Protocol for a Large-Scale Multi-Sample Registered Replication Study of the Theory of Planned Behavior

Title

Testing the Replicability of the Theory of Planned Behavior: A Large-Scale Multi-Sample Registered Replication Study

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Overview

Identifying the determinants of social behavior, and the specific processes by which the determinants relate to behavior, are important in the development of theory to predict social behavior. Predicting behavior also has utility for organizations and stakeholders interested in developing effective interventions and strategies to promote behavior change. The theory of planned behavior (Ajzen, 1991) is a prominent social psychological theory developed to predict social behavior. The theory derives its assumptions from theories of attitude and social cognition (Albarracín & Johnson, 2019; Eagly & Chaiken, 1993; Fishbein, 1967), and focuses on predicting intentional behavior from sets of beliefs about future behavioral engagement. The theory has been tested in over 2000 studies, and over 30 meta-analytic syntheses. Cumulative findings indicate its efficacy in accounting for variance in behaviors across multiple domains. However, considerable unresolved heterogeneity in effects has been observed, which could be attributable to methodological artifacts or genuine variability across contexts, behaviors, and populations. In addition, some theory predictions, particularly interactions among constructs, have not been tested and replicated consistently. The current project will conduct a large-scale replication of the theory in general population and student samples adopting an identical protocol and measures. The result of the study will be a series of data sets testing theory predictions analyzed by meta-analytic structural equation modeling.

Rationale

A central premise of the theory is that intentions are the most proximal predictor of behavior. Intention is a motivational construct that reflects individuals' readiness to pursue a target behavior. Intentions are a function of three sets of belief-based constructs that summarize individuals' personal, social, and control related judgments with respect to performing the target behavior. Attitudes are positive and negative evaluations of performing the behavior (based on beliefs whether or not the target behavior has utility, is affectively fulfilling, and consistent with values). Subjective

norms are individuals' perceived social pressure to engage in the target behavior, based on perceptions of significant others' approval or disapproval of their future participation in the target behavior. Perceived behavioral control, or perceived self-efficacy, is individuals' beliefs that they have the capacity to perform the behavior, based on beliefs about the perceived presence or absence of factors that can facilitate or impede performance of the behavior in question. Intentions are expected to completely mediate effects of attitudes, subjective norms, and perceived behavioral control on intentions. The effect of intention on behavior, however, is said to depend on actual control over performance of the behavior. When perceived behavioral control accurately reflects actual behavioral control (e.g., genuine facilitating factors and barriers or obstacles), it can serve as a proxy for actual control to predict the extent to which individuals are able to enact or follow through on their intentions. In this case, perceived behavioral control will moderate the intention-behavior relationship, such that individuals with high perceived control will be more effective in acting on their intentions than those who have low perceived control.

Attitude, subjective norm, and perceived behavioral control are assessed by means of reflective indicators, often referred to as direct measures. These direct measures are proposed to be predicted by corresponding sets of specific beliefs with respect to future behavioral engagement. An expectancy x value approach is invoked, such that the effect of a belief on its respective direct measure is a function of belief strength and its associated value. Measures of the belief-based constructs are therefore formative indicators and are often referred to as indirect measures of the theory's main predictors. Attitudes are a function of individuals' judgements that the behavior will lead to specific outcomes, behavioral beliefs, and the value attached to those outcomes, outcome evaluations. Subjective norms are proposed to be determined by individuals' judgments of specific salient referents' approval or disapproval of their participation in the behavior, normative beliefs, and the extent to which they value the referents' judgement, motivation to comply. Perceived behavioral control follows from individuals' judgments of the presence of facilitating and impeding factors with respect to performing the behavior, control beliefs, and the power of each of these factors. Each belief is multiