A comparison of three models of attitude–behavior relationships in the studying behavior domain

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Abstract

The theory of reasoned action (TRA; Fishbein & Ajzen, 1975), the theory of planned behavior (TPB; Ajzen, 1985) and the theory of self-regulation (TSR; Bagozzi, 1992) were applied to Italian undergraduate students' studying behavior. The main focus of the research was to ascertain the predictive power of past behavior on intention and behavior and thus test for the sufficiency of the theories. For theory sufficiency to be demonstrated, past behavior influences on intention and present behavior should be totally mediated by the focal variables of the theories (attitudes, subjective norms, perceived behavioral control and desire). It is argued that past behavior affects intentions and present behavior over and above attitudinal variables and that these effects will be weaker on intention for the TPB and TSR models. A structural equation approach was used to test the construct validity of measures such as the predictive validity of the theories. A total sample of 240 Italian college students participated in the research. A subsample of 90 subjects provided a self-report behavioral measure one week later. Results show that past behavior is a strong predictor of both intention and behavior in the TRA model, while it is a weaker predictor of intention in the TPB and in the TSR models. Implications for attitude–behavior relationships are discussed. Copyright © 1999 John Wiley & Sons, Ltd.

INTRODUCTION

Many approaches are used to predict and understand a specific behavior, and the concept of attitude plays an important part in them, at least within the North American tradition. We focus here on three widely used models for predicting behavior which are based on the attitude construct.

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Fishbein and Ajzen’s Theory of Reasoned Action (TRA) (Fishbein & Ajzen, 1975; Ajzen & Fishbein, 1980) and Ajzen’s Theory of Planned Behavior (TPB) (Ajzen, 1985; Ajzen & Madden, 1986) are the best known and most widely applied models of attitude–behavior relationships within the expectancy-value (EV) approach (Chaiken & Stangor, 1987; Eagly & Chaiken, 1993; Olson & Zanna, 1993; Tesser & Shaffer, 1990). The theories are simple, parsimonious, easy to operationalize and applicable to a wide range of behavioral domains. The TRA has been successfully applied to the prediction of intentions and behavior in such domains as seat belt usage (Stasson & Fishbein, 1990), moral behavior (Vallerand, Deshaies, Cuerrier, Pelletier & Mongeau, 1992), dental care (Hoogstraten, De Haan & Ter Horst, 1985), university class attendance (Fredricks & Dossett, 1983), and weight loss (Bagozzi & Warshaw, 1992), to name only a few. The more recent TPB has also been widely applied in behavioral domains such as class attendance and academic achievement (Ajzen & Madden, 1986), weight loss (Bagozzi & Kimmel, 1995; Shifter & Ajzen, 1985), dishonest behavior (Beck & Ajzen, 1991), sleeping, listening to an album, taking vitamins and others (Madden, Ellen & Ajzen, 1992).

Both theories have been criticized (Bagozzi, 1982, 1984, 1992; Evans, 1991; Miniard & Cohen, 1981; Schmidt, 1973; Triandis, 1977), on the grounds that some relevant variables seem to be excluded from the processes leading to intention formation and behavior performance, and because past behavior may have significant effects on intentions and present behavior (Bentler & Speckart, 1979, 1981; Bagozzi, 1981; Bagozzi & Warshaw, 1990, 1992; Fredricks & Dossett, 1983). Bentler & Speckart (1979, 1981) suspected that past behavior works as a proxy of unmeasured variables excluded from the theories. Bagozzi (1992) claimed that if intentions are to be fully understood, motivational processes have to be included in the models and suggested that a motivational based variable such as desire be included in attitude theory as an antecedent of intentions. This theory has been called Theory of Self-Regulation (TSR) (Bagozzi, 1992). Let us now take a closer look at the main relationships hypothesized by the TRA, TPB and TSR.

Overview of the Theories

The Theory of Reasoned Action (TRA)

The theoretical model is depicted in Figure 1(a). The main aim of the theory is to predict and understand the causes of behavior (Ajzen & Fishbein, 1980). The direct predictor of behavior is intention which can be viewed as a conative dimension of the attitude construct (Kothandapani, 1971), following the tri-component hypothesis of attitude (Breckler, 1984). Intention is interpreted as a transition between the cognitive and evaluative components of attitude and the behavior (Ajzen, 1988) and intentions are direct functions of both individual and social related variables (Ajzen, 1988), namely attitude toward the act, a personal evaluative response, and subjective norms, the social information available and the perceived social pressure to behave. Moreover, intentions mediate the influences of attitudinal variables on behavior totally so that no direct path from attitude to behavior is hypothesized. As mentioned above, both attitudes toward the act and subjective norms are based on cognitive information (Ajzen, 1988) so that the model is interpreted as a sufficient representation of
attitude–behavior relationships, since all possible external influences on intentions and behavior are thought to be totally mediated by the information processing that underlies attitudes and subjective norms (Ajzen & Fishbein, 1980). The TRA also claims that the motivational components regarding the behavior are included in the intention construct, so that no particular integrative variable is needed to account for motivational processes. Hence, the TRA is assumed to be self-contained and requires no additional variables or relationships for the explanation of behavior. Finally, note that Fishbein & Ajzen (1975) define the theory as only applicable to behaviors under total volitional control. The theory applies only to behaviors in which no external or internal impediments exist to prevent performance of a behavior, once an intention to do so is established.

Bentler & Speckart (1979, 1981) criticized the assumptions of sufficiency and internal completeness, hypothesizing a direct influence of past behavior on intentions and present behavior and direct paths from attitudes to behavior. In their first study (Bentler & Speckart, 1979), the authors tested their augmented model in the domain of drug and alcohol usage and their hypotheses were confirmed. In a later study (Bentler & Speckart, 1981), dating, studying, and exercising behaviors were studied. The results confirmed a significant direct influence of past behavior on intentions and behavior, whereas direct paths from attitude to behavior were not significant once the effects of intentions had been controlled for. There was an unexpected finding for studying, in which attitudes predicted behavior, but in a negative direction. Bagozzi (1981) and Fredricks & Dossett (1983) compared the TRA and the augmented

Figure 1. (a) Theory of reasoned action. (b) Theory of planned behavior. (c) Theory of self-regulation

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Bentler and Speckart models. Bagozzi (1981), investigating blood donation, found no evidence for a direct path linking attitude and behavior, but the direct influence of past behavior was confirmed. Similar results were reported by Fredricks & Dossett (1983) in their study of class attendance. In conclusion, because of these studies showing the influence of past behavior, the sufficiency of the TRA cannot be claimed to have been established.

The Theory of Planned Behavior (TPB)

One explanation for past behavior effects is the incomplete volitional control of behaviors. However, since the assumption of total volitional control is difficult to apply to most everyday acts (Ajzen, 1988), the assumptions of the TRA are probably too restrictive. Ajzen (1985; Ajzen and Madden, 1986) was aware of this problem and tried to solve it by including a variable that would highlight the non-volitional part of behavior in the TRA structure. This variable is ‘perceived behavioral control’, defined as the perception of how difficult or easy an action is to perform for a given subject (see Figure 1(b)). As Ajzen (1988) has pointed out, perceived behavioral control is strongly linked to the concept of perceived self-efficacy (Bandura, 1977, 1982). According to TPB theory, perceived behavioral control is hypothesized as directly influencing both intention and behavior in such a way that the greater the perceived behavioral control, the more positive the behavioral intention and the more likely the performance of behavior. Note, however, that the direct path from perceived control to behavior is not necessary in all cases. In fact, this direct path is assumed to exist only if perceived behavioral control is a good proxy of actual control; this cannot be the case when, for instance, the behavior is new to the subjects (Ajzen & Madden, 1986).

