. Therefore, in describing the theory, it is useful to work backwards from behavior to more distal variables. According to the theory, the immediate determinant of behavior is behavioral intention. Put simply, people are likely to perform behaviors that they intend to perform and not to perform behaviors they do not intend to perform. In the original theory of reasoned action (Fishbein & Ajzen, 1975), the assumption was that behavioral intention is determined by two variables; these are attitude and subjective norm. Attitude refers to a person's evaluation of the behavior (e.g. how much they like or dislike it), whereas subjective norm refers to one's opinion about what important others think he or she should do. Subsequently, Ajzen (1988) suggested perceived behavioral control as an additional variable that can help determine a person's intention, and also, under particular circumstances, directly influence the behavior or moderate the effects of attitude or subjective norm on behavior. Perceived behavioral control refers to the extent to which a person believes that performing the behavior is under his or her control.

Thus far, then, behavioral intention determines behavior whereas attitude, subjective norm, and perceived behavioral control determine behavioral intention. At the next level, attitude, subjective norm, and perceived behavioral control are determined by various kinds of beliefs. Attitude is determined by behavioral beliefs that pertain to how likely various consequences would be to occur (and how good or bad it would be if they actually were to occur). Subjective norms are determined by normative beliefs that pertain to what specific important others think one should do (and how much one wishes to comply with each normative referent). Finally, perceived behavioral control is determined by specific beliefs about the factors that render the behavior under one's control or not under one's control.

To understand where the sufficiency assumption comes into play, it is important to be clear about what the reasoned action approach is not saying as well as what it is saying. The theory is not saying that the foregoing variables are the only ones that influence behavior. But the theory does say that the effects of all variables on behavior are mediated by the foregoing variables. Put more directly, many variables influence behavior but all of them do so by first influencing attitude, subjective norm, or perceived behavioral control. Therefore, because the influence of all variables that have behavioral relevance work through attitudes, subjective norms, and perceived behavioral control, it is only necessary to consider these three variables to have a sufficient account of behavioral intentions or behaviors. Given that many philosophers of science have promoted the importance of simplicity in a theory, the reasoned action approach to behavior can be argued to be one of the most elegant theories in the history of social psychology. Instead of having to consider a large number of behaviorally relevant variables, the reasoned action approach accounts for an impressive proportion of variance in behavior without incurring the cost of having a complex theory. In a word, the reasoned action approach to behavior is *parsimonious*.

There has been debate about the sufficiency assumption, most of which has depended on hierarchical regression analyses (see Trafimow, 2004 for details). In a typical reasoned action hierarchical regression study, the reasoned action variables are included at earlier steps of the analysis and the new variable under investigation is included in a later step. The idea is to compute the variance accounted for in behavioral intentions or behaviors by the reasoned action variables and compare that to the variance accounted for in behavioral intentions or behaviors by the combination of the reasoned action variables and the new variable under investigation. If the combination of the reasoned action variables and the new variable under investigation account for more variance than do the reasoned action variables alone, this is taken as evidence that the new variable has a unique effect on behavioral intentions or behaviors. And if the new variable has a unique effect on

behavioral intentions or behaviors, this seems to go against the sufficiency assumption that the reasoned action variables mediate all effects of outside variables on behavioral intentions or behaviors. In contrast, if the combination of the new variable with the reasoned action variables fails to account for more variance than do the reasoned action variables alone, this is taken as support for the sufficiency assumption. The argument, in this case, is that the reason the addition of the new variable fails to increase the variance accounted for in behavioral intentions or behaviors is because attitudes, subjective norm, and perceived behavioral control mediate the effects of all outside variables.

It is interesting that the reason for augmenting the original theory of reasoned action with the inclusion of perceived behavioral control was that perceived behavioral control consistently increased the amount of variance accounted for in behavioral intentions and behaviors (see Ajzen, 1988; Fishbein & Ajzen, 2010 for reviews). The wide acceptance of perceived behavioral control by reasoned action researchers indicates that the sufficiency assumption was disconfirmed with respect to how it was used in the original theory of reasoned action. However, now that the sufficiency assumption includes perceived behavioral control, as well as attitude and subjective norm, many researchers accept it.

