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A Meta-Analytic Review of the Theories of Reasoned Action and Planned Behavior in Physical Activity: An Examination of Predictive Validity and the Contribution of Additional Variables

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Abstract

The aim of the present study was to examine relations between behavior, intentions, attitudes, subjective norms, perceived behavioral control, self-efficacy and past behavior across studies using the Theories of Reasoned Action (TRA) and Planned Behavior (TPB) in a physical activity context. Meta-analytic techniques were used to correct the correlations between the TRA/TPB constructs for statistical artefacts across 72 studies and path analyses were conducted to examine the pattern of relationships among the variables. Results demonstrated that the TRA and TPB both exhibited good fit with the corrected correlation matrices, but the TPB accounted for more variance in physical activity intentions and behavior. In addition, self-efficacy explained unique variance in intention and the inclusion of past behavior in the model resulted in the attenuation of the intention-behavior, attitude-intention, self-efficacy-intention and self-efficacy-behavior relationships. There was some evidence for the moderation of the study relationships by attitude-intention strength and age, but there was a lack of homogeneity in the moderator groups. It was concluded that the major relationships of the TRA/TPB were supported in this quantitative integration of the physical activity literature and the inclusion of self-efficacy and past behavior are important additions to the model.

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Introduction

Acknowledging the strong evidence in favour of regular physical activity for positive health benefits (Bouchard, Shepherd & Stephens, 1994), exercise psychologists have sought to model the decision-making processes that lead people to participate in regular physical activity (Brawley, 1993a). Such an endeavour may identify the key psychological constructs to be targeted for social-cognitive interventions that promote physical activity participation (Brawley, 1993b). Social cognitive models have been shown to be useful to this end (Maddux, 1993) and the Theories of Reasoned Action (TRA; Ajzen and Fishbein, 1980) and Planned Behavior (TPB; Ajzen 1985) have been identified as particularly useful social cognitive theoretical frameworks that help explain people's physical activity behavior (Blue, 1995; Godin, 1994).

Hausenblas, Carron and Mack (1997) conducted a cumulative research synthesis of the TRA and TPB in a physical activity context using meta-analytic techniques. Such analyses treat each individual study as a single test of the theory relationships and provide a powerful assessment of the effect sizes across studies by correcting for the statistical artefacts of sampling and measurement error. The study supported the utility and applicability of the TRA and TPB in the explanation of physical activity intentions and behavior. However, there is a need to investigate additional issues raised in the growing body of literature using these social cognitive approaches in a physical activity context. Specifically, the predictive and construct validity of the arrangement of the theory constructs, the influence of other social cognitive variables and the influence of moderators are issues that have not been addressed in previous quantitative research syntheses of the TRA/TPB in physical activity and requires further investigation (Spence, 1999).

The present study aimed to extend, using meta-analysis and path analytic techniques, the research of Hausenblas and coworkers (1997) by examining the construct and predictive validity of the TRA/TPB in physical activity research and evaluating the role of self-efficacy and past behavior in these models. A sub-aim was to assess the efficacy of three moderator variables, namely attitude-intention strength, age and time frame of past behavior on the TRA/TPB relationships.

The TRA hypothesizes that an individual's stated intention to perform a given behavior is the most immediate predictor of that behavior (Ajzen & Fishbein, 1980). Intention is proposed to represent a person's immediate behavioral orientation towards performing a given target behavior, like physical activity, and is a reflection of a person's motivation towards that behavior. The intention-behavior link is a strong one and this is supported by meta-analytic reviews (Randall & Wolff, 1994; Sheppard, Hartwick, & Warshaw, 1988). The TRA posits that the intention construct completely mediates the effect of two social cognitive variables on behavior; attitude and subjective norm. Attitude reflects a personal disposition towards engaging in the behavior. It represents an individual's assessment of their beliefs regarding the target behavior's agency in producing outcomes and an evaluation of these outcomes. Subjective norm is a normative-based cognition and represents the person's evaluation of whether significant others want them to engage in the target behavior and their motivation to comply with these others. Ajzen and Fishbein (1980) propose that the TRA is a versatile theory and is applicable to all volitional human behaviors. This notion has been confirmed on numerous occasions (Randall & Wolff, 1994; Sheppard et al., 1988).

However, recognising that not all behaviors are under complete volitional control of the individual, Ajzen (1985) modified the theory by including the perceived behavioral control (PBC) construct as an independent predictor of intention. PBC represents an individual's

assessment of their capacities and faculties regarding their behavioral engagement. For example, some behaviors may have 'problems of control' in which case attitude and subjective norm, while favourable, may not contribute the behavioral intention because of lack of volitional control. In such cases PBC may independently predict intention. Ajzen and Madden (1986) also proposed a second version of the TPB in which PBC may also directly influence behavior independent of the intention-mediated effect. This unique PBC-behavior effect was supposed to reflect the degree to which actual barriers to the behavior influence enactment of intentions in which case the PBC measure is a proxy measure of actual control over behavior. Ajzen and Madden (1986) argue that, for some behaviors, PBC can predict both intention and behavior because it reflects resources and opportunities as well as actual barriers.

Researchers comparing the TPB and TRA in a physical activity context have demonstrated that the TPB is superior to the TRA in accounting for the variance in intention. This is because PBC has been shown to have a large effect on physical activity intentions in the TPB. Indeed, meta-analytic and narrative reviews of the use of the TRA and TPB in physical activity behavior research suggest that PBC has an effect on intentions that is almost as strong as that of attitudes (Blue, 1995; Godin, 1993; Hausenblas et al., 1997). Conversely, these reviews also suggest that the contribution of subjective norm to the prediction of intention is typically smaller than the effect of attitude and PBC. This may be consistent with the notion that participation in physical activity relies more on personal motivational judgements and is less subject to the influence of pressure from others (Godin, 1993).

The corrected effect sizes yielded by Hausenblas et al.'s (1997) meta-analysis provided support of the relationships between the TRA/TPB variables, physical activity intentions and behavior observed in single tests of the model. However, it is important that these relationships

are not considered in isolation if a valued judgement on the construct and predictive validity of the TRA and TPB is to be made. Hausenblas et al. acknowledge that these important mediator variables are not accounted for in zero-order relationships and may give a false impression of the actual effect sizes. For example, it is possible to observe a significant and substantial effect size between two variables, such as attitude and behavior. Yet, when other influential mediator variables are partialled out, like intention, the relationship in question can be attenuated or extinguished altogether (Spence, 1999). Therefore, if an informed decision is to be made on the validity of the TRA and TPB in an physical activity context, it is important to apply multivariate techniques, like regression and path analysis, to the synthesis so that the unique relations between the variables can be generated with the influential mediators partialled out. Adopting the techniques of meta-analysis and multivariate analyses like path analysis can assist in providing a strong case for hypothesised mediator relationships in the TRA/TPB for physical activity behavior.

In addition, Hausenblas et al. (1997) acknowledged that they did not consider additional variables[1] as potential predictors of intention and behavior in their meta-analysis of the TRA/TPB in an exercise context. Studies adopting the TRA/TPB for physical activity behavior have catalogued the independent influence of self-efficacy (Courneya & McAuley, 1994a; Estabrooks & Carron, 1998; Terry & O'Leary, 1995) and frequency of past behavior (Yordy & Lent, 1993; Godin, Valois, Shephard & Desharnais, 1987) on intention and behavior. The inclusion of each of these additional variables increased the explanatory power of the model by addressing some of the shortcomings of the conceptualisation and measures of the existing TRA/TPB predictors or served to further explain the arrangement of relationships in the model.

Focussing on the concept of self-efficacy, a number of studies have shown that self-efficacy provides an additional influence on physical activity intentions and behavior (Dzewaltowski, 1989; Dzewaltowski, Noble & Shaw, 1990; Hagger, Chatzisarantis & Biddle, 2001; Yordy & Lent, 1993). Conceptually, Ajzen (1991; in press) has aligned the concept of PBC with Bandura's (1977) self-efficacy construct. However, close examination of the operationalization of PBC and its system of underlying beliefs has revealed that there may be more than one control-related construct with independent effects on the TPB variables. Terry and O'Leary (1995) have shown that items that have been traditionally used to measure PBC can be classified into internal and external aspects of control and that these may be responsible for the poor internal consistency values often reported for this measure. The authors characterized these internal aspects of control as perceived ability and personal agency over the behavior. This construct was measured by items that make reference to 'ability' and 'capability' and was labelled self-efficacy. Conversely, the external aspects of control were defined as the influence of external barriers on behaviour. This was measured by items referring to 'difficulty' and 'control' and was labelled perceived behavioral control. Recently, Armitage and Conner (1999b) have corroborated this internal-external distinction by confirming the criterion validity of the control variables using their underlying beliefs. Since this distinction is now well established and the differential effects of self-efficacy acknowledged in recent reviews of the TPB (Conner & Armitage, 1998), a cumulative examination of the influence of this variable within the TPB is timely and will provide further support for making the distinction between PBC and self-efficacy.