One obvious problem to be addressed is the sufficiency of the TPB, and the independence of perceived behavioral control from past behavior effects on intentions and behavior (Ajzen & Madden, 1986; Beck & Ajzen, 1991). Ajzen & Madden (1986) investigated the application of the TPB to class attendance and academic achievement (getting an ‘A’). To test for theory sufficiency, the authors used a hierarchical regression analysis whereby first past behavior then perceived behavioral control were added as predictors to the TRA. Results showed that perceived behavioral control was still a significant predictor, even when past behavior effects were statistically controlled. A similar result was found by Beck & Ajzen (1991) in their application of the TPB model to dishonest behaviors. Notice, however, that their regressions did not test the sufficiency of the theory completely, but only that perceived behavioral control and past behavior measures did not totally overlap. A more stringent test for theory sufficiency would be obliged to show that all past behavior effects are mediated by perceived behavioral control and the variables of the TRA. Bagozzi & Kimmel (1995) showed that past behavior significantly improves the prediction of intentions and behavior in the TPB. The sufficiency of the TPB cannot therefore be validated (see also Ajzen, 1991).

The Theory of Self-regulation (TSR)

The TPB attempts to solve the sufficiency problem by including a formerly omitted variable (a self-efficacy based construct) to control for lack of volitional control.
However, past behavior still seems to be a strong predictor of both intentions and behavior, therefore pointing to the presence of other omitted variable effects. On his outline of TSR, Bagozzi (1992) claimed that the main omitted factor is desire, a motivation-based variable which leads to intention. According to the TSR, desire is hypothesized as being a proximal cause of intentions, whereas attitudes are considered a distal cause whose influence is totally mediated by desire. The TSR retains the effects of subjective norms on intentions and the effect of intentions on behavior (Figure 1(c)).

In the TSR, Bagozzi (1992) provided some rationale for the role of desire. Attitudes are usually conceived as evaluative appraisals. If evaluations are strong enough, attitudes will lead to intentions to perform or not to perform the target act. However, evaluative appraisals do not imply motivational commitment and intentions cannot arise without any motivational push (desire). Nevertheless, attitudes can stimulate volitive desires since both are based on reasons: for instance, one can have a positive attitude toward exercising because it is healthy and this attitude can lead to a desire to exercise. Hence a moderate to high association between attitudes and desires is to be expected, since the former influences intentions through the latter. Empirical evidence (Bagozzi & Kimmel, 1995) confirmed the distal effects of attitude on intentions through desires. Fishbein & Stasson (1990) argued that desires can be viewed as a proxy of intention, since both variables are based on motivational processes as the TRA and the TPB claim (Ajzen, 1988). Bagozzi (1992), on the other hand, argued that intention implies desire, but that desire does not necessarily imply intention. For example, an intention to see a movie is closely linked to a desire to do so, whereas one can have a great desire to eat a high-calorie dessert without necessarily any implied intention to behave according to the desire. Philosophers of action (e.g. Brand, 1984) have provided other arguments in favour of the distinctiveness of intentions and desires. It is possible to have opposite desires but not opposite intentions (Davidson, 1980; McCann, 1986). The means necessary for carrying out a particular behavior are always intended but not always desired. Intentions, but not desires, have to be self-directed (it is meaningful to say ‘I desire that Pat votes’, but not ‘I intend that Pat votes’). This critical distinction underlines the fact that intending is more closely connected to action than desiring (Brand, 1984).

Bagozzi (1992) has also addressed the processes linking desires and intentions. Once a desire is present, an outcome–desire appraisal takes place based on comparisons of the desire and possible end states. Appraisals related to different end states lead to emotional reactions and coping responses (Lazarus, 1991) as intentions (Bagozzi, 1992). The theoretical distinction between desires and intentions is further supported by empirical findings. A recent meta-analysis of TPB has found evidence for their distinctive roles (Armitage & Conner, unpublished manuscript). Intentions and self-predictions were found to be superior predictors of behavior than desires, and the impact of attitudes on intention was found to be almost entirely mediated by desire. A quick review of published and unpublished work in which intentions and desires have been measured gives further direct empirical support to the distinction between desire and intention. Considering six available data sets, the correlations

1Desires can be volitive or appetitive. The latter are directed at consuming activities (e.g. a desire to eat) and are based on urges, while the former are based on reasons and apply to a wide range of behaviors (Davis, 1984).
between desire and intention ranged from 0.52 to 0.89, with an average value of 0.72.\(^2\) This value supports an empirical distinction between the two constructs.

According to the TSR, intentions have an important role in behavior prediction, without excluding the potential influence of past behavior variables. At the same time, intention can be partially explained by past behavior. The influences of past behavior are divided by Bagozzi (1992) into those due to frequency of past behavior and those associated with recency of past behavior (Bagozzi & Warshaw, 1990), in which the former is defined as the frequency of performance of the target behavior over a relatively long period of time, and the latter as the performance of the behavior in the recent past. Conceptually the two variables are distinct. For example, one may often have eaten cookies in the past year but in the past week been obliged to avoid them for dietary reasons. Examples of the reverse pattern are also possible. Frequency and recency of past behavior can affect intention and present behavior to different degrees and through different processes (Bagozzi, 1992; Bagozzi & Warshaw, 1990, 1992). Frequency can lead to intentions when attitudinal and subjective norm influences are not clear or are not available in memory (Fazio & Williams, 1986). Direct frequency effects on behavior may occur in instances in which intentions are badly or incompletely formed, for example when alternatives are quite similar, or when the behavior is to be performed far in the future, or when one is unsure of future performance (Bagozzi & Warshaw, 1992). Direct recency effects on intentions may be due to availability and anchoring-adjustment heuristic effects (Tversky & Kahneman, 1974) in response to intention measures. In fact, recency information is almost always easily available when trying to produce a probability estimate of a behavioral intention, so that the final response will be biased in the direction of the first recency-based estimate. Moreover, direct recency-behavior paths may be due to recency memory effects when the decision to perform a behavior is at least partially dependent on evaluation of past behavior. This is the case when habit influences are present (Triandis, 1977) or self-perceptions guide behavior (Bem, 1972). Bagozzi (1992) pointed out that in any case frequency and recency play a role of statistical control which is when testing the sufficiency of the theories of attitude–behavior relationships. Bagozzi & Kimmel (1995) found significant effects of past behavior on intentions and present behavior for exercising and dieting.

The TRA, TPB, and TSR theories deal with sufficiency problems in different ways, and give different answers to them. The overall objective of the present study is to ascertain which of the answers is the most effective in the behavioral domain of studying and which theory achieves the best predictive performance in this domain. Studying is a behavior which is low in volitional control, since there are internal as well as external impediments between behavioral intentions and performance. For instance, you may have a strong intention to study and fail to do so because you spend too long on the phone to friends or because you have an urge to sleep; someone with a strong intention to study a particular book may stop studying because the book is just too difficult for him or her. Ajzen (1988) noted that impediments between intention and behavior are common to almost all everyday actions.

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\(^2\)The data sets were taken from the following sources: Bagozzi & Kimmel, 1995; Bagozzi & Edwards, 1998; Perugini & Bagozzi, unpublished manuscript. The behaviors were physical exercise, dieting, and studying.
Since studying behavior is not under complete volitional control, it is a very strict test for TRA sufficiency. We expect the TPB and TSR to be less sensitive to non-volitional features of studying behavior because they take self-efficacy (TPB) and motivational factors (TSR) into account.