There have been many recent demonstrations of statistically significant increases in the variance accounted for by new variables, over and above that engendered by reasoned action variables (e.g. Booth, Norman, Harris, & Goyder, 2014; Boudreau & Godin, 2014; Fleming, Barner, Brown, Shepherd, & Strassels, 2014; Montanaro & Bryan, 2014). These findings suggest that the sufficiency assumption is wrong, even with the augmented version that includes perceived behavioral control. On the other hand, there also have been recent failures of new variables to account for statistically significant increases in variance (e.g. Askew et al., 2014; O'Neal et al., 2014; Yzer & van den Putte, 2014). Furthermore, there are complicating factors. For example, when new variables succeed in accounting for more variance, this could be due to invalid (or not completely valid) measures of the theory of reasoned action variables that leave more variance available to be accounted for by other variables (Trafimow, 2004). In this case, hierarchical regression successes hardly can be counted as strong evidence against the sufficiency assumption. On the other hand, if all evidence that contradicts the sufficiency assumption is to be attributed to invalid measures of reasoned action variables, there could be a problem regarding the falsifiability of the sufficiency assumption (Greve, 2001; see Trafimow, 2015 for a general philosophical discussion).

My goal is not to test the sufficiency assumption, but rather to address a more basic issue that has arisen as a consequence of the sufficiency assumption and the relevant debate. I have no objection to the sufficiency assumption per se. It might be true or false, and like most assumptions in theories, it is subject to empirical investigation. Rather, my objection is to an unnecessary consequence of the sufficiency assumption. To understand this, consider the statement that Ajzen often has made that it is acceptable to add variables to the theory, but only if they account for enough unique variance in behavioral intentions or behaviors (e.g. Ajzen, 1988; Fishbein & Ajzen, 2010). It is permissible to give up some parsimony if it can be justified by a large increase in predictive ability, but to give up parsimony without an impressive increase in predictive ability seems ill advised. Again, I have no objection to this reasoning; it is quite reasonable to demand a substantial gain to justify a substantial loss. In fact, as I suggested earlier, an original justification for including perceived behavioral control in the approach is that it increased predictive ability substantially above and beyond that engendered by attitudes and subjective norms. But let us continue to where I do object.

As I detailed above, because of the necessity to demonstrate the ability of one's favored variable to increase the prediction of behavioral intentions or behaviors, above and beyond that engendered by attitudes, subjective norms, and perceived behavioral control, researchers have used hierarchical regression paradigms. The debate on both sides is about whether new variables increase or fail to increase the variance accounted for in behavioral intentions or behaviors above and beyond that engendered by reasoned action variables alone. And here is where I object. According to the theory,

attitudes, subjective norms, and perceived behavioral control determine (cause) behavioral intentions (and subsequently behaviors). But, hierarchical regression focuses on accounting for variance whereas researchers should be focused on producing variance. My argument hinges on distinguishing between producing variance versus accounting for variance.

2. Producing variance versus accounting for variance

Before continuing, let me be clear about where I am not going. Trafimow (2004) has argued against hierarchical regression on technical grounds pertaining to the dependence of the findings on what happens at earlier steps in the analysis. Greve (2001) has argued that the whole approach is not falsifiable because it depends on a tautology. The objection I wish to make is neither of these, but rather depends on taking seriously the issue of variance causation.

I reiterate that attitudes, subjective norms, and perceived behavioral control cause behavioral intentions and behaviors (Fishbein & Ajzen, 2010). To quicken the pace, we can skip behavioral intentions and proceed directly to behaviors. Also, for the sake of simplicity—but there will be more on this later—let us imagine that attitudes, subjective norms, and perceived behavioral control are unit weighted causes of the behavior of eating tiramisu, and that there is no random error. Equation 1 below summarizes the example where the number of ounces of tiramisu eaten by each person (B) is determined completely by that person's attitude (A), subjective norm (S), and perceived behavioral control (P).

$$B = A + S + P \tag{1}$$

Suppose that each scale point corresponds to one ounce of tiramisu eating. If Sarah scores a 2.3 on attitude, a 1.1 on subjective norms, and a 2.0 on perceived behavioral control, the sum is 5.4 and so Sarah would eat 5.4 oz of tiramisu.