The application of the TRA, the TPB and other related social cognitive approaches have identified that past behavioral engagement, often measured as frequency of past behavior, has an important and significant influence on prospective behavior, intention and the other social

cognitive variables in the model (Bagozzi, 1981; Bentler & Speckart, 1981). The inclusion of past behavior, a term often used synonymously with habit, has typically revealed three effects on the variables in the TRA/TPB. Firstly, past behavior significantly influences the variables of intention, attitude, subjective norm, PBC and behavior. Secondly, the inclusion of past behavior in multivariate tests of the influence of these cognitions on intentions and behavior tends to attenuate the influence of attitudes on intention and intentions on behavior (Bagozzi, 1981; Hagger, Chatzisarantis, Biddle & Orbell, 2001). Thirdly, while the attenuation effect has reduced the relationships in studies of some health behaviors (Norman, Conner and Bell, 1999), others have shown that there are unique effects of the TRA/TPB social cognitions on behavior, independent of past behavioral engagement (Bentler & Speckart, 1981). Such attenuation effects have been observed in a number of studies that have examined physical activity behavior (Dzewaltowski et al., 1990; Godin, Valois, Jobin & Ross, 1991; Godin et al.,1993; Hagger, Chatzisarantis & Biddle, 2001; Hagger, Chatzisarantis, Biddle & Orbell, 2001; Norman & Smith, 1995; Theodorakis, Doganis, Bagiatis & Gouthas, 1991) while others have only observed small or nil attenuation effects (Sheeran & Orbell, in press; Godin, Vezina & LeClerc, 1989; Theodorakis, 1992; Theodorakis, Goudas, Bagiatis & Doganis, 1991; Yordy & Lent, 1993). It seems that taking past behavior into consideration may account for some of the observed effects of current cognitions regarding physical activity behavior, like attitudes and intentions.

While the attenuation effects of past behavior in the TRA/TPB have been documented in previous studies, few hypotheses regarding the mechanisms responsible have put forward. Bagozzi (1981) suggested that the effects of the current cognitions in the TRA on intention and behavior become spurious with increasing past behavioral engagement. “As habit increases, the performance of the behavior becomes less one of a rational evaluation of the consequences of the

act and more one of a learned response" (Bagozzi, 1981, p. 625). Therefore, without controlling for past behavior, the decision making process is biased towards current judgements regarding the behavior when, in reality, the decision to engage in the behavior will be less subject to cognitive evaluation and more one of habitual participation on presentation of the appropriate cues to action. It was surmised that the extent of past behavioral engagement dictated the degree of cognitive intervention required before the behavior could be performed, or its level of 'automaticity' (Aarts & Dijksterhuis, 2000; Triandis, 1977).

In this way, the role of frequency of past behavior may be able to account for some or all of the conscious elements that are involved in the decision-making process. While some attenuation effects have been observed, this has not been systematically investigated across studies of physical activity behavior, nor has the exact contribution of past behavior to the prediction of intentions and behavior been documented. Examining the effect of previous experience may shed light on the extent of the attenuation effects observed in other studies when artefacts of sampling and measurement error are statistically controlled.

Meta-analyses of the TRA/TPB have also identified some potential moderator variables of the theory relationships (Sheeran & Orbell, 1998; Sheppard et al., 1988). One possible moderator is the strength of the attitude-intention relationship. Recent conceptualisations of the TPB have examined how attitude-based intentions tend to result in stronger intention-behavior relationships than intentions based on subjective norms. Sheeran, Norman and Orbell (1999) suggest that a person's action plan to engage in a behavior is more likely to be translated into behavior if it is based largely on attitudes. Considering the attitude-intention strength as a moderator of the TRA/TPB variables in a cumulative research synthesis would provide evidence to support

whether studies reporting strong attitude-intention relationships among their participants also have strong intention-behavior relationships.

In addition to the moderating effect of attitude-intention strength, previous studies have highlighted that sample demographics may result in different relative contributions of the TRA/TPB cognitions to the explanation of intention and behavior. Indeed, Ajzen and Fishbein (1980) suggest that the relative influences in the TRA will change according to behavior and sample. It would not, therefore, be unreasonable to assume that in a cumulative analysis there would be a moderating influence of sample characteristics such as gender, age and socio-economic status. Moderators such as gender and socio-economic status (SES) are precluded from the present study because few studies segregate their sample by gender and there is lack of availability of SES data. However, age is typically reported in most studies making it a viable to conduct a moderator analysis. Previous meta-analyses of the TPB have shown that age moderates the intention-behavior relationship (Sheeran & Obell, 1998). Further, studies have shown that physical activity behavior declines with age (Armstrong and McManus, 1994; USDHHS, 1996). Therefore it is expected that age would moderate the intention-behaviour relationship.

The time period over which past behavior is assessed is another variable that may serve to moderate the theory relationships in studies of the TRA/TPB that incorporate the past behavior variable. A distinction must be made between participants who are asked to report their frequency of past physical activity behavior over a few weeks or one month and those asked to assess their past behavior over a period of months or even years. Clearly, there is likely to be a greater abstraction and generalisation of the past behavior the longer the stated period and this is likely to be reflected in the measure. It has been suggested that recent assessments of behavioral engagement are likely to correspond better with future behavior and judgements regarding further

participation (Bagozzi & Warshaw, 1992). Indeed, research has suggested that recency of past behavior is an important element when assessing the influence of past experience in social cognitive models (Bagozzi & Kimmel, 1995; Hagger, Chatzisarantis, Biddle & Orbell, 2001). Godin, Valois, Shepherd and Desharnais (1987) concluded that "if exercise has been experienced quite recently, [subsequent] behavior should be predictable from a knowledge of exercise habits" (p. 155). It is therefore important that the moderating effects of the proximity of measurement of past physical activity behavior is examined when studying the prediction of behavior from past behavior in a cumulative synthesis of the TRA/TPB research.

Hypotheses

The present study aims to evaluate the predictive validity of the TRA and the TPB in physical activity behavior by applying path analysis to corrected correlations derived from a meta-analytic cumulation of the available literature. Specifically, is it hypothesized that the TPB will account for more variance in intention and behavior than the TRA. It is also expected that the present analysis will corroborate the findings of other reviews (e.g. Blue, 1995; Godin & Kok, 1996) that attitude and PBC will have the most pervasive influence on physical activity intentions.

Further, recognising that the additional variables of self-efficacy and past behavior have been successful in explaining additional variance in physical activity intentions in the TRA/TPB, the present study aims to examine the contribution of these additional variables across studies. Specifically, it is expected that self-efficacy will have a significant and unique effect on physical activity intention and behavior. Further, it is expected that self-efficacy will exhibit discriminant validity from PBC as Terry and O'Leary (1995) have found.

The inclusion of past behavior as a predictor of all of the TPB variables will help to unravel the unbiased effects of the attitude, subjective norm, PBC and self-efficacy on intention and intention on behavior. It is expected that past behavior will attenuate the attitude-intention and intention-behavior relationships as shown in individual studies (e.g. Bagozzi & Kimmell, 1995; Yordy & Lent, 1993).

Finally, the present study will examine the role of three moderating variables in the meta-analytic cumulation of the TRA/TPB studies on physical activity behavior; strength of the attitude-intention relationship, age and time period of past behavior assessment. In particular, it is expected that, according to Sheeran et al.'s (1999) findings, that studies that report strong average attitude-intention relationships will also exhibit strong intention-behavior correlations. Further, according to Sheeran and Orbell (1998), it is anticipated that age will moderate the intention-behavior relationship. It is expected that studies that have measured past behavior in close proximity to the TPB variables will have stronger past behavior-future behavior relationships because the assessment is likely to be more accurate due to memory salience.

Method

Literature search

An electronic literature search was conducted using the ATLANTES (1980-1996), HERACLES (1975-1997), MEDLINE EXPRESS (1980-2001), psychINFO (1977-2001), SPORT Discus (1975-2001) and Web of Science Social Science Citation Index (1980-2001) databases. Key words used for the search included exercise, physical activity, theory of planned behavior, theory of reasoned action, attitudes, intentions and past behavior. A manual search was conducted on pertinent journals, reference lists and conference proceedings available and we also performed manual searches of the abstracting journals Dissertation Abstracts International and

Psychological Abstracts. In addition, attempts were made to locate "fugitive literature" (Rosenthal, 1995, p. 185) by contacting authors to request missing correlations and unpublished data sets. Criteria for inclusion were studies that defined the target behavior as physical activity, either as leisure time physical activity or more formal forms such as sports training or exercise, and reporting at least one correlation between constructs derived from the TRA or TPB.