**Hypotheses of the Present Study**

Our first aim is to compare the predictive power of the three theories for studying behavior. A first main hypothesis will be tested:

**H1**: Of the three theories (TRA, TPB, and TSR) the TRA will give the weakest prediction of intentions and the TSR the strongest.

The rationale for H1 is that the TRA is a weak predictor of intentions because it omits self-efficacy variables and motivation variables. As regards the performance of behavior, there is no variable in the TRA that measures non-volitional processes connected with appraisals of self-efficacy and perceived control. Studying is not under total volitional control and therefore we expect the TRA to yield weak predictions of intention compared to the TPB. In fact, the TPB includes a measure of perceived behavioral control which is expected to cover the non-volitional processes involved in studying. However, neither the TPB nor the TRA include a variable directly based on motivational processes for the prediction of intention. The TSR claims that desire is a necessary antecedent of intention because attitudes, subjective norms and perceived behavioral control are not able to capture broad motivational processes (desire-outcome appraisals) that lead to an intention to perform a behavior (Bagozzi, 1992). Hence we expect the TSR to be the strongest predictor of intention.

Our second aim is to assess the influence of past behavior variables on intentions and behavior in the three theories (augmented theories). Two specific hypotheses will be tested:

**H2**: We expect a continuum in the influences of past behavior variables on intentions: the increase in intention prediction for the TRA will be higher than for the TPB, and the increase for the TPB will be higher than for the TSR.

The TRA is assumed to apply only to total volitional behaviors, and thus past behavior can be a proxy for some of the non-volitional processes expected to be involved in studying, based on internal (e.g. lack of ability, lack of motivation) or external factors. Perceived behavioral control might account for some of these influences thereby reducing the impact of past behavior (cf. Ajzen & Madden, 1986). However, desire is expected to be more effective than perceived behavioral control in mediating the influences of past behavior on intention. Because the TPB neglects the role of motivation in the formation of intention, an omitted variable problem exists in the TPB. Effects of past behavior on intention should reveal this problem. For its part, the TSR includes desire as a variable based on motivational processes as outcome-desire appraisals (Bagozzi, 1992). Thus we expect the influences of past behavior on intention based on unmeasured effects of motivational processes to be accounted for by desire.

**H3**: Past behavior variables will lead to significant improvements in the prediction of present behavior within all theories.
The rationale is that the possibility of unmeasured causes of present studying behavior is very high because of the non-total volitional control of the behavior and the likely effects of repetitive past behavior patterns and habits (Bagozzi, 1992; Triandis, 1977). Intentions are hypothesized to lead to behavior in all three theories. Nevertheless, unexpected events can interfere with goal attainment because of the non-total volitional control of the behavior. Past behavior is expected to function as a statistical control for these unmeasured and unknown events. Moreover, studying is influenced by habit, and in some cases habit components may be strongly related to behavior, regardless of the direction of intention. For instance, a strong intention to study for more than four hours per day may be ineffective because of the habit of having a long nap in the afternoon or watching television in the evening. Triandis (1977) hypothesized the presence of unmeasured habit influences in past behavior. Bagozzi (1982) interpreted the significant prediction of behavior from past behavior in the Bentler & Speckart study (1979) as an effect of habit components present in drug and alcohol usage. Bentler & Speckart (1981) found that past behavior also predicted studying. We must also stress that the performance of a specific behavior is a function of innumerable causes (Ajzen, 1988). It thus seems very implausible to hypothesize that the variables of attitude theories can fully mediate for all these unmeasured variables. It is reasonable to expect that the statistical control role played by past behavior will be significant, improving the prediction of present behavior.

**METHOD**

**Behavior Operationalization**

As a first step we operationalized studying behavior as a specific time-related act. A student might say that he or she had studied a lot on a particular day, but if the student was asked how many hours we might obtain answers ranging from 30 minutes to 10 hours. So the exact number of hours of study was included in our operative definition of the behavior. A pilot study was conducted with this purpose in mind: 20 subjects, 10 males and 10 females, were asked to estimate how many hours they spent studying (a) in a typical day during the semester but not near to an examination, (b) in a typical day in anticipation of an examination. The average estimate for (a) was 4 hours and 15 minutes and for (b) 8 hours and 15 minutes. We strongly suspected that the latter was a rather large estimate as a result of self-presentation effects and so the former estimate was chosen for the operationalization of studying behavior. In other words, studying for ‘more than 4 hours per day in the next 7 days’ was used in the questionnaire. The 7-day period is the time gap between the two data waves.

3It might be argued that this kind of behavioral operationalization is vague and that ambiguities might arise, since the way in which the time spent in different studying-related activities (lessons, seminars) is counted has not been specified. However, it is important to stress that undergraduate students at the University ‘La Sapienza’ at Rome mainly study at home using textbooks and hence the obtained estimate is related only to home-based study of textbooks. Facilities in the various faculties are not sufficient for the huge number of students (with about 180,000 students ‘La Sapienza’ is the largest university in Europe). Moreover, the data were gathered in late spring when lessons and seminars had finished. We are therefore confident that subjects answered questions about studying while thinking only about their time spent studying textbooks at home, and that our criterion neatly encapsulates what is meant by studying at ‘La Sapienza’.

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Measures

First Wave

- **Attitude toward the act.** ‘I think that my attitude towards studying for more than 4 hours per day in the next 7 days can be described as.’ 4 subjects responded to four semantic-differential 7-point scales defined as useful/useless, rewarding/punishing, wise/foolish and positive/negative. The measures were adapted from Bagozzi & Kimmel (1995).

- **Subjective Norms.** Subjects were asked to ‘List the three most important persons for you and indicate how much each of them would approve or disapprove of the fact that you are going to study for more than 4 hours per day in the next 7 days’. Each of the three answers were measured on 7-point scales anchored by ‘approve’ and ‘disapprove’.

- **Perceived Behavioral Control.** This variable was measured with a single item adapted from Bagozzi and Kimmel (1995): ‘Please indicate how easy or difficult it is for you to study for more than 4 hours per day in the next 7 days’, followed in the next line by: ‘For me studying for more than 4 hours per day in the next 7 days is . . .’. Subjects responded to a 7-point scale anchored by ‘difficult’ and ‘easy’.

- **Desire.** Desire was measured with two items adapted from Bagozzi and Kimmel (1995): (1) ‘I want to study for more than 4 hours per day in the next 7 days.’ Subjects responded on 7-point scales anchored by ‘false’ and ‘true’. (2) ‘My desire to study for more than 4 hours per day in the next 7 days can be defined as . . .’. Subjects selected one of the following: (a) ‘no desire’, (b) ‘very weak desire’, (c) ‘weak desire’, (d) ‘moderate desire’, (e) ‘strong desire’, (f) ‘very strong desire’. Responses were coded from 1 for answer (a) to 6 for answer (f).

- **Intention.** Intention was measured by two items adapted from Bagozzi and Kimmel (1995): (1) ‘Please express the likelihood that you intend to study for more than 4 hours per day in the next 7 days.’ A 7-point scale was used anchored by ‘unlikely’ and ‘likely’. (2) ‘I plan to study for more than 4 hours per day in the next 7 days.’ Answers were measured on a 7-point scale anchored by ‘false’ and ‘true’.

- **Frequency of Past Behavior.** Subjects were asked: ‘Last year, how many days did you study for more than 4 hours in a typical week?’ followed by a scale from 1 to 7 days.