Equation 1 provides an easy way to compute how much tiramisu each person eats, based on the three variables that determine the behavior. But typical reasoned action research is different. In general, reasoned action researchers measure the variables and then compute the amount of variance accounted for in behavior by variance in the other variables. In other words, reasoned action researchers are not interested in behavior, but rather in *variance* in behavior. This might seem like an over-subtle distinction, but it has important consequences. The equations used to compute variance accounted for are well known and so there is no point in going into them here. But the equations for computing variance produced, which is what is at issue here, are not well known and so I provide them here. In the present example, the variance law, in combination with Equation 1, implies Equation 2.

$$\sigma_B^2 = \sigma_A^2 + \sigma_S^2 + \sigma_P^2 + 2\sigma_{AS} + 2\sigma_{AP} + 2\sigma_{SP} \tag{2}$$

Equation 2 is noteworthy because it not only includes variance terms (σ_A^2 , σ_S^2 and σ_P^2) but also covariance terms ($2\sigma_{AS}$, $2\sigma_{AP}$ and $2\sigma_{SP}$). In ANOVA, classical true score theory, and others, the researcher arranges matters so that the covariance terms equal zero and drop out of the equation, thereby rendering a nice, clean, split of dependent variable variance into component variances. But suppose that the components correlate with each other, so that the covariance terms exceed zero. In that case, the covariance terms provide independent contributions to total variance.

Equation 2 is a specific instantiation of the variance law, which is given below as Equation 3, and specific instantiations with 2, 3, 4, 5, or 6 component variables are included in Table 1.

$$\text{Var}(Z) = \sum_{i=1}^N \sum_{j=1}^N \text{Cov}(X_i, X_j) \tag{3}$$

Suppose that the variance in each component variable (A , S , and P) is 1. In addition, suppose that each component variable is uncorrelated with each of the other component variables. In that case, variance in tiramisu-eating behavior would equal $1 + 1 + 1 + (2)0 + (2)0 + (2)0 = 3$. However, to take

Table 1. The forms Equation 2 takes when there are 2, 3, 4, 5, or 6 components summing to variable Z, respectively

$\sigma_{Z=A+B}^2 = \sigma_A^2 + \sigma_B^2 + 2\sigma_{AB}$
$\sigma_{Z=A+B+C}^2 = \sigma_A^2 + \sigma_B^2 + \sigma_C^2 + 2\sigma_{AB} + 2\sigma_{AC} + 2\sigma_{BC}$
$\sigma_{Z=A+B+C+D}^2 = \sigma_A^2 + \sigma_B^2 + \sigma_C^2 + \sigma_D^2 + 2\sigma_{AB} + 2\sigma_{AC} + 2\sigma_{AD} + 2\sigma_{BC} + 2\sigma_{BD} + 2\sigma_{CD}$
$\sigma_{Z=A+B+C+D+E}^2 = \sigma_A^2 + \sigma_B^2 + \sigma_C^2 + \sigma_D^2 + \sigma_E^2 + 2\sigma_{AB} + 2\sigma_{AC} + 2\sigma_{AD} + 2\sigma_{AE} + 2\sigma_{BC} + 2\sigma_{BD} + 2\sigma_{BE} + 2\sigma_{CD} + 2\sigma_{CE} + 2\sigma_{DE}$
$\sigma_{Z=A+B+C+D+E+F}^2 = \sigma_A^2 + \sigma_B^2 + \sigma_C^2 + \sigma_D^2 + \sigma_E^2 + \sigma_F^2 + 2\sigma_{AB} + 2\sigma_{AC} + 2\sigma_{AD} + 2\sigma_{AE} + 2\sigma_{AF} + 2\sigma_{BC} + 2\sigma_{BD} + 2\sigma_{BE} + 2\sigma_{BF} + 2\sigma_{CD} + 2\sigma_{CE} + 2\sigma_{CF} + 2\sigma_{DE} + 2\sigma_{DF} + 2\sigma_{EF}$

the other extreme, suppose that each variable is perfectly correlated with each other variable. In that case, variance in tiramisu-eating behavior would equal $1 + 1 + 1 + (2)1 + (2)1 + (2)1 = 9$. In other words, the fact of perfect inter-component correlations causes the production of triple the variance in behavior relative to if these correlations were zero. Although this is, perhaps, an overly dramatic example, it does serve to illustrate the potential importance of the covariance terms.