An initial search identified 90 potentially relevant articles that matched the search criteria. Some studies were rejected because they did not report the necessary correlations between the TRA/TPB variables or were qualitative in nature. Some studies scheduled for rejection were later re-instated when the missing correlations were acquired by contacting the author directly. Eighteen studies were rejected on the basis of the selection process leaving a total of 72 studies to be included in the final analysis. Since some studies included multiple data sets, the total possible sample size was 79. Further, the search yielded 12 studies that included measures of self-efficacy and 25 studies that included measures of frequency of past behavior within the TRA/TPB framework.

Meta-analytic strategy

The measure of effect size adopted for evaluation in the present study was the average correlation coefficient across the studies corrected for statistical artefacts. The meta-analytic strategy reported by Hunter & Schmidt (1990)[2] was used to correct the intercorrelations between the TRA/TPB variables and past behavior for sampling and measurement error.

Assessment of construct validity

The corrected correlation coefficients were used as input for a path analysis model using the EQS structural equation modelling programme (Bentler, 1989) to test the construct and predictive validity of the relationships between the TRA and TPB variables and to test the attenuation

effects of past behavior in the model. The models were evaluated using multiple criteria for goodness-of-fit: The goodness of fit index (GFI), the comparative fit index (CFI) and the normed fit index (NNFI), all of which should be greater than .95 for adequate fit of the model with the input matrix (Hu and Bentler, 1999). In addition, the 'badness of fit index', the standardised root mean squared residual (SRMSR), was also used to evaluate the model. SRMSR values of less than .08 are proposed to be indicative of an acceptable model (Hu and Bentler, 1995).

Evaluation of moderator variables

The evaluation of moderator variables was conducted by dividing the studies into groups according to the moderator under scrutiny and recalculating the average reweighted correlations, standard deviations, standard errors, confidence intervals and credibility intervals using the meta-analytic strategy outlined previously. The attitude-intention relationships strength and age moderator variables were coded according to criteria set out in other studies. The moderator was considered to have a significant effect if the average corrected correlation coefficients from the moderator groups were significantly different. Moderation was further supported if (a) the credibility intervals of the moderated analysis were narrower than those reported in the overall meta-analysis and (b) a small or zero overlap of the confidence intervals of the moderated groups correlations. Hunter and Schmidt (1990) point out that "to the extent that these confidence intervals do not overlap, we have sharp confirmation of the predicted moderator variable" (p. 438).

To evaluate the moderating effect of attitude-intention strength, the criteria adopted by Sheeran et al. (1999) were used. Studies with a significant individual sample-reweighted attitude-intention relationship of .40 or greater were considered to have a 'strong' attitude-intention relationship and therefore base their intentions predominantly on their attitudes. Due to the

dichotomous nature of the evaluation, the consideration of the subjective norm-intention relationship was not accounted for. However, in the evaluation of this moderator, the difference in the strength of the subjective norms-intention relationship between the groups was used as an additional check on the efficacy of the coding system. It was expected that the high attitude-intention strength group would have a low subjective norm-intention correlation and vice-versa.

The age moderator was classified according to Sheeran and Orbell's (1998) criteria. The sample was divided into groups comprised of adolescent and college/University samples and older samples. This was done on the basis of reported mean age of the sample with consideration of the standard deviation and range statistics. If the average age of a sample fell within the adolescent or college/University age bracket (age less than 25 years) but the range was particularly high or the standard deviation in excess of 5 years, suggesting a large number of participants were above this age range, then the study was excluded. Similarly, if no age statistics were provided, the study was excluded from the moderation analysis. To ensure the classification system was implemented correctly, three raters were employed to code the studies according to the criteria outlined above and all agreed perfectly as to the classification of the studies into 'adolescent' and 'older' samples ($r = 1.00$).

Finally, the moderating variable of time frame of past behavior measure coded as 'proximal' or 'distal'. Proximal studies were those that asked respondents to report the frequency of their past physical activity behavior in the last 4 weeks while distal studies were those that asked respondents about their past physical activity behavior over more than 1 month. Some studies did not specify a time frame and opted for the 'average' or 'typical' frequency of past behavior. These studies were excluded from the analysis.

A summary table of the studies included in the meta-analysis is provided in Table 1. The table shows the study characteristics and the three moderator variable groups; attitude-intention strength, age and time frame of past behavior measure.

Results

Corrected correlations

Average correlations corrected for sampling and measurement error for the TRA/TPB variables and the additional variables of self-efficacy and past behavior are presented in Table 2. Of the theoretically derived relationships, the correlation matrix followed an expected pattern with the strongest association being between attitude and intention, followed by the intention-behavior, PBC-intention and the subjective norm-intention relationships. Interestingly, strong corrected correlations were exhibited between the control and attitude constructs. These variables are hypothesised to co-vary in the TPB, but a strong association may be indicative of possible issues of discriminant validity (multicollinearity) or a possible causal relationship as indicated in some tests of the TPB (Courneya, 1995; Hagger, 1998). The present analysis demonstrated moderate-to-strong, positive corrected average correlations between self-efficacy and the TPB variables. Strong associations were also observed between the TRA/TPB variables and past behavior, the subjective norms-past behavior relationship excepted. An examination of the 95% confidence interval for this correlation revealed that it included the value of zero. Therefore, the hypothesis of a non-zero value for this association in the present sample of studies had to be rejected. Only three studies reported correlations between self-efficacy and past behaviour and, while the average is reported, it must be noted that this does not represent a suitable sample size for such an analysis and is likely to be biased despite the correction for statistical artefacts (Hunter & Schmidt, 1990).

The credibility intervals for the average sampling and measurement error corrected correlations from this set of studies included the value of zero or one for five of the correlations, indicating that there is a great deal of variation in the correlations across the studies. This is corroborated by the percentage error variance accounted for by the statistical artefacts corrected for in this meta-analysis. None of the relationships exceeded the Hunter and Schmidt (1990) 75% rule. This is indicative of heterogeneity in the distribution of the correlations across the studies and suggestive of the presence of moderating variables.

Path analysis models

Path analysis models were used to evaluate the study hypotheses relating to the construct and predictive validity of the TRA, TPB and augmentation of the model including self-efficacy and past behavior[3]. A systematic approach to the modelling process was employed to address each study hypothesis in turn. The correlation matrix of the corrected correlations from the meta-analysis was used as input to the EQS structural equation modelling program. The models were assessed using a maximum likelihood estimation method with standard deviations of the correlations fixed to 1.00 as recommended by Bentler (1989). The results of the model tests are shown in Table 3.

Firstly, the construct validity of Ajzen and Fishbein's (1980) TRA was assessed. This model exhibited good fit with the input correlation matrix from the meta-analysis according to the multiple criteria adopted (Table 3). As expected, intentions significantly predicted behavior ($\beta = .51$, $p < .01$), attitudes were the strongest significant predictor of intention ($\beta = .56$, $p < .01$) while subjective norms had a small but significant influence on intentions ($\beta = .12$, $p < .01$). In this multivariate test of the TRA relationships, attitude accounted for much of the social influences on

intention. Overall, the TRA model constructs explained 37.27% of the variance in intentions and 26.04% of the variance in behavior.

The second step in the analysis involved testing Ajzen's (1985) TPB. The estimated model was similar to the TRA, the only difference being that the input matrix contained correlations with the PBC variable and the model specified a free path between PBC and intention. Estimation of this model resulted in a significant increase in the goodness of fit χ^2 and a lowering of the fit indexes indicating a compromise in the adequacy of the model to account for the corrected correlation matrix (Table 3). The model demonstrated that attitude ($\beta = .40$, $p < .01$) and PBC ($\beta = .33$, $p < .01$) were the best predictors of intentions. In order to test whether the inclusion of PBC significantly attenuated the path coefficients in the model, 95% confidence intervals ($CI_{0.95}$) were calculated for the standardized path coefficients for the models in steps 1 and 2. Attenuation is supported if the higher bound of the $CI_{0.95}$ for the lower coefficient does not overlap with the lower bound of the $CI_{0.95}$ for the higher coefficient. There was no change in the magnitude of the intention-behavior relationship, but the inclusion of the PBC significantly attenuated the attitude-intention relationship. As hypothesised, this model accounted for more variance in intention than the TRA (44.50%).

A third step in the analysis was to test the second version of the TPB in which PBC contributed directly to the explanation of behavior (Ajzen & Madden, 1986). To this end, the model estimated in step 2 was modified by releasing a free parameter between PBC and behavior. This model indicated a significant improvement in model fit as indicated by a significant reduction in the goodness of fit χ^2 and the marginal increase in the fit indices (Table 3). The contribution of PBC to behavior was significant ($\beta = .15$, $p < .01$). This version of the TPB

accounted for slightly more variance in behavior (27.41%) compared with the first version in step 2.