- **Recency of Past Behavior.** Subjects were asked: ‘Please indicate in how many of the past 7 days you studied for more than 4 hours’ followed by a scale from 1 to 7 days.

Second Wave

- **Behavior.** This was measured with the same question used for Recency of Past Behavior, but 7 days later.

Subjects and Procedure

Undergraduate students from the University of Rome were used as subjects in the present study. Subjects had been asked to participate in a research program about

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4The study was conducted in Italy and the questionnaire was presented in Italian.
undergraduate student studying habits’. They indicated the date of their nearest examination and were selected if their examination fell within a 21–45 day range, to avoid effects of excessive proximity or distance from examinations. A subsample was asked to participate in the second wave of data collection 7 days later. Subjects were told that the second questionnaire would be shorter and would contain different questions. Subjects of the subsample were contacted personally or via telephone. Privacy was guaranteed by allowing the subjects to use pseudonyms.

A total sample of 240 undergraduate college students belonging to different faculties participated in the first wave of data collection (44 from Psychology, 13 from Political Sciences, 24 from Classics and Modern Letters, 7 from Philosophy, 15 from Engineering, 18 from Economics and Business, 20 from Statistics, 32 from Law, 2 from Sociology, 3 from Foreign Languages, 9 from Medicine, 26 from Mathematics, 3 from Physics, 8 from Geology, 4 from Architecture, 1 from Pedagogy, 5 from Chemistry, 6 missing information), with 102 males and 136 females (2 missing information). Ages ranged from 18 to 29 with a mean of 22.24, s.d. = 2.06. The average number of years in college was 3.42, s.d. = 1.66 and the mean examination distance was 28.67, s.d. = 6.46. Due to time and budget constraints about half of the subjects in the total sample were not planned to be included in the second wave of data collection. Subjects were generally contacted in the central campus and were not asked to give any address or write their names in the questionnaire.

The behavioral measure was taken seven days later on a 90-subject subsample (mean age 23.22, s.d. = 1.81; 40 males and 50 females; mean college year 4.30; s.d. = 1.34; 35 from Psychology, 6 from Political Sciences, 4 from Classics and Modern Letters, 3 from Philosophy, 9 from Engineering, 15 from Economics and Business, 2 from Statistics, 9 from Law, 2 from Sociology, 1 from Geology and 3 from Architecture). The proportion of students participating in the second wave of data collection was about 80% of those who had been asked to participate.

**Statistical Analyses**

All the analyses were performed using the structural equation modeling (SEM) approach (Bagozzi, 1994; Jöreskog and Sörbom, 1989). The method will be used both for confirmatory factor analytic models devoted to ascertain convergent and discriminant validity and for predictive models in testing the three theories of attitude–behavior relationships. Figure 2 is an example.

In the figure squares represent observable variables and ellipses represent latent variables. The $\xi$s are referred to as exogenous variables and the $\eta$s as endogenous variables. Arrows associated with $\delta$s and pointing to the observed variables represent error variance due to measurement error; arrows associated with $\lambda$s pointing from the latent variables to the observed variables stand for the influence of the unobservable construct on the observed indicators and are equivalent to factor loadings in classical factor analysis; curved arrows associated with $\phi$s represent functional association (correlations) between the exogenous variables, while the $\gamma$s linking the exogenous variables to the endogenous variables are equivalent to regression parameters. The $\zeta$ represents a disturbance term or an error in an equation. Notice that $\phi$s and $\gamma$s are corrected for attenuation of measurement error due to the explicit modeling of error variance in the observed variables. All the parameters depicted in Figure 2 and their
standard errors can be estimated with a maximum likelihood (ML) estimation procedure. A likelihood ratio chi-square statistic tests the null hypothesis of equality between the observed and reproduced covariance or correlation matrix. However, two drawbacks with the chi-square statistic must be noted:

1. The value of the chi-square is dependent on sample size, so that with large samples small differences between the observed and fitted matrices may lead to the rejection of the null hypothesis, while with small samples, large differences may go undetected.
2. The chi-square is not bound by 0 and 1 and model comparisons may not therefore be straightforward.

Relative fit indexes are available and provide solutions to the chi-square drawbacks (Bagozzi & Baumgartner, 1994; Bentler, 1990; Bollen, 1989; McDonald & Marsh, 1990). These compare the fits of the null model and the focal model of theoretical interest, in which the null model assumes zero correlations between the observed variables and only error variances are freely estimated. The Comparative Fit Index (CFI)—also equivalent to the Relative Noncentrality Index (RNI; McDonald & Marsh, 1990)—was used in the present study. Monte Carlo studies show that the CFI performs well for small and large sample sizes, providing unbiased estimates of the population values (Bentler, 1990). The CFI is defined as:

$$CFI = \frac{(\chi_n^2 - df_n) - (\chi_f^2 - df_f)}{(\chi_n^2 - df_n)}$$

in which the subscripts $n$ and $f$ refer to the null and focal model to be compared. The CFI ranges from 0 and 1 therefore comparisons between different models are straightforward. Unfortunately, the distribution of the CFI is unknown, and thus no formal tests are available. Nevertheless, as a rule of thumb, models associated with CFI values greater than or equal to 0.90 are considered satisfactory.

Figure 2. SEM diagram

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5 Covariance matrices are necessary for multi-group comparisons or for testing equalities of the parameter estimates (Bollen, 1989; Jöreskog & Sörbom, 1989; Long, 1984).
The Root Mean Square Error of Approximation (RMSEA), proposed by Steiger & Lind (1980), can also be used to overcome the drawbacks of the chi square (Reise, Widaman and Pugh, 1993). The RMSEA is an absolute fit measure assessing lack of fit of the model per degree of freedom. The lower bound of the RMSEA is zero (perfect fit). Browne (1990) stated that models with RMSEA values lower that 0.05 indicate a close fit to data. The null hypothesis of close fit (RMSEA < 0.05) can be formally tested. LISREL 8 output provides RMSEA values and tests for close fit hypothesis (Jöreskog & Sörbom, 1993).

Another comparison strategy is available if the models to be compared are nested, i.e. if one model is a less restricted version of the other. The chi-square difference between the more and less restricted model formally tests the null hypothesis that both specifications yield the same fitted matrix; if the test fails to reject the null hypothesis, the more restricted model is the one to be retained because of its greater parsimony. If the comparisons deal with models based on different variables (i.e. do not involve nested models) the CFI is the suitable index. Finally another comparison strategy, regardless of whether the models are nested, involves the inspection of the $R^2$ values for the endogenous variables estimated by different models. Notice that $R^2$ based comparisons give totally different information from the comparisons based on fit indexes. The former refer to the practical predictive utility of a model, while the latter represent the capability of the specified model to reproduce the observed data. These comparisons are absolutely independent and in fact it is possible to obtain high values for the $R^2$ and poor global fit indexes, and vice versa.

The models were estimated using of LISREL 8 software (Jöreskog & Sörbom, 1993).

**Analytical Strategy**

To test our hypotheses we followed a three-step strategy:

1. We assessed the convergent and discriminant validity of the whole set of measures on the 240 subjects. In fact the larger sample appeared to be more suited to this kind of research question. To test for self-selection of subjects in the subsample of 90 subjects which answered the behavioral measure, we performed some multi-sample analyses (Jöreskog & Sörbom, 1989). We hypothesized that the subsample was representative of the total sample and that no self-selection effects of subjects were present. Hence, we expected the reliability of measures as well as the relations between the constructs to be the same across samples. If the 90- and 150-subject subsamples proved to be comparable in terms of reliability and relations among constructs, generalizability of results found on the smaller sample could be sustained with an acceptable degree of confidence, and might strengthen theoretical conclusions.