With the idealized example and basic concept of the variance law out of the way, we are in a position to consider less ideal cases. In the example, there was no random error, but in normal reasoned action research, there is random error. So, let us amend Equation 1 accordingly to represent not only the reasoned action variables but also measurement error. In Equation 4, behavior is produced not only by the reasoned action variables but also by measurement error (E).

$$B = A + S + P + E \tag{4}$$

But if we care about variance in behavior, rather than in behavior by itself, the combination of Equations 3 and 4 (also see Table 1) implies Equation 5.

$$\sigma_B^2 = \sigma_A^2 + \sigma_S^2 + \sigma_P^2 + \sigma_E^2 + 2\sigma_{AS} + 2\sigma_{AP} + 2\sigma_{AE} + 2\sigma_{SP} + 2\sigma_{SE} + 2\sigma_{PE} \tag{5}$$

Because the correlation of any variable with random error can be assumed to be zero, Equation 5 simplifies to Equation 6 below.

$$\sigma_B^2 = \sigma_A^2 + \sigma_S^2 + \sigma_P^2 + \sigma_E^2 + 2\sigma_{AS} + 2\sigma_{AP} + 2\sigma_{SP} \tag{6}$$

But Equation 6 is not the finishing point. In the typical reasoned action study, the researcher generally proposes some favored variable and attempts to show that the favored variable accounts for variance above and beyond the variance accounted for by the reasoned action variables. For example, Sparks and Shepherd (2002) showed that moral norms accounted for significant variance in behavioral intentions pertaining to eating food produced with genetic engineering techniques. If reasoned action thinking is correct about intentions causing behaviors (as I will imagine here), then it follows that moral norms account for variance in actual behaviors. Given that moral norms have, on several occasions, been demonstrated to account for unique variance in behavioral intentions or behaviors (see Manstead, 2000 for a review), the reader might wonder why moral norms are not included in the theory. The most likely reason is that the behaviors in moral norm research were specifically chosen to be ones where moral norms were likely to account for variance. That moral norms account for variance, for behaviors in general, is not clear. And with this not being clear, a concern for parsimony suggests that it is premature to include moral norms in the theory.

Following the moral norm tradition, let us make moral norms the favored variable that is proposed to account for variance in behaviors. This means that Equation 4 needs to be expanded into Equation 7 below, so as to include moral norms as the favored variable (F).

$$B = A + S + P + E + F \tag{7}$$

In turn, Equation 7 implies Equation 8 below, and Equation 8 includes all of the covariance terms.

$$\sigma_B^2 = \sigma_A^2 + \sigma_S^2 + \sigma_P^2 + \sigma_E^2 + \sigma_F^2 + 2\sigma_{AS} + 2\sigma_{AP} + 2\sigma_{AE} + 2\sigma_{AF} + 2\sigma_{SP} + 2\sigma_{SE} + 2\sigma_{SF} + 2\sigma_{PE} + 2\sigma_{PF} + 2\sigma_{EF} \quad (8)$$

After removing all of the covariance terms that can be assumed to equal zero because of random error, Equation 8 reduces to Equation 9 below.

$$\sigma_B^2 = \sigma_A^2 + \sigma_S^2 + \sigma_P^2 + \sigma_E^2 + \sigma_F^2 + 2\sigma_{AS} + 2\sigma_{AP} + 2\sigma_{AF} + 2\sigma_{SP} + 2\sigma_{SF} + 2\sigma_{PF} \quad (9)$$