A fourth step was to include the influence of self-efficacy in the model. It was hypothesised that self-efficacy would influence both intentions and behavior as shown in other research (e.g. Dzewaltowski et al., 1990). In order to test this hypothesis from the meta-analytic data, the corrected correlations for self-efficacy from the meta-analysis were included in the input matrix of the path analysis and structural paths freed between self-efficacy and intention and between self-efficacy and behavior. The resulting model fit the data well (Table 3) and indicated that self-efficacy was a significant predictor of physical activity intention ($\beta = .28$, $p < .01$) and behavior ($\beta = .15$, $p < .01$). Examination of the $CI_{0.95}$ for the coefficients between step 3 and step 4 indicated that the attitude-intention relationship was significantly attenuated as a result of the inclusion of self-efficacy. This model accounted for 50.30% of the variance in intention and 29.10% of the variance in behavior.

In the fifth and final step, the input matrix included correlations with past behavior and the estimated model introduced free parameters between past behavior and all of the TPB and additional variables. This model also demonstrated good fit with the data according to the multiple criteria adopted for this study, although there was a significant increase in the χ^2 value and a slight lowering of the fit indices (Table 3). As hypothesised, past behavior was a significant predictor of behavior ($\beta = .55$, $p < .01$), intention ($\beta = .37$, $p < .01$), attitude ($\beta = .39$, $p < .01$), SN ($\beta = .05$, $p < .01$), PBC ($\beta = .23$, $p < .01$) and self-efficacy ($\beta = .58$, $p < .01$). Most pervasive, though, were the attenuation effects of past behavior in the model. According to $CI_{0.95}$ statistics, the inclusion of past behavior in the model significantly attenuated the intention-behavior, attitude-intention, self-efficacy-intention and self-efficacy-behavior relationships as

hypothesized. The model constructs accounted for the greatest amount of variance in intentions (86.60%) and behavior (48.16%) compared with the other models tested. This model is represented schematically in Fig. 1.

Assessment of moderator variables

The evaluation of moderator variables was performed by conducting separate meta-analyses on the moderator subgroups indicated in Table 1. Results of the moderation analyses for the attitude-intention strength, age and time frame of past behavioral measurement moderators are provided in Table 4. Turning first to the attitude-intention relationship strength moderator, the average, corrected correlation for the intention-behaviour relationship in the strong attitude-intention relationship group (r_c = .50) was significantly lower than the correlation for the weak attitude-intention group (r_c = .58, z = 5.51, p < .01). Not surprisingly the average attitude-intention correlation was also significantly higher in the strong attitude-intention group.

The examination of age as a moderator of the TPB relationships indicated that older samples had significantly stronger relationships between intentions and behavior (r_c = .57) than younger samples (r_c = .48, z = 8.98, p < .01). This provides some evidence that the older samples may be more likely to translate their intentions to participate in physical activity into actual behavior. Finally, there were no significant differences in the corrected correlations between past-future behavior for the time frame of past behavior moderator groups.

A caveat to these results is that the confidence and credibility intervals of all the effect sizes in the moderation analysis exhibited substantial overlap and the percentage variance accounted for by statistical artefacts (sampling and measurement error) indicated that the moderator groups were not homogenous. This means that there may well be other moderator variables that explain the residual variance in the effect sizes of each group. Although the statistical artefacts accounted

for the majority of the error variance in the low attitude-intention strength group (64.26%), it did not surpass the critical 75% value proposed by Hunter and Schmidt (1990) for a homogenous group of studies. This suggests that the criteria for classifying the groups did not produce the homogenous groups as expected. Therefore, even though these results are suggestive of a moderating effect, they must be treated with caution as a significant difference in the average correlations do not alone confirm moderation (Hunter and Schmidt, 1990).

Discussion

The main focus of the present study was to provide a meta-analytic cumulation of the studies that have adopted the TRA/TPB as a framework for explaining physical activity intentions and behavior. The present study aimed to extend the findings of Hausenblas et al. (1997) by providing path analytic models of the theoretical relationships among the TRA/TPB variables. This was intended to provide a test of the effectiveness of each model to explain physical activity behavior. The present study also made a unique contribution to previous research by examining the role that the external variables of self-efficacy and past behavior have in the TPB and evaluating the influence of three moderating variables, attitude-intention strength, age and time frame of past behavior measurement.

An examination of the average correlations corrected for sampling and measurement error in the present study corroborates the effect sizes reported by Hausenblas et al. (1997). Of the hypothesised TRA/TPB relationships, medium to large effect sizes were found for the intention-behavior, attitude-intention and PBC-intention relationships. A smaller effect was shown for the subjective norm-intention relationship. Substantial non-zero average corrected correlations were exhibited between all the TRA/TPB variables with the notable exceptions of the relationships of subjective norm with behavior, PBC and past behavior and the past behavior-PBC relationship. It

was expected that many of these significant zero-order corrected correlations would be mediated in multivariate tests of the TRA/TPB using path analysis.

A path analysis using the average corrected correlations derived from the meta-analysis supported the TRA. Intention was the only predictor of behavior and completely mediated the influence of attitudes and subjective norms on behavior. Intentions were predominantly a function of attitudes with a small contribution from subjective norms. According to narrative reviews, the majority of studies in using the TRA/TPB in physical activity behavioral research have shown that attitudes have the most pervasive influence on intentions and also confirm the complete mediation of attitudes on behavior by intention (Godin, 1993; Blue, 1995). Further, the finding that subjective norm had a peripheral influence on intention corroborates the findings of Hausenblas et al. (1997) who noted that "attitude was over two times more useful as a predictor of intention than subjective norm" (p. 43). Testing the version of the TPB with only an indirect PBC-behavior path showed that the PBC variable had a significant influence on intention. This model exhibited better fit with the input corrected correlation matrix and accounted for more variance in intention, but not behavior, than the TRA. Such a finding supports the conclusions put forward by Hausenblas et al. (1997) that the TPB is superior to the TRA, a notion that is also corroborated by individual research articles comparing the theories in the physical activity domain (Dzewaltowski et al., 1990; Kimiecik, 1992; Yordy & Lent, 1993). These results also confirm the conclusion by other reviewers that the contribution of PBC to intentions is as substantial as that of attitude (Blue, 1995; Hausenblas et al., 1997). However, the present results show across a number of studies in a physical activity context, that the influence of attitude on intention is significantly attenuated by the inclusion of PBC. Such attenuation has been observed in some single empirical studies in a physical activity context (Ajzen & Driver, 1992; Godin et

al., 1989; Kimiecik, 1992) but not in others (Courneya & Friedenreich, 1997, 1999; Courneya et al., 2000; Kerner & Grossman, 1998). This highlights the importance of a multivariate approach in a cumulative synthesis of research to show the consistency of such attenuation effects once study bias has been removed. These findings suggest that attitudes may have some aspects that are directly related to PBC. A possible reason for this is that the beliefs that underpin attitudes and PBC may exhibit some conceptual overlap which is reflected in participants responses to measures of these constructs (Trafimow & Duran, 1998).

Testing the version of the TPB that included a direct PBC-behavior path revealed a significant direct effect of PBC on behavior. This model also had superior fit with the input correlation matrix and explained more variance in behavior. It seems that the version of the TPB in which PBC has dual effects on behavior, direct and indirect via the mediation of intention, is valid for this sample of studies in a physical activity context (Ajzen & Madden, 1986). It follows that a person's intention to participate in physical activity is a function of their attitudinal evaluation of their future physical activity behavior followed by the degree of subjective control they have over their ability to engage in physical activity. Further, these findings indicate that some aspects of control, reportedly those related the barriers and external constraints over the behaviour (Terry & O'Leary, 1995), are responsible for the enactment of behavior directly. Such influences transcend the purely cognitive influences of PBC on intention, in which case, PBC acts as a 'proxy' measure of actual control (Ajzen, 1985, 1991). Importantly, this cumulative synthesis does not make the distinction, as others have (Armitage & Conner, 1999b), between internal and external aspects of perceived control. This is because this distinction is relatively recent and most studies tend to confound the two aspects of control by including items measuring the internal and external aspects of control in a single scale. This has partly been addressed in the

present study by examining the influence of self-efficacy in the TRA/TPB. The self-efficacy variable makes the internal-external distinction in the present analysis possible, in part, because self-efficacy is expected to account for the effects that PBC has on intentions and behavior that are due to internal aspects of control.

The significant influence of self-efficacy on intentions supports the majority of findings in individual physical activity research articles that have augmented the TPB to include self-efficacy (e.g. Courneya & McAuley, 1994a; Dzewaltowski et al., 1990; Estabrooks & Carron, 1998; Hagger, Chatzisarantis & Biddle, 2001; Terry & O'Leary, 1995; Van Ryn, Lytle & Kirscht, 1996). In addition, the fact that the inclusion of self-efficacy has the effect of attenuating the influence of PBC on intentions, suggests that PBC does indeed have some features that are largely due to internal aspects of control. This additional variance may be an artefact of measurement overlap and more precise measures of PBC and self-efficacy that focus clearly on the internal and external distinction may eliminate this attenuation effect. These results highlight the importance of both aspects of control to the explanation of physical activity intentions.