2. We tested the models of the three theories about attitude–behavior relationships, specifying the presence of frequency and recency of past behavior factors but not allowing them to influence intention or behavior. However, frequency and recency were allowed to correlate freely with the predictors of intention. Notice

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6The null and focal models used to compute the CFI are nested models.
that these models hypothesize that the influences of past behavior are totally mediated by the core variables of the theories, as claimed by their authors (Ajzen, 1988; Ajzen & Fishbein, 1980; Ajzen & Madden, 1986; Fishbein & Ajzen, 1975). If past behavior effects are indeed mediated through attitudinal variables, the models should fit the data, although no direct paths from past behavior to intentions and present behavior are estimated.

(3) We tested augmented models in which the influences of recency and frequency on intentions and behavior were freely estimated. The comparisons between the models in steps 1 and 2 test the sufficiency of the theories concerning the attitude–behavior relationships in that they are able to mediate all the influences of the past behavior variables on intention and behavior through attitude, subjective norms (Fishbein & Ajzen, 1975), perceived behavioral control (Ajzen & Madden, 1986) and desire (Bagozzi, 1992). Inspection of $R^2$-estimates provided information about the predictive power hypotheses.

**RESULTS**

**Validity of Measures**

Figure 3 shows the confirmatory factor analysis model we tested to assess the convergent and discriminant validity of our set of measures in the total sample of 240 subjects. The correlation matrix was used as input.

Preliminary analyses suggested eliminating the third measure for subjective norms because it was weakly correlated with the other two. This finding can be explained by the greater variability in identity and importance of the third most important person...
across respondents, while the first two items generally referred to the parents of the respondents. We also computed two random aggregates of the four indicators of attitude because the second semantic-differential scale anchored by punishing-rewarding was only moderately correlated with the single factor we hypothesized for the attitude construct. The final CFA model thus contains eleven observed variables and seven latent factors.

The model fits quite satisfactorily ($\chi^2(29, N = 240) = 25.60, p = 0.65, CFI = 1.00$) so we could not reject the null hypothesis of equality between the observed and fitted correlation matrices. This is a necessary but insufficient condition for achieving convergent and discriminant validity. We need to look at the magnitude of the parameter estimates, particularly the factor loadings ($Ax$ matrix) to assess convergent validity, and the matrix of correlations between latent factors ($\Phi$ matrix) for discriminant validity. Estimates in the former must be significant and above, say, 0.65 (Bagozzi, 1994, suggests that $\lambda^2$ should be at least 0.40), while correlations should be statistically less than 1.00. Table 1 shows the standardized parameter estimates for the CFA model.

The factor loadings values were all significant and above 0.65. The computed reliabilities$^7$ for the constructs were 0.71 for attitudes, 0.70 for subjective norms, 0.77 for desire and 0.89 for intentions and thus seemed satisfactory, though not very high for attitudes and subjective norms. However, one must remember that each factor was based on only two measures and we can therefore claim to have achieved an acceptable degree of convergent validity for the constructs with multiple indicators.

The disattenuated correlations were moderate to low, except for the estimated correlation between intention and desire (0.89, s.e. = 0.03); this was high but statistically less than 1.00$^8$ (0.83 $\leq$ $\phi_{d,t} \leq$ 0.95) and therefore achieved statistical discriminant validity. Bagozzi & Kimmel (1995) found similar results in their study of dieting and exercising behaviors. The TSR implies a strong association between the two constructs, since desires are regarded as a fundamental antecedent of intentions; a high correlation is thus to be expected. However, one might be suspicious of the empirical discrimination of the two constructs. Bagozzi & Kimmel (1995) defended discriminant validity of desires and intentions claiming that (a) the $\phi$s are correlations corrected for attenuation and are expected to be higher than raw coefficients, and (b) the test of discriminant validity via the CFA approach using variables that share one common method factor is a relatively stringent one, because any common method variance will tend to inflate all the correlations (Bagozzi, 1994). These considerations hold for the present results as well. Moreover, as we have argued above, recent empirical findings support the distinction between the two constructs.

$^7$Reliability estimates for the total scales are obtained by (Bagozzi, 1994; Bollen, 1989):

$$\rho = \frac{(\Sigma \hat{\lambda})^2}{((\Sigma \hat{\lambda})^2 + \sum \hat{\delta})}$$

where $\hat{\lambda}$ are the factor loadings and $\hat{\delta}$ the error variances.

$^8$An alternative way of proving that the correlation is statistically less than 1.00 is to compare the model with the more restricted model that assumes perfect correlation for desire and intention. We obtain $\chi^2\text{diff}(1, N = 240) = 12.36, p < 0.001$; hence we must reject the hypothesis of perfect correlation for desire and intention.
Table 1. Parameter estimates for confirmatory factor analysis (\(N = 240\))

**Matrix \(\mathbf{\Lambda} \times\)** of factor loadings

<table>
<thead>
<tr>
<th></th>
<th>Attitude ((\xi_1))</th>
<th>Subjective Norms ((\xi_2))</th>
<th>Desire ((\xi_3))</th>
<th>Intention ((\xi_4))</th>
<th>Perceived Behavioral Control ((\xi_5))</th>
<th>Frequency of Past Behavior ((\xi_6))</th>
<th>Recency of Past Behavior ((\xi_7))</th>
<th>Error variances</th>
</tr>
</thead>
<tbody>
<tr>
<td>at1</td>
<td>0.67 (0.07)*</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>0.56 (0.08)</td>
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</tr>
<tr>
<td>at2</td>
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<td>—</td>
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<td>—</td>
<td>—</td>
<td>0.34 (0.10)</td>
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</tr>
<tr>
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<td>—</td>
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<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>0.51 (0.12)</td>
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<tr>
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<td>0.76 (0.10)*</td>
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<tr>
<td>des1</td>
<td>—</td>
<td>0.87 (0.06)*</td>
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<td>—</td>
<td>—</td>
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<td></td>
</tr>
<tr>
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<td>—</td>
<td>0.70 (0.06)*</td>
<td>—</td>
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<td>—</td>
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<td>0.51 (0.05)</td>
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<tr>
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<td>0.86 (0.05)*</td>
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<td>0.27 (0.03)</td>
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<tr>
<td>int2</td>
<td>—</td>
<td>0.93 (0.05)*</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>0.14 (0.03)</td>
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<tr>
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<td>0.08 (0.07)</td>
<td>0.22 (0.07)*</td>
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<td>r</td>
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<td>—</td>
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<td>1.00b</td>
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</table>

\* Standard errors in parentheses.

\(p < 0.05\).