Equation 9 provides us with the basis to properly analyze the effect of moral norms with respect to either (a) accounting for variance in behavior or (b) producing variance in behavior. In Figure 1, I set all variances of all component variables at unity so that covariances would conveniently equal correlations (remember that a correlation is a covariance divided by the product of the standard deviations). I also let the correlations vary simultaneously between 0 and 1 to find out what happens to the variance accounted for by the favored variable versus the variance produced by the favored variable. However, there is an ambiguity. In Equation 9, moral norm as the favored variable is included in its own variance term (σ_F^2), but it also is included in three of the covariance terms ($2\sigma_{AF}$, $2\sigma_{SF}$, and $2\sigma_{PF}$). An argument can be made that all of these terms should be included when assessing the proportion of variance produced by the favored variable. However, as my goal is to emphasize the importance of the covariance terms, it also is possible to argue that only the covariance terms should be included when assessing the proportion of variance produced by the favored variable. So I performed two mathematical simulations. In the first, illustrated by Figure 1, I included the moral norm variance term (σ_F^2), in combination with the covariance terms that contain moral norm ($2\sigma_{AF}$, $2\sigma_{SF}$, and $2\sigma_{PF}$), in computing how much behavioral variance moral norm helps to produce. In Figure 2, I only included the covariance terms that feature the moral norm variable ($2\sigma_{AF}$, $2\sigma_{SF}$, and $2\sigma_{PF}$) and did not include the variance term (σ_F^2). In both cases, my goal is to determine the variance accounted for or produced by moral norm—the favored variable—as a function of the correlation between the component variables.

Let us first consider Figure 1. The lower curve represents the proportion of variance accounted for in behavior by the favored variable. Most researchers are aware of the effects that large correlations among the component variables have; they decrease the ability of the component variables to account for variance in the dependent variable. Therefore, the fact that the lower curve decreases as the correlations among the component variables increase, is not surprising. But the upper curve, which represents the proportion of variance in behavior that the moral norm variable helps to produce, actually increases as the correlations among the component variables increase. It is the covariance terms in Equation 9, to which the moral norm variable contributes, that cause this surprising effect. Because the two curves go in opposite directions as the correlations among the

Figure 1. The decreasing curve describes proportion of variance accounted for by the favored variable as a function of the correlation among the component variables. The increasing curve describes the proportion of variance produced by the favored variable, including both its own variance term and the covariance terms to which it contributes, as a function of the correlation among the component variables.

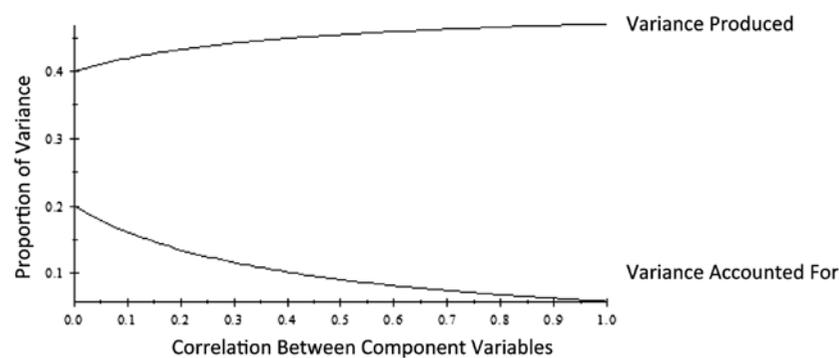
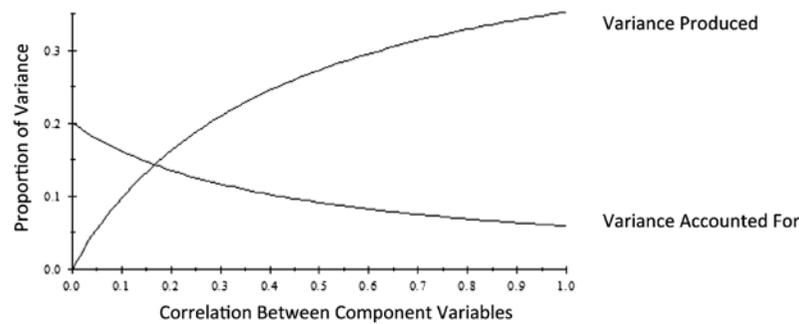


Figure 2. The decreasing curve describes proportion of variance accounted for by the favored variable as a function of the correlation among the component variables. The increasing curve describes the proportion of variance produced by all of the covariance terms to which the favored variable contributes (but not the favored variable variance term).



component variables increase, it provides a nice illustration of the inability of the usual proportion of variance accounted for statistics to provide a good account of what really matters from a theoretical perspective, which is the proportion of variance produced.