These results suggest that interventions to promote increased physical activity behavior in a population should focus on the promotion of a positive attitude as well as on fostering positive control over physical activity situations, particularly internal perceptions of control or self-efficacy. Indeed, research has suggested that attitude and PBC may interact or influence each other (Courneya, 1995). This indicates that encouraging people to participate in a physical activity at which they feel competent may promote perceived control over that behavior as suggested by Skinner (1995). This may, in turn, be considered when a person evaluates their attitudes towards performing physical activity in the future.

The attenuation effects of past behavior demonstrated in individual studies with the TRA/TPB (e.g. Godin et al., 1993; Hagger, Chatzisarantis, Biddle & Orbell, 2001; Norman & Smith, 1995; Yordy & Lent, 1993) is corroborated by the inclusion of past behavior as an additional variable in present path analysis. When the average corrected correlations of the TPB constructs with past behavior were included in the input matrix for the path analysis of the TPB, the intention-behavior, attitude-intention, self-efficacy-intention and self-efficacy-behavior relationships were significantly attenuated. This suggests that the effects of intentions on behavior and attitude on intentions observed in studies that do not control for past behavior are spuriously high.

Despite this attenuation, attitudes remain a pervasive influence on physical activity intentions even when the effects of past behavior are partialled out, supporting the findings of Hagger, Chatzisarantis, Orbell and Biddle (2001). This indicates that the immediate decision-making cognitions prior to forming intentions to participate in physical activity are important as is an established pattern of physical activity behavior in the past. It seems that while past behavior has a significant direct influence on intention, attitude, PBC and self-efficacy, these cognitions are also necessary to translate past decisions about behavioral involvement into action. This is consistent with the notion that involvement in volitional behaviors like regular physical activity involves both conscious and automatic influences (Bargh & Chartrand, 1999). Indeed, there may be elements to people's attitudes and control that are automatically activated upon presentation of stimuli. These help people to arrive at their decisions more quickly. However, the immediate weighing up of the positive and negative aspects of the current attributes of the upcoming physical activity is also instrumental in determining physical activity behavior. Practically, then it is important for those involved with organising exercise sessions and

promoting regular physical activity, that the immediate environment is one in which the person is comfortable and in which they feel confident. This will help enhance positive attitudes and perceived control toward the physical activity context and promote engagement in the activity. Since past behavior also has an effect on continued participation, it is also important for exercise promoters to be aware of these automatic processes and to use them in motivating participation in physical activity.

Assessing the effect of attitude-intention relationship strength as a moderator of the corrected correlations demonstrated, not surprisingly, that the high group had a stronger attitude-intention relationship than the low group. However, the present analysis did not support the hypothesis that studies with strong attitude-intention relationships exhibited a stronger intention-behavior relationship as found by Sheeran and colleagues (1999). Rather, the results suggest that a strong attitude-intention relationship is linked to lower intention-behavior relations. It may be that the moderating effect of the attitude-intention relationship may hold for certain behaviors and under particular circumstances. Since the present meta-analysis incorporates studies from many different contexts and with numerous different actions this effect may be confounded, as indicated by the lack of homogeneity in the moderator groups.

An interesting finding in the present study is the moderation of the intention-behavior relationship by age. This suggested that older samples were more likely to implement their intentions than younger samples. This effect has been found in meta-analyses of the TPB with other behaviors (Sheeran & Orbell, 1998). These authors suggest that the instability of intentions among younger samples' intentions or their relative inexperience with the target behavior may have resulted in this effect. For physical activity behavior, it is possible that both explanations are valid. Adolescents and children generally exhibit different operationalizations of the TPB than

adults (Atsalakis & Sleap, 1996; Craig et al., 1996) and may have more difficulties in enacting their intentions due to external compromises on control such a parental influence (Armstrong & McManus, 1994). Further, younger samples are not likely to have encountered the physical activity decision-making process as frequently as older samples and therefore they may form intentions that are more inconsistent with their behavior. For these reasons, intentions are less likely to reflect behavior and intention-behavior correlations may be lower for such samples.

It was hypothesized that individuals who have performed physical activity more recently in the past would possess more elaborate decision-making schema in their memory. However, present results indicate that the a priori hypothesis that the more recent and distal effects of past behavior would have differential effects on future behavior should be rejected as time frame of past behavior was not found to moderate the relationship between past physical activity behavior and future behavior. This is contrary to the findings of Bagozzi and Kimmel (1995) who demonstrated that recency of past behavior had a more pervasive effect on intentions than frequency of past behavior. There are two possible reasons for this incongruence. Firstly, the classification of the studies into 'proximal' and 'distal' groups to define the moderator variable in the present analysis may not have been sensitive enough to make a meaningful distinction. Further, the relative dearth of studies in the moderator groups may have affected the power of the analysis as indicated by the large overlap in the confidence intervals, which highlights the inability of moderator to define homogenous groups.

Conclusion

The present analysis suggests that after accounting for statistical artefacts, people's attitudes and, to a lesser extent, perceived behavioral control and self-efficacy seem to be the key influences in forming intentions to participate in physical activity. Practically, this suggests that

interventions based on the enhancement of attitudes toward physical activity may lead to a concomitant increase in physical activity behavior. This is supported by other researchers who suggest that intentions based on attitudes have the strongest effect on behavior (Sheeran et al., 1999). Further studies have demonstrated that attitude-based messages are very effective in social-cognitive interventions designed to enhance behavior (Armitage & Conner, 1999a). The influence of PBC is not as pervasive as reported by other reviews (Blue, 1995), but it is an important predictor of physical activity behavior nevertheless. The addition of self-efficacy indicates that internal aspects of control have an unique effect on physical activity intention and behavior. In summary, the substantial independent contributions made by PBC and self-efficacy to the explanation of intention and behavior suggests that the TPB augmented by self-efficacy seems to provide the comprehensive account of the social-cognitive influences on physical activity motivation and participation.

In addition, the present study indicates that past behavior attenuates relationships among the TPB constructs in a physical activity context, but does not completely remove the effects of attitudes on intentions, of intentions on behavior or of PBC on behavior. In some individual studies the effects of past behavior have been seen to negate much of the influence of attitudes, subjective norms and PBC on intentions and intentions on behavior. This may precipitate concern that cognitions like attitudes and subjective norms may not have utility in motivating behavior in those who have elaborate past experience. However, the most complete demonstration of these effects have been observed for behaviors that are less subject to volitional control (e.g. smoking) than physical activity (Norman et al., 1999). Further, there has been no systematic attempt to control for the statistical artefacts across studies. The present study has controlled for such artefacts and demonstrated that while past behavioral effects did attenuate the TPB relationships,

current cognitions, particularly control and self-efficacy, are the most important predictors of physical activity behavior. Future studies in the physical activity domain adopting the TPB as a framework would do well to account for past physical activity behavior in their analyses in order to examine the unique influences of conscious social cognitions on intentions and behavior.

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Note.

[1]Since researchers have acknowledged that the subjective norms construct only taps a limited number of a multitude of possible social influences on physical activity intentions, studies have recently examined the influence of alternative approaches to social factors in the TPB. Variables such as social support (Courneya & McAuley, 1995; Courneya et al., 2000) and role beliefs (Bozionelos & Bennett, 1999) have been included in the TPB and have been shown to explain unique variance in physical activity intentions. However, the limited number of studies adopting these alternative subjective norms variables in a physical activity context precludes a meta-analytic cumulation of studies using social support and role beliefs at this stage.

[2]The Hunter and Schmidt approach is one of three prominent traditions in meta-analysis that have emerged since Glass' (1976) classic paper on research synthesis. The two alternative set of techniques that have received much attention are those put forward by Hedges and Olkin (1985) and Rosenthal and Rubin (1988). It is important to note that the Hunter and Schmidt (1990) methods have been criticised for producing anomalous results. For example, Johnson, Mullen and Salas (1995) report that the Hedges and Olkin (1985) and Rosenthal and Rubin (1998) approaches confirm that the likelihood of finding the same result due to chance in a sample of studies decreases as the number of studies included increases, while the Hunter and Schmidt (1990) technique does not. However, Schmidt and Hunter (1999) have shown that the differences found in Johnson and colleagues' (1995) analysis can be accounted for by the latter researchers' use of a formula for the standard error of the mean correlation that Hunter and Schmidt (1990) did not use. Further, Schmidt and Hunter (1999) claim that the use of a fixed-effects (FE) model is less accurate in computer simulations of population correlations than a random effects (RE) model. The FE model assumes no real variance in the population

correlations and is favoured by the Hedges and Olkin (1985) and Rosenthal and Rubin (1988) while the RE model assumes that the sampling error variance varies across studies and is used in the Hunter and Schmidt (1990) algorithms. Given that Osburn and Callender (1992) contend that it is improbable that the error variance across real sets of studies is likely to be zero, the use of a RE model to calculate the mean standard error of the average correlations is the most appropriate method to adopt.