**Matrix \(\Phi\) of factor correlations**

|                  | Attitude (\(\xi_1\)) | Subjective Norms (\(\xi_2\)) | Desire (\(\xi_3\)) | Intention (\(\xi_4\)) | Perceived Behavioral Control (\(\xi_5\)) | Frequency of Past Behavior (\(\xi_6\)) | Recency of Past Behavior (\(\xi_7\)) |
|------------------|-----------------------|--------------------------------|--------------------|-----------------------|------------------------------------------|-------------------------------------|----------------|-----------------|
| \(\xi_1\)        | 1.00                  |                                |                    |                       |                                          |                                     |                |
| \(\xi_2\)        | 0.38 (0.08)*          | 1.00                           |                    |                       |                                          |                                     |                |
| \(\xi_3\)        | 0.55 (0.07)*          | 0.27 (0.08)*                   | 1.00               |                       |                                          |                                     |                |
| \(\xi_4\)        | 0.45 (0.07)*          | 0.26 (0.08)*                   | 0.89 (0.03)*       | 1.00                  |                                          |                                     |                |
| \(\xi_5\)        | 0.08 (0.07)           | 0.07 (0.08)                    | 0.29 (0.07)*       | 0.38 (0.06)*         | 1.00                                    |                                     |                |
| \(\xi_6\)        | 0.22 (0.07)*          | 0.02 (0.08)                    | 0.31 (0.06)*       | 0.34 (0.06)*         | 0.21 (0.06)*                           | 1.00                                |                |
| \(\xi_7\)        | 0.20 (0.07)           | 0.14 (0.08)                    | 0.42 (0.06)*       | 0.50 (0.05)*         | 0.41 (0.05)                           | 0.48 (0.05)*                       | 1.00b          |

\(b\) Fixed parameter.
Finally, the last column in Table 1 displays the error variances for the observed measures. The estimates were all significant, as is to be expected for self-reported paper and pencil data (Bagozzi, 1994; Bagozzi & Burnkrant, 1985).

Multi-sample Analysis

Since the theories were tested using the subsample \((N = 90)\) which includes the behavioral criterion, we performed a multi-sample analysis to compare the subsample with the rest of the subjects \((N = 150)\). The main hypothesis to be tested was the equality of factor loadings and covariances between latent factors across samples. Equality of factor loadings allows for invariant interpretation of the latent factors across samples; equality of covariances between latent factors means that the relations between theoretical concepts are generalizable across samples. Variance–covariance matrices were used as input for hypothesis testing (Long, 1984). Results showed that the model constraining to invariance of factor loadings and of covariance between latent factors across samples obtained a borderline (although not significant) fit \(\chi^2(77, N = 90,150) = 97.46, p \approx 0.06;\) the CFI is very high (0.98) and well above the 0.90 threshold; the RMSEA was very low (0.03) and statistically lower than 0.05 \((p = 0.92)\), and the hypothesis of close fit could not be rejected (Browne, 1990). One can therefore claim that the meaning of constructs and the magnitude of their relationships was the same across samples. This is a very important result, since it implies that conclusions drawn from the 90-subject sample can be generalizable to the whole sample.

Basic Theories

Once validity of measures was assessed, we analyzed the theories about the attitude–behavior relationships. The correlation matrix was used as input. Means and standard deviations of measures are shown in Table 2.

The Theory of Reasoned Action (TRA)

We first analyzed the TRA, including the past behavior factors in the model but not allowing them to influence either intention or behavior (Figure 4(a)). Since past behavior factors are freely correlated with attitudes and subjective norms (curved arrows are not depicted in the figure for reasons of simplicity), the model can be viewed as a test of Fishbein and Ajzen’s hypothesis about the mediation of past behavior effects through attitudes and subjective norms. If past behavior effects are totally mediated the model should fit the data.

The model obtained a rather poor fit: \(\chi^2(23, N = 90) = 69.23, p < 0.001,\) CFI = 0.87. We had to reject the null hypothesis of equality between the observed and fitted matrices from a statistical standpoint (the chi-square statistic). The CFI was not very high and lower than 0.90, so we had to conclude that the hypothesized model was not a good representation of the data, even from a practical standpoint. The standardized parameter estimates are shown in panel (a) of Table 3.
Table 2. Zero-order correlations, means and standard deviations for the variables used for structural equations models (N = 90)

<table>
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<th>4</th>
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<td>0.59**</td>
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<tr>
<td>Desire 1</td>
<td>0.46**</td>
<td>0.43**</td>
<td>0.31*</td>
<td>0.30*</td>
<td>1.00</td>
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<td></td>
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<tr>
<td>Desire 2</td>
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<td>0.75**</td>
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<td>PBC</td>
<td>0.12</td>
<td>0.05</td>
<td>0.14</td>
<td>0.10</td>
<td>0.34**</td>
<td>0.33**</td>
<td>1.00</td>
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<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Intention 1</td>
<td>0.42**</td>
<td>0.38**</td>
<td>0.37**</td>
<td>0.29*</td>
<td>0.66**</td>
<td>0.54**</td>
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<td>1.00</td>
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<tr>
<td>Intention 2</td>
<td>0.46**</td>
<td>0.34**</td>
<td>0.42**</td>
<td>0.36**</td>
<td>0.71**</td>
<td>0.58**</td>
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<tr>
<td>Behavior</td>
<td>0.28*</td>
<td>0.34**</td>
<td>0.33**</td>
<td>0.36**</td>
<td>0.47**</td>
<td>0.31*</td>
<td>0.28*</td>
<td>0.52**</td>
<td>0.51**</td>
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<tr>
<td>Frequency</td>
<td>0.13</td>
<td>0.14</td>
<td>0.12</td>
<td>0.09</td>
<td>0.42**</td>
<td>0.29*</td>
<td>0.28*</td>
<td>0.32*</td>
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<td>Recency</td>
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<td>0.20</td>
<td>0.20</td>
<td>0.24</td>
<td>0.49**</td>
<td>0.31*</td>
<td>0.55**</td>
<td>0.49**</td>
<td>0.52**</td>
<td>0.62**</td>
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<td>0.147</td>
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<td>3.333</td>
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<td>s.d.</td>
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<td>2.174</td>
<td>1.316</td>
<td>1.306</td>
<td>1.735</td>
<td>1.107</td>
<td>1.427</td>
<td>1.623</td>
<td>2.016</td>
<td>2.035</td>
<td>1.602</td>
<td>1.966</td>
</tr>
</tbody>
</table>

PBC = Perceived Behavioral Control.
* p < 0.05.
** p < 0.01.
aMeasures were mean centered (based on the total sample).
Looking first at the $\mathbf{G}$ matrix, the $\gamma$ regression coefficients on intention of both attitudes and subjective norms were significant but moderate in magnitude, accounting for 40% ($R = 0.63$) of the total variance in intention. The $\mathbf{B}$ matrix displays the influence of intention on behavior that was significant and moderate in magnitude, with $R^2$ for behavior of 0.31 ($R = 0.56$). This result is consistent with most previous findings in the prediction of behavior from self-reported data. Sheppard, Hartwick & Warshaw (1988) reported an $R$ value for behavior of 0.53 in a meta-analytic review of the findings of the theory of reasoned action. Sheppard et al. (1988) also reported an average $R$ value for intention of 0.66, while the present application of the TRA obtained a lower value (0.63). This last finding is unsatisfactory since the regression parameters and hence the $R$ values were corrected for attenuation in the present study. The correlations between frequency and recency and TRA independent variables were moderate to low range (from 0.19 to 0.35), consistently lower than the raw correlations between recency and frequency, and intention and behavior (from 0.32 to 0.62). This pattern of correlations shows that attitudes and subjective norms only partly mediate the association between past behavior variables and intentions and behavior.

Figure 4. The basic models tested
The Theory of Planned Behavior (TPB)

The model (Ajzen, 1985; Ajzen & Madden, 1986) includes the effects of perceived behavioral control on intention and behavior in the structure of the theory of reasoned action. The model depicted in Figure 4(b) is a formal test of the hypothesized mediatory power of perceived behavioral control (remember that past behavior factors were freely correlated with the predictors of intention, though for reasons of simplicity these relations are not depicted in the figure). If the hypothesis is correct we would obtain a good fit for the model, high predictive power for perceived behavioral control and moderate to high correlations between this and past behavior factors. In other words, the effect of past behavior on both intentions and present behavior should be totally mediated by attitude and perceived behavioral control variables.