And yet, Figure 1 has the arguable disadvantage of including the moral norm variance term. Also, because the two curves are so far apart, the extent of the increase or decrease is difficult to visualize. Figure 2 shows a “crossover effect” that is easy to visualize. As in Figure 1, the decreasing curve gives the proportion of variance accounted for in behavior by the moral norm variable. In contrast, the increasing curve gives the proportion of behavioral variance that the moral norm variable helps to produce, because it figures into the covariance terms. In Figure 2, only the covariance terms involving the moral norm variable ($2\sigma_{AF}$, $2\sigma_{SF}$, and $2\sigma_{PF}$) are included to determine the increasing curve. The dramatic crossing over of the two curves illustrates the invalidity of using variance accounted for to study how variance is produced. Interestingly, both figures could have been made to be even more dramatic. To see this, consider that I used “variance accounted for” but I could have used “unique variance accounted for,” which is more commonly used in reasoned action research. Had I done so, the lower curves in both figures would have decreased to zero as the correlations among the component variables increased to unity. Thus, the basic message of Figures 1 and 2 would not have changed, though the contrast would have increased slightly.

3. Discussion

We have seen that as the correlations among component variables increase, the proportion of variance accounted for in behavior by the favored variable (e.g. the moral norm variable) decreases whereas the proportion of variance produced by the favored variable increases. Clearly, then, if the theory is about the production of variance in behavior, it is a poor strategy to test it by using paradigms that emphasize accounting for variance in behavior. To be sure, I made the simplifying assumption that all component variables are equally weighted at unity. But it is not strictly necessary to assume this. The variance law extends to unequally weighted variables too (see Rozeboom, 1966 for the formula), and had I chosen this more complicated route, the message of Figures 1 and 2 would be similar. The covariance terms still would have been there and still would have caused variance produced and variance accounted for to go in opposite directions as the correlations among the component variables increased. Yet, it is possible to question why we care about variance at all.

3.1. Why we care about variance?

Consider again Equation 7 (or even Equation 1), where the component variables combine to produce the behavior. Suppose that we wish to know if Joe will use a seatbelt when he drives to a neighboring town next Saturday. We measure all of the component variables and find that, in this specific case, they favor the behavior. Thus, we predict that Joe will use a seatbelt. Or alternatively, if the component variables militate against the behavior, our prediction is that Joe will not use a seatbelt. There is a single behavior and no reason to be concerned with variance. So I repeat: Why do we care about variance?

The answer resides in the distinction between causation that is within a single person versus causation that is between-persons. Consider again that, according to the theory, attitude, subjective norm, and perceived behavioral control cause behavior (through behavioral intentions), and presumably this is so at the level of individual persons. That is, for Sarah, Joe, and anyone else, each of their behaviors is determined by their own standings on the component variables, and the component variables presumably are not weighted exactly the same. But whereas the weightings would be straightforward if reasoned action theory provided them in a prior fashion, this is not actually so. Instead, the onus is on the researcher to collect data from a group of people, and then perform a multiple regression analysis, so that the obtained regression weights describe the relative importance of the component variables for the behavior under investigation. But notice what has happened here. By employing a multiple regression analysis, we went from a within-persons conception at the theoretical level to a between-persons conception at the empirical level. No longer are we talking about causation within a person, but rather about causation between persons. And here is where variance creeps in. At the within-persons level, where we are trying to predict a single behavior performed by a single person, variance is irrelevant. But at the between-persons level, where we are trying to predict behaviors across people, there is no way out; we are forced to consider the issue of behavioral variance. Given, then, that reasoned action researchers are forced to deal with behavioral variance at the empirical level, and given that the theory makes causal claims, the important variance issue is not how to account for behavioral variance but rather how it is produced. The issue of variance accounted for versus variance produced is disguised by the voluminous literature where researchers have attempted to account for variance in behaviors without considering the production of variance.