[3]Carron, Hausenblas and Mack (1999) report that they did not perform a multivariate analysis in their meta-analysis (Hausenblas et al., 1997) because they did not have enough statistical power to justify the analysis. It was therefore important to conduct a power analysis with the present data to ensure sufficient effect sizes were available to warrant such an analysis. Assuming large effect sizes between the model variables and setting alpha at .05 and power at .80, it would be necessary to have 12 effect sizes (correlations) for a meaningful path analysis to be conducted (see Howell, 1992, p. 210). Table 2 shows that there were sufficient effect sizes available to conduct a path analysis with the present data set for all of the TRA/TPB relationships.

Table 1. Study characteristics and grouping data for the three moderator variables.

Authors	N	Sample composition	A-I correlation	A-I strength[a]	Mean Age (years), SD & Range	Age category[b]	Time frame of past behavior measure	Proximity[c]
Ajzen & Driver (1991)	111	College students	-	-	20.1 (range: 17 to 40)	Younger	-	-
Ajzen & Driver (1992)	146	College students	.44	Strong	20.1 (range: 17 to 40)	Younger	-	-
Amato-Vealey (1992)	185	Post-myocardial infarction patients	.37	Weak	61.0 (range: 35 to 80)	Older	-	-
Autrey (1999)	101	Participants in exercise program at personal training centers	.52	Strong	Age range 18 to 71	Not classified	Past 3 months	Distal
Bagozzi & Kimmel (1995)	139	Undergraduate students	.64	Strong	-	-	-	-
Biddle, Goudas & Page (1994)	131	University employees	.55	Strong	-	-	-	-
Bozionelos & Bennett (1999)	114	Undergraduate students	.44	Strong	22.0 (SD=4.88)	Younger	Past 3 weeks	Proximal
Brenes, Strube & Storandt (1998)	105	Exercise class attendees	.13	Weak	68.29 (SD=6.63) (range: 53 to 84)	Older	Frequency in each decade of life	Not classified
Brickell (2000)	208	Members and staff of health clubs	.28	Weak	23.94 (3.92) (range: 18 to 32)	Younger	-	-

Table 1. Continued

Authors	N	Sample composition	A-I correlation	A-I strength[a]	Mean Age (years), SD & Range	Age category[b]	Time frame of past behavior measure	Proximity[c]
Chatzisaratis & Biddle (1998)	102	Company employees and manual workers	.89	Strong	39.96 (SD=10.66)	Older	-	-
Chatzisarantis & Biddle (in preparation)	70	School children	.61	Strong	-	-	-	-
Chatzisaratis, Biddle & Meek (1997)	100	School children	-	-	13.5 (range: 11 to 15)	Younger	-	-
Chow & Lindner (2001)	923	School children	.50	Strong	Age range 12 to 15	Younger	2 weeks	Proximal
Courneya (1995)	288	Randomly selected members of social service center	.89	Strong	71.5	Older	-	-
Courneya, Bobick & Schinke (1999) (sample 1)	300	Female undergraduates	.58	Strong	19.56 (SD=3.82)	Younger	-	-
Courneya, Bobick & Schinke (1999) (sample 2)	300	Aerobics class participants	.46	Strong	25.00 (SD=7.98)	Older	-	-
Courneya & Friedenreich (1997)	110	Colorectal cancer survivors	.54	Strong	60.9 (SD=10.8) (range: 26 to 77)	Older	Typical week	Not classified
Courneya & Friedenreich (1999)	164	Breast cancer patients	.41	Strong	53.0 (SD=9.4)	Older	-	-

Table 1. Continued

Authors	N	Sample composition	A-I correlation	A-I strength[a]	Mean Age (years), SD & Range	Age category[b]	Time frame of past behavior measure	Proximity[c]
Courneya, Friedenreich, Arthur & Bobick (1999)	66	Colorectal cancer patients	.46	Strong	60.8 (SD=11.5)	Older	Typical week	Not classified
Courneya & McAuley (1994a, 1994b)	170	Undergraduate students	.44	Strong	20.34 (SD=2.15)	Younger	Past 4 weeks	Proximal
Courneya & McAuley (1995)	62	Volunteers from University aerobic program	.29	Weak	38.79 (SD=14.73)	Older	-	-
Courneya, Nigg & Estabrooks (1998)	131	Members of social, recreational and educational facility	.49	Strong	71.5 (SD=6.0)	Older	-	-
Courneya, Plotnikoff, Hotz & Birkett (2000)	1557	Randomly selected residents from Canadian telephone exchange	.41	Strong	38.97 (SD=11.39)	Older	-	-
Craig, Goldberg & Dietz (1996) (sample 1 – grade 5 students)	154	Elementary school children	.43	Strong	10.8 (SD=.05)	Young	-	-
Craig, Goldberg & Dietz (1996) (sample 2 – grade 8 students)	151	Elementary school children	.47	Strong	13.9 (SD=.05)	Young	-	-

Table 1. Continued

Authors	N	Sample composition	A-I correlation	A-I strength[a]	Mean Age (years), SD & Range	Age category[b]	Time frame of past behavior measure	Proximity[c]
Daltroy & Godin (1989)	132	Cardiac patients on medically supervised exercise programs	-	-	53.5 (SD=7.6)	Older	-	-
Dzewaltowski (1989)	328	Undergraduate students	.48	Strong	-	-	-	-
Dzewaltowski, Noble & Shaw (1990)	254	Undergraduate students	.83	Strong	-	-	Past 1 week	Proximal
Estabrooks & Carron (1998)	157	Exercise class attendees	.07	Weak	68.0 (SD=7.87)	Older	-	-
Godin, Colantonio, Davis, Shepherd & Simard (1986)	62	Male adults with lower limb disability	.24	Weak	30.70	Older	Frequency per month	Not classified
Godin & Gionet (1991)	444	Employees of electric power commission	.38	Weak	36.3 (SD=8.8)	Older	Past 6 months	Distal
Godin & Shepherd (1986a)	90	University employees	.54	Strong	Stratified into three age groups (ranges: 45 to 54, 55 to 64, 65 to 74)	Older	Past 4 months	Distal
Godin & Shepherd (1986b)	698	High school students	.59	Strong	13.0 (SD=1.0)	Younger	-	-

Table 1. Continued

Authors	N	Sample composition	A-I correlation	A-I strength[a]	Mean Age (years), SD & Range	Age category[b]	Time frame of past behavior measure	Proximity[c]
Godin, Valois, Jobin & Ross (1991)	161	Coronary Heart Disease patients	.42	Strong	52.8 (SD=8.1)	Older	Past 3 months	Distal
Godin, Valois & Lepage (1993) (study 1)	347	Randomly selected persons from telephone directory	.46	Strong	Age range 18 to 40	Not classified	Past 3 months	Distal
Godin, Valois & Lepage (1993) (study 2)	136	Postnatal women	.54	Strong	-	-	Past 3 months	Distal
Godin, Valois, Shepherd & Desharnais (1987)	129	University employees	.62	Strong	Stratified into three age groups (ranges: less than 30, 30 to 44, 45 and above)	Not classified	Past 4 months	Distal
Godin, Vezina & Leclerc (1989)	98	Pregnant women attending antenatal classes	.50	Strong	28.6 (SD=3.9)	Older	Past 12 months	Distal
Greenockle, Lee & Lomax (1990)	136	School children	-	-	14.7 (SD=.96)	Younger	-	-
Gyurcsik & Brawley (2000)	82	University students	-	-	23.7 (SD=5.8)	Younger	-	-

Table 1. Continued

Authors	N	Sample composition	A-I correlation	A-I strength[a]	Mean Age (years), SD & Range	Age category[b]	Time frame of past behavior measure	Proximity[c]
Hagger (1998)	181	School children	.73	Strong	Age range 12 to 14	Younger	-	-
Hagger, Cale & Ashford (1997)	45	School children	.24	Weak	Age range 9 to 11	Younger	-	-
Hagger, Chatzisarantis and Biddle (in press)	1088	School children	.51	Strong	Age range 12 to 14	Younger	-	-
Hagger, Chatzisarantis & Biddle (2001)	1152	School children	.93	Strong	Age range 12 to 14	Younger	-	-
Hagger Chatzisarantis, Biddle & Orbell (2001)	386	School children	.74	Strong	Age range 12 to 14	Younger	-	-
Jackson, Smith & Conner (1999)	168	Employees of a Higher Education college	.50	Strong	42.9 (SD=9.36)	Older	-	-
Kerner & Grossman (1998)	73	Members of commercial fitness center	.38	Weak	44.7 (SD=9.9) (range: 20.3 to 67.1)	Older	-	-
Kimiecik (1992)	332	Corporate employees	.77	Strong	39.1 (range: 18 to 67)	-	-	-
Legg (1986)	99	College students	.33	Weak	Age range 18 to 54	Not classified	-	-