The TPB basic model obtained a $\chi^2(27, N = 90) = 66.42, p < 0.001$. However, the CFI had an acceptable value of 0.90, showing that TPB predictors were partially able to mediate direct effects of past behavior on intention and present behavior.

Panel (b) in Table 3 displays the regression parameter estimates of the model. Intention regressed significantly on perceived behavioral control with a $r$ coefficient of...
The Theory of Self-regulation (TSR)

We hypothesized that the desire factor introduced by the TSR would mediate a high proportion of frequency and recency influences on intention, since it is strongly correlated with both past behavior factors. Figure 4(c) shows the SEM model of the TSR (curved arrows are not depicted in the figure for reasons of simplicity).

The model did not fit well from a purely statistical point of view ($\chi^2 (35, N = 90) = 65.15, p < 0.002$) but showed a satisfactory CFI (0.94); we could therefore accept the model for practical purposes. The regression matrices are shown in panel (c) of Table 3. As expected, desire was a strong predictor of intention. Its inclusion reduced the influence of attitudes to zero while the effect of subjective norms was marginally significant ($t = 1.90$); the $R^2$ for intention was 0.68. The correlation between attitudes and desires was high (0.60), showing an important degree of overlapping between the two. This was an expected result since Bagozzi (1992) stated that attitudes can stimulate desires and that both constructs are based on reasons. As regards the effects of past behavior on intentions, they seemed to be partially mediated through desires because of the strong associations between frequency and recency with desire (0.45 and 0.53, respectively).

The results for the three theories show that the imposed specification that did not allow the free estimation of direct paths from frequency and recency to intention and behavior led to poor chi-square goodness of fit indexes. However, the relative fit indexes (CFIs) for the TPB and the TSR models were equal to or higher than 0.90, the threshold value generally associated with acceptable models from a practical standpoint. The TRA was insufficient to account for the influences of past behavior factors. These influences were also present in the TPB as well as in the TSR, but they were at least partially mediated by the main relationships hypothesized by the theories (i.e. perceived control and desire as predictors of intentions for the TPB and TSR models respectively).

Augmented theories

To obtain further insight into past behavior effects we tested three models in which the direct influences of past behavior factors on intention and behavior were freely estimated. We expected that (1) the goodness of fit indexes for the three models would be acceptable, (2) the $R^2$ for behavior would be higher in the three augmented models.
of the theories, and (3) the $R^2$ for intention would be higher for the augmented TPB and TRA models but not for the augmented TSR model, as implied by hypotheses H2 and H3.

The Augmented TRA

The model is depicted in Figure 5(a). The chi-square goodness of fit index was satisfactory ($\chi^2(19, N = 90) = 21.05, p = 0.33$), as well as the CFI (0.99). The chi-square difference test between this model and the basic TRA model was: $\chi^2_{\text{diff}}(4, N = 90) = 48.18, p < 0.001$. Hence the direct influences of past behavior on both intentions and present behavior improved the fit significantly compared to the basic model. Standardized regression parameter estimates are displayed in panel (a) of Table 4.

Only the direct effect of frequency on behavior was not significant ($t = 0.14$), while the effects of both past behavior factors on intention and of recency on behavior were significant and moderate in size. The effects of attitudes and subjective norms on
intention and of the latter on behavior were still significant but weaker, as was to be expected from the inclusion of new predictors in both regression equations. $R^2$ values for intention and behavior were 0.54 and 0.44 respectively, with an improvement in results of the basic model of 0.14 and 0.13 respectively.

The results clearly show that the basic model for the TRA is not sufficient to account for the observed relationships between the variables and that the influences of recency and frequency of past behavior are distinct and work largely over and above the effects of attitudes and subjective norms.

**The Augmented TPB**

The model is shown in Figure 5(b). The goodness of fit was satisfactory ($\chi^2(23, N = 90) = 30.41, p = 0.14; CFI = 0.98$) and was a significant improvement on the basic model ($\chi^2_{\text{diff}}(4, N = 90) = 36.01, p < 0.001$). The parameter estimates are shown in panel (b) of Table 4.

As found for the augmented TRA model, frequency did not significantly influence behavior but significantly influenced intention, though with a rather weak effect.
Recency influenced behavior strongly and significantly, but intention only weakly (0.20). These results show the mediatory power of perceived behavioral control over the effects of past behavior on intention. However, direct effects of past behavior were significant and the $R^2$ for intention improved to 0.58, an improvement over the basic TPB model where $R^2$ was 0.52. A closer look at the prediction of behavior shows that the effects of perceived behavioral control were now negative and marginally significant ($t = -1.90$), while in the basic model the $\gamma$ coefficient estimate was zero (Table 3, panel (b)). Moreover, the effect of recency on behavior is now slightly enhanced with respect to the $\gamma$ obtained for the augmented TRA model. This pattern of results and the strong correlation (0.55) for recency of past behavior and perceived behavioral control may indicate suppressor effects or multicollinearity between the two variables (Tabachnick & Fidel, 1989).9

Similarly, the $\beta$ regression weight for behavior on intention was still significant and slightly higher than the value obtained for the augmented TRA model because of the likely influence of the same suppressor effect or of multicollinearity as noted above. Finally, the $R^2$ for behavior was relatively high (0.47) with an improvement of 0.15 over the basic TPB model.

**The Augmented TSR**

The model (Figure 5(c)) shows a satisfactory fit ($\chi^2(31, N = 90) = 37.01, p = 0.21; CFI = 0.99$), significantly better than the basic TSR model ($\chi^2_{\text{diff}}(4, N = 90) = 28.14, p < 0.001$). Parameter estimates are shown in Table 4, panel (c).

Frequency was no longer a significant predictor of intention, since its effects were totally mediated through desire. The direct effect of recency on intentions was also weak, albeit still significant ($t = 2.08$). The effect of desire on intention was lower than in the basic TSR model because of the correlated predictors included in the regression equation for intention. As expected, recency of past behavior was again a significant predictor of behavior. The $R^2$ values are 0.67 and 0.44, respectively, for intention and behavior. Notice that there was no improvement in the $R^2$ for intention (−0.01) as compared to the basic TSR model (see Table 3, panel (c)) while the increment for behavior, was 0.13. Thus, even though the estimation of the direct effects of past behavior factors on intention improved the global fit of the model, it was not necessary for good prediction of behavioral intentions.

**DISCUSSION**

On the basis of the chi square test, the basic models of the three theories are unable to reproduce the observed data if direct paths from past behavior factors to intention and present behavior are omitted. Nevertheless, with one exception, the basic models achieve an adequate fit from a practical point of view. The TRA was not tenable even

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9We are not able to give a full interpretation of this negative direct path of perceived control on behavior. For the time being, we prefer to interpret it as an artifact with no theoretical relevance in this behavioral domain. Moreover, note that the value is only marginally statistically significant and may therefore be due to chance.
from a practical standpoint (CFI = 0.87), whereas the TPB and the TSR achieved satisfactory incremental fit indexes equal to or greater than the 0.90 standard (CFI = 0.90 and 0.94 respectively). The augmented models for each theory achieved even better fit indexes on both statistical and practical grounds, with nonsignificant chi square values and high CFIs (0.99, 0.98 and 0.99, for the TRA, the TPB, and the TSR augmented models respectively). These results clearly show the relevant role played by past behavior factors in all three theories. For a deeper insight into the drawbacks and advantages of the basic models, as well as the effects of past behavior in the three theories, we will now examine our hypotheses.