In addition, the confusion is compounded by the heavy reliance on hierarchical regression paradigms. These techniques are based on the fact of variance across persons and so any tests of causal hypotheses have to be about between-persons rather than within-persons causation. I hasten to add that I have no principled objection to between-persons causation and I have no intention to denigrate it (see Grice, 2011, for an excellent discussion). But I do have an objection to confusion between accounting for variance versus variance production. Researchers should not use paradigms that account for variance and then think they are testing notions about how variance is produced. These are different, and as Figures 1 and 2 illustrate, they can go in opposite directions.

Although between-persons causation forces a strong concern with variance production, within-persons causation does not necessarily render variance production to be irrelevant. It depends upon whether the researcher wishes to investigate a single behavior or multiple behaviors. If there is only a single behavior being performed by a single person, dependent variable variance is irrelevant, as I explained earlier. But one might be concerned with multiple behaviors performed by the same person, in which case variance becomes important and the researcher is faced with the issue of the production of variance (but within-persons). In research of this type, the implications of Equation 9, or a weighted variant of it, imply that typical multiple regression paradigms are inadequate because they concern the wrong issue. If within-persons variance in behavior is important, there remains the issue of how it is produced.

3.2. Directions for future research

Equations 2, 3, 6, and 9 (and the equations in Table 1) underscore the importance of the covariance terms in producing behavioral variance. Although correlations among component variables are a mere nuisance from the usual variance accounted for point of view, the production of variance point of view indicates that they are well worth studying in their own right. After all, each covariance term provides an independent contribution to behavioral variance. Thus, an alternative approach might be to feature component covariances instead of trying to control for them. If we wish to know what produces variance in seatbelt use, condom use, exercise, eating healthy food, and so on, it is likely that much of the behavioral variance will be produced by covariance terms. This is especially so when we recall that each covariance term has a multiplier (2) that goes with it. One might gain by knowing, for any particular type of behavior, what the covariance terms are, so that researchers can gain a better understanding of how behavioral variance is produced.

The present equations also suggest an implication for the introduction of new variables. They make clear that whether or not the new variable accounts for much behavioral variance is not necessarily important. A variable that does not uniquely account for much behavioral variance might nevertheless produce much behavioral variance, by virtue of its own variance term, by virtue of its covariances with other component variables, or both, as we saw in Figures 1 and 2. Thus, researchers should think twice before concluding that a new variable is unimportant because it correlates too highly with other component variables or fails to account for unique behavioral variance. If more behavioral variance is produced by virtue of the covariances that the new variable has with reasoned action variables, instead of eliminating the new variable due to its inability to increase the variance accounted for in behavior as is current practice, it would be better if researchers recognized that perhaps the behavior is important after all, because of its influence through the covariance terms.

It seems worthwhile to add that correlations between reasoned action component variables (including the new variable) are more likely to occur than not to occur. Typically, people's attitudes and subjective norms correlate positively, though it is not clear whether this is because attitudes are influenced by subjective norms, the reverse, or whether there are outside variables at play. In addition, people tend to have more positive attitudes towards performing behaviors where they have control than where they do not. Even typical new variables, such as the moral norm variable, often correlate with attitudes, subjective norms, or perceived behavioral control. The same is true when other favored variables are added, such as self-identity (see Rise, Sheeran, & Hukkelberg, 2010, for a review), impulsivity (e.g. Churchill & Jessop, 2010; Churchill, Jessop, & Sparks, 2008), anticipated regret (e.g. Elliott & Thomson, 2010; McMillan, Higgins, & Conner, 2005), and so on.