Table 1. Continued

Authors	N	Sample composition	A-I correlation	A-I strength[a]	Mean Age (years), SD & Range	Age category[b]	Time frame of past behavior measure	Proximity[c]
Lowe, Eves & Carroll (in press)	369	Patients from four General Practitioner patient lists	.58	Strong	Males (N=149): 46.4 (SD=15.5); Females (N=220): 44.2 (SD=15.5)	Older	-	-
Michels & Kugler (1998)	394	Random sample of persons aged 65 to 70 years from hospital registration list	.33	Weak	Age range 65 to 70	Older	Past 1 week	Proximal
Miller, Wikoff, McMahon, Garrett & Ringel (1985)	141	Patients from cardiac rehabilitation centres	-	-	Age range 30 to 70	Older	-	-
Mummery, Spence & Hudec (2000) (sample 1 – grade 3 students)	163	School pupils randomly selected from Canadian schools	.40	Strong	8.2 (SD=0.5)	Younger	-	-
Mummery, Spence & Hudec (2000) (sample 2 – grade 5 students)	139	School pupils randomly selected from Canadian schools	.69	Strong	10.3 (SD=0.7)	Younger	-	-

Table 1. Continued

Authors	N	Sample composition	A-I correlation	A-I strength[a]	Mean Age (years), SD & Range	Age category[b]	Time frame of past behavior measure	Proximity[c]
Mummery, Spence & Hudec (2000) (sample 3 – grade 8 students)	191	School pupils randomly selected from Canadian schools	.44	Strong	13.9 (SD=1.1)	Younger	-	-
Mummery, Spence & Hudec (2000) (sample 4 – grade 11 students)	184	School pupils randomly selected from Canadian schools	.60	Strong	16.4 (SD=0.9)	Younger	-	-
Norman, Conner & Bell (2000)	87	Undergraduates	.33	Weak	-	-	-	-
Norman & Smith (1995)	83	Sample identified by undergraduate psychology class	.42	Strong	29.89 (SD=9.27)	Older	Frequency per week	Proximal
Payne, Jones & Harris (2000)	241	Employees of a UK computer company	.33	Weak	Stratified into four age groups (ranges: 16 to 24, 25 to 34, 35 to 44, 45 to 54, 55 or over)	Not classified	-	-

Table 1. Continued

Authors	N	Sample composition	A-I correlation	A-I strength[a]	Mean Age (years), SD & Range	Age category[b]	Time frame of past behavior measure	Proximity[c]
Payne, Jones & Harris (2001)	331	Employees of a UK computer company	32	Weak	Stratified into four age groups (ranges: <19, 20 to 39, 40 to 59, ≥60)	Not classified	-	-
Pender & Pender (1986)	377	Community residents randomly selected	.18	Weak	38 (SD=12)	Older	-	-
Reynolds et al. (1990)	374	School children	-	-	15 (range: 14 to 16)	Younger	-	-
Riddle (1980)	237	Volunteers to research project	.73	Strong	>30 years	Older	-	-
Rosen (2000)	149	Undergraduate students	.45	Strong	-	-	Past 1 week	Proximal
Schmelling (1985)	135	University employees	.77	Strong	Age range 30 to 55	Older	-	-
Sheeran & Orbell (in press)	163	Undergraduate students	.61	Strong	-	-	Past 2 weeks	Proximal
Smith & Biddle (1999) (sample 1)	96	Members of private sector health club	.12	Weak	34.0 (SD=12.6)	Older	-	-
Smith & Biddle (1999) (sample 2)	155	Employees of rural district council in South-West England	.49	Strong	36.0 (SD=11.6)	Older	-	-

Table 1. Continued

Authors	N	Sample composition	A-I correlation	A-I strength[a]	Mean Age (years), SD & Range	Age category[b]	Time frame of past behavior measure	Proximity[c]
Terry & O'Leary (1995)	146	Undergraduate students	.65	Strong	20.29	Younger	Past 2 weeks	Proximal
Theodorakis (1992)	98	Young people attending swimming	.20	Weak	Age range 10 to 13	Younger	Past 1 month	Proximal
Theodorakis (1994)	395	Female attendees to fitness clubs	.39	Weak	29.27 (SD=8.75) (range 18 to 45)	Older	-	-
Theodorakis, Doganis, Bagiatis & Gouthas (1991)	56	Children volunteering to take part in study	.32	Weak	Age range 10 to 11	Younger	Past 3 years	Distal
Theodorakis, Goudas, Bagiatis & Doganis (1991)	105	Young people attending swimming	.30	Weak	Age range 9 to 12	Younger	Past 3 years	Distal
Trafimow & Trafimow (1998)	23	Patients diagnosed with lower back pain	.07	Weak	-	-	-	-
Valois, Desharnais & Godin (1991)	166	University employees	-	-	39.7 (SD=10.7)	Older	-	-
Van Ryn, Lytle & Kirscht (1996)	142	Telephone company employees	.43	Strong	42 (range: 26 to 61)	Older	-	-

Table 1. Continued

Authors	N	Sample composition	A-I correlation	A-I strength[a]	Mean Age (years), SD & Range	Age category[b]	Time frame of past behavior measure	Proximity[c]
Wankel, Mummery, Stephens & Craig (1994)	3629	Household-based, stratified, multistage cluster survey	.36	Weak	Stratified into four age groups (ranges: <19, 20 to 39, 40 to 59, ≥60)	Not classified	-	-
Warshaw & Davis (1985)	197	Undergraduate students	-	-	-	-	-	-
Yordy & Lent (1993)	284	Psychology undergraduates	.76	Strong	19.4 (SD=2.29)	Younger	Past 4 weeks	Proximal

Note. [a] Moderator group for attitude-intention strength

[b] Moderator group for age

[c] Moderator group for proximity of past behavior measure

Table 2. Results of the meta-analysis of the TRA/TPB and past behavior in an exercise context.

Relationship	k	N	r_c [a]	r_c [b]	Confidence Interval[†]		Credibility Interval[††]		SD	SE	Variance [c]
					Lower bound	Upper bound	Lower bound	Upper bound			
Intention-Behavior	60	10985	.42	.51	.45	.67	.17	.85	.21	.03	15.69
Attitude-Intention	70	20240	.48	.60	.55	.65	.26	.93	.20	.03	12.21
Sub. Norm-Intention	65	19579	.25	.32	.27	.37	.01	.63	.19	.03	13.33
PBC-Intention	49	16732	.44	.57	.51	.63	.25	.90	.19	.03	18.48
PBC-Behavior	35	7173	.31	.39	.33	.45	.12	.66	.17	.03	20.75
Attitude-Sub. Norm	49	13637	.27	.36	.29	.42	.01	.71	.21	.03	11.59
Attitude-PBC	39	11857	.39	.55	.46	.65	.08	1.02	.29	.05	8.51
Sub. Norm-PBC	39	11857	.25	.37	.28	.46	-.06	.80	.26	.04	10.01
Attitude-Behavior	44	8493	.30	.35	.30	.41	.11	.60	.15	.03	23.07
Sub. Norm-Behavior	42	8651	.15	.17	.23	.12	-.07	.43	.15	.03	22.74
Past beh. -Behavior	22	4110	.58	.64	.56	.72	.33	.95	.19	.04	7.55
Past beh. -Intention	25	4727	.48	.58	.51	.66	.31	.86	.17	.04	21.71
Past beh. -Attitude	22	4303	.33	.39	.33	.44	.20	.57	.11	.03	32.91
Past beh. -Sub. Norm	22	4303	.04	.05	-.08	.19	-.45	.56	.31	.07	6.88
Past beh. -PBC	18	3930	.18	.23	.08	.39	-.30	.76	.32	.08	6.96
Self-eff.-Behaviour	9	2402	.36	.40	.34	.46	.28	.52	.07	.03	39.27
Self-eff.-Intention	11	2841	.47	.55	.43	.66	.24	.86	.19	.06	9.77
Self-eff.-Attitude	9	2645	.40	.48	.34	.61	.15	.81	.20	.07	8.33
Self-eff.-Sub Norm	8	2475	.22	.26	.16	.37	.03	.49	.14	.05	17.48
Self-Eff.-PBC	7	2119	.31	.42	.31	.53	.23	.62	.11	.05	28.08
Self-Eff.-Past beh.	3	1353	.39	.45	.33	.57	.29	.61	.19	.06	18.28

Note. k = Number of Studies
N = Sample size
[a] Average re-weighted correlation corrected for sampling error only
[b] Average re-weighted correlation corrected for sampling error and measurement error

Note. [†] 95% Confidence Interval of average re-weighted correlation corrected for sampling error only
[††] 90% Credibility Interval of average re-weighted correlation corrected for sampling and measurement error
SD = Standard deviation of mean
SE = Standard error of mean
[c] Percentage of error variance accounted for by statistical artefacts

Table 3. Results of path analyses tests of the TRA, TPB, TPB augmented with self-efficacy and TPB with past behavior using meta-analytic derived correlations.

Step	χ^2	df	GFI	CFI	NNFI	SRMSR	$\Delta\chi^2$	I→B	A→I	SN→I	PBC→I	PBC→B	SE→I	SE→B	PB→B	PB→I	PB→A	PB→SN	PB→PBC	PB→SE
1	51.890	2	.998	.996	.987	.014	-	.510*	.557*	.119*	-	-	-		-	-	-	-	-	
2	246.654	3	.992	.986	.952	.028	194.764*	.510*	.399*	.054*	.331*	-	-		-	-	-	-	-	
3	15.574	2	.999	.999	.996	.006	231.080*	.426*	.399*	.054*	.331*	.147*	-		-	-	-	-	-	
4	16.480	3	1.000	.999	.995	.006	.906	.356*	.302*	.038*	.272*	.123*	.281*	.153*	-	-	-	-	-	
5	86.602	2	.998	.997	.972	.009	70.122*	.047*	.200*	.087*	.281*	.223*	.149*	.035*	.546*	.366*	.390*	.050*	.450*	.450*

Note.

Step 1. Theory of Reasoned Action
Step 2. Theory of Planned Behavior
Step 3. Theory of Planned Behavior augmented with direct PBC→ B path
Step 4. Theory of Planned Behavior augmented with PBC→ B, SE→ I and SE→ B paths
Step 5. Theory of Planned Behavior augmented to include control for Past Behavior
I = Intention
B = Behavior
A = Attitude
SN = Subjective Norms
PBC = Perceived Behavioral Control
SE = Self-Efficacy
PB = Past Behavior
* $p < .01$
** $p < .05$

Table 4. Summary of the results of the moderator analyses.

Moderator	Relationship	k	N	r_c[a]	r_c[b]	Confidence Interval[†]		Credibility Interval[††]		SD	SE	Variance[c]
						Lower bound	Upper bound	Lower bound	Upper bound			
A-I strength	I-B	17 (34)	2853 (6721)	.39 (.45)	.58 (.50)	.43 (.43)	.72 (.57)	.11 (.19)	1.04 (.81)	.29 (.19)	.07 (.03)	12.81 (11.31)
	Att-I	22 (48)	7272 (12968)	.33 (.57)	.45 (.68)	.41 (.63)	.49 (.73)	.35 (.39)	.55 (.96)	.06 (.17)	.02 (.03)	64.26 (12.54)
	SN-I	19 (45)	6945 (12502)	.22 (.27)	.29 (.34)	.22 (.27)	.35 (.40)	.09 (.01)	.48 (.69)	.12 (.21)	.03 (.03)	27.39 (10.35)
Age	I-B	21 (26)	4361 (4343)	.41 (.40)	.48 (.57)	.40 (.46)	.56 (.68)	.20 (.13)	.75 (1.01)	.17 (.27)	.04 (.06)	15.79 (14.37)
Time frame of PB	PB-B	12 (6)	2740 (867)	.57 (.61)	.64 (.65)	.52 (.56)	.75 (.73)	.32 (.50)	.96 (.80)	.19 (.09)	.06 (.04)	6.10 (27.14)

Note. Statistics for strong attitude-intention strength, older samples and distal time frame within parentheses, weak attitude-intention strength, younger samples and proximal time frame outside parentheses;
I = Intention
Att = Attitude
SN = Subjective Norm
B = Behavior
PB = Past behavior
k = Number of Studies
N = Sample size
[a] Average re-weighted correlation corrected for sampling error only
[b] Average re-weighted correlation corrected for sampling error and measurement error
[†] 95% Confidence Interval of average re-weighted correlation corrected for sampling error only
[††] 90% Credibility Interval of average re-weighted correlation corrected for sampling and measurement error
SD = Standard deviation of mean
SE = Standard error of mean

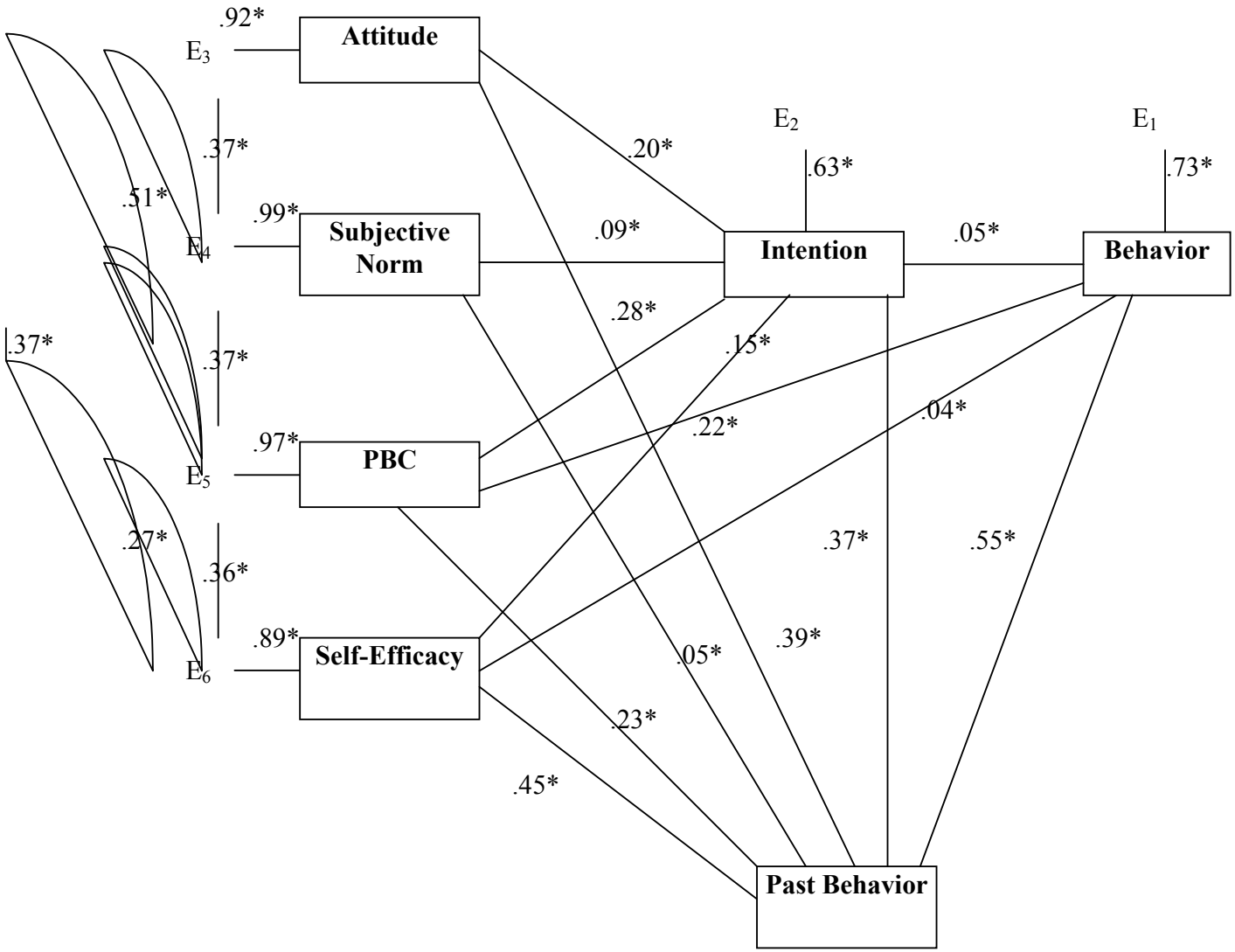
[c] Percentage of error variance accounted for by statistical artefacts

Figure Caption

Figure 1. Path analysis diagram showing structural relationships between the TPB variables, self-efficacy and past behavior from corrected correlations derived by meta-analysis.

Note. * $p<.01$

**$p < .05$


.92*
E3
Attitude
.37*
.51*
.99*
E4
Subjective Norm
.37*
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.97*
E5
PBC
.27*
.36*
.89*
E6
Self-Efficacy
.20*
E2
.63*
E1
.73*
.09*
Intention
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Behavior
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Past Behavior