\( H1 \). Different degrees of prediction in intention were hypothesized for the basic models: the TRA was supposed to show the weakest predictive power for intention, and the TSR the highest. This hypothesis is well supported by the data. The basic TRA model predicts 40% of intention, while the TPB shows an \( R^2 \) of 0.52 and the TSR an \( R^2 \) of 0.68. Hence, we must conclude that the hypothesized relationships of the TRA are unable either to reproduce the observed data or to achieve high proportions of explained variance in intention. A likely reason for this poor performance is that the TRA was designed to explain only behaviors under total volitional control (Ajzen, 1988; Ajzen & Fishbein, 1980; Fishbein & Ajzen, 1975). Studying behavior, however, seems to contain non-volitional elements caused by internal as well as external factors (lack of motivation or ability, lack of opportunities). Non-volitional factors are at least partially captured by the significant effect of perceived behavioral control on intentions. The \( R^2 \) for intention was 0.52. The improvement in the \( R^2 \) compared to the TRA is 0.12, a considerable increase. Moreover, perceived behavioral control mediates some of the effects of past behavior factors, because it is correlated with frequency and particularly with recency of past behavior. Finally, desire in the TSR model improves the prediction of behavioral intentions further, achieving an \( R^2 \) of 0.68. As predicted in the TSR, desires mediate the direct influence of attitudes on intentions. Desire also seems able to mediate a portion of past behavior effects because of its moderately high correlations with past behavior measures. Thus, this study shows the important role of motivational processes in intention formation and in subsequent behavioral performance. This theoretical conclusion seems appropriate for studying behavior in which strong motivational effects are expected to be at work.

\( H2 \). As noted above, the augmented models fit quite well; however, they had different results as regards their predictive power. We hypothesized that the TRA augmented model would be the most affected by past behavior influences in the prediction of intentions because of a lack in mediatory power of attitudes and subjective norms. The results confirm the hypothesis in that an increment of 0.14 was found in the coefficient of determination for intentions (i.e. \( R^2 \) went from 0.40 of the basic model to 0.54 in the augmented model). In turn, the increase in the prediction of intention under the TPB augmented model is about 0.06, a noticeable but small improvement. Perceived behavioral control thus seems able to tap a portion of past behavior effects on intention. The likely theoretical reason for this mediatory power is the role of self-efficacy as the basis for perceived control (Ajzen, 1988) and also as one of the determinants of frequency and recency of past behavior. As regards the latter, notice that perceived behavioral control is strongly related to recency. The causal direction of this association, i.e. whether self-efficacy beliefs influence behavior or whether behavior leads to self-efficacy appraisals, is an open question. The former is a
cognition-based explanation and would support Bandura’s theory of self-efficacy (Bandura, 1977) while the latter is a neo-behaviorist hypothesis that would support Bem’s self perception theory (Bem, 1967, 1972). Finally, as hypothesized, the augmented model of the theory of self-regulation achieves the highest $R^2$ for intention (0.67) compared to the augmented TRA and TPB models. However, there was no increase in the prediction of intention ($\Delta R^2 = -0.01$) compared to the basic model that hypothesizes no direct influence of past behavior on intention (see panel (c) in Table 3). This is evidence for the mediatory role of desires with regard to the influence of recency and frequency on intentions. It suggests a role for desire as a proximal cause of intention and as a distal cause of behavior (through intention). Indeed, one might even argue that the remarkable association between past behavior factors (recency in particular) and desire is due to this indirect causal stream from motivational processes to the enactment of behaviors. Obviously, this is only one interpretation; an alternative would be a self-perception based explanation of this association that reverses the causal stream from recency of past behavior to desire appraisals.

$H3$. The hypothesized improvements for behavior prediction due to past behavior are supported. The $R^2$ values for behavior in the augmented models are 0.44, 0.47 and 0.44 for the TRA, TPB and TSR models respectively, with considerable increases on the values for the basic models ($\Delta R^2$ of 0.13, 0.15 and 0.13, respectively). Notice, however, that the coefficient of determination obtained in the TPB augmented model may not be reliable. We strongly suspect that the high $R^2$ value here is partially due to suppressor effects or multicollinearity between perceived behavioral control, recency of past behavior and behavioral intentions, as mentioned in the Results section above.

The Role of Past Behavior

The basic models for attitude–behavior relationships are sensitive to past behavior effects on intention and behavior, though differently as regards the prediction of intention. The reasons for past behavior effects are largely unknown. However, using past behavior mainly as a control variable may give some insight into the processes mediated through it. The way in which past behavior influences on intentions decrease from the TRA to the TPA and TSR models in the present study can shed light on the role of past behavior. Past behavior effects on intentions noticeably decreased from the TRA to the TPB because of the inclusion of perceived control, a self-efficacy-based construct. Past behavior can be a fundamental source of self-efficacy appraisals which are crucial to the formation of an intention to act and are not represented within the TRA. However, past behavior predicts intentions even when perceived control is included. In the light of the distinction between self-efficacy and outcome beliefs (Bandura, 1977, 1982), perceived control can be interpreted as resembling the former, not unlike Heider’s (1958) notion of ‘can’ as a disposition, whereas outcome beliefs are likelihood estimates of end states (Bagozzi, 1992). Although these kinds of estimate are currently used to measure intentions, one should note that the easiest way of producing such an estimate is based on past behavior (Tversky & Kahneman, 1974). Hence past behavior may be able to mediate the unmeasured influence of outcome beliefs since they are not explicitly modeled as a predictor of intentions. Past behavior effects decrease even more when one compares the TPB with the TSR. The TSR (Bagozzi, 1992) claims that the effects of desires on intentions are due
to outcome–desire appraisals that lead to emotional and motivational processes. Past behavior can play an important role in these appraisals, since they inform about past end states and outcomes; therefore, desire can account for past behavior effects on intentions when it is included as a predictor.

We acknowledge that these interpretations of past behavior effects are speculative and are tentative answers to still open questions. However, we think that motivation based variables and self-efficacy deserve a more important role in theories about attitude–behavior relationships.

Some limitations of this study should also be acknowledged. First, the 90-subject sample used to test the theories might be regarded as too small to perform SEM. However, results of multi-sample analysis showed that the 90-subject sample gives stable and generalizable information.

A second limitation involves the high correlation between intention and desire. However, the distinction between the two constructs seems to be well supported not only on philosophical and theoretical grounds but also on empirical ones.

A final limitation is that behavioral measures were self-reported. An optimal study would include objective indicators of behavioral performance.

CONCLUSION

The theoretical models under investigation have shown their usefulness for the particular behavior under study. Variables included in the theories are easy to operationalize and their predictive power is high. However, the different results for the three theories suggest that important variables have been omitted in the TRA model. The TRA does not include self-efficacy-based variables nor motivational factors as desire. The theory is able to represent behaviors under total volitional control but under less stringent circumstances the prediction of intention is not good. Both TPB and TSR models seem to be largely independent of past behavior influence in the prediction of intention, and are able to represent intention formation for behaviors under incomplete volitional control. Even though both TSR and TPB outperform TRA, the two models explain intention and behavior from two rather different points of view. The TPB is focused on the role of self-efficacy appraisals in intention and behavior. However, the processes linking self-efficacy to intention formation are not clearly specified. The TSR focuses on motivational factors, which are at work through desire. The processes linking desire and intention are well specified by philosophers of action and seem to give a more complete theoretical explanation of attitude–behavior relationships than those given by TRA and TPB. A next step in this research field should therefore involve a deeper analysis of the processes working through self-efficacy appraisals and their integration with motivational factors represented by desire.

REFERENCES