3.3. Back to the sufficiency assumption

We commenced with the sufficiency assumption, that it is not necessary to study the plethora of variables that undoubtedly influence behaviors because these variables work through attitudes, subjective norms, and perceived behavioral control. So once attitudes, subjective norms, and perceived behavioral control are included in an analysis, the inclusion of additional variables will not increase the amount of behavioral variance accounted for. This assumption might work so long as the researcher is concerned only with causation within persons for a single behavior, where variance and covariance terms are not relevant. But, we already have seen that reasoned action researchers use research paradigms that force an assumption of between-persons causation which, in turn, means that they are concerned with the production of variance, even though they may not realize it. Given the importance of the covariance terms in the production of behavioral variance, the sufficiency assumption cannot be maintained simply by showing that new variables fail to account for much behavioral variance. My point is not that the sufficiency assumption is wrong, only that the kinds of paradigms reasoned action researchers employ fail to test it adequately. If the covariance terms of outside variables with reasoned action variables, or with each other, produce behavioral variance, it would disconfirm the sufficiency assumption. But as long as reasoned action researchers continue using paradigms based on the notion of accounting for variance, the potential importance of covariance terms will remain untested. In fact, even without outside variables, the covariances among the familiar variables attitude, subjective norm, and perceived behavioral control likely produce behavioral variance, and thus far even this has not been properly investigated.

4. Conclusion

To my knowledge, the present article is the first to demonstrate that as the correlations among component variables increase, variance accounted for and variance produced go in opposite directions. Consequently, research paradigms featuring behavioral variance accounted for by new variables provide poor tests of whether or not these variables produce behavioral variance. As several hundred published articles in the reasoned action tradition use such paradigms (see Fishbein & Ajzen, 2010 for a review), this discovery clearly is important. However, there is a potential objection to my thesis. Specifically, the variance law assumes that the component variables are linearly related to the behavior and this might not be so. To the extent that the assumption is not true, the accuracy

of my conclusions becomes increasingly untenable. Therefore, a way to “save” the normal way of performing reasoned action research is to simply assert that my linearity assumption is wrong, and continue to attempt to account for variance.

But there is a cost to denying linearity, and the reasoned action researcher should face it squarely. Specifically, the reasoned action approach is itself linear. Furthermore, the regression methods used to study reasoned action variables also assume linearity. Therefore, if my analysis is to be discarded on nonlinearity grounds, both the theoretical and empirical foundations of reasoned action research also would have to be discarded. The ironic consequence is that although an insistence on nonlinearity can be used to refute the specific implications of Equation 9 and Figures 1 and 2, such an insistence forces agreement with my more general conclusion, which is that current reasoned action research practices are not good enough. Whether one assumes linearity and reaches that general conclusion through the implications of Equation 9 and Figures 1 and 2, or whether one assumes nonlinearity and invalidates reasoned action research paradigms (and the theory too) right from the start, the result remains that change is necessary.

Finally, let me assert that despite the thrust of the present argument, I actually am an aficionado of the reasoned action approach. Remembering the state of attitude research in the 1960s, where it was not even clear that attitudes were relevant to behavior (e.g. see the famous review by Wicker, 1969), the changes instigated by the reasoned action approach were clearly beneficial. The benefits were not just at the level of theory; the numerous measurement advantages conferred by new principles such as that of correspondence, aggregation, and so on, are undeniable. There also were philosophical benefits, including the parsimony engendered by the sufficiency principle, falsifiability (see Trafimow, 2009 for an analysis but see Greve, 2001 for an opposing perspective), and others. The reasoned action approach has been a good thing for social psychology.

And yet, the rate of progress seems to have slowed substantially in the twenty-first century. It is difficult to name important new reasoned action principles, at the theoretical, methodological, or philosophical levels, that have come to light in the new century. I believe that one of the reasons for this slowing rate of progress is the continued reliance on accounting for variance. As Fishbein himself explained to me on more than one occasion (e.g. Fishbein, personal communication, 1991–1992), according to the reasoned action approach, the more distal variables “determine” or “cause” the variables that are more proximal to behavior. Taking Fishbein’s own admonitions seriously leads inevitably to the conclusion that investigating how behavioral variance is produced is of much greater importance than investigating how to account for it. Researchers have tacitly assumed that variance accounted for is a valid way to assess how variance produced. I have demonstrated here that this is not so. Given the demonstration, there is no excuse for researchers to continue to depend on empirical strategies based on the goal of accounting for variance.

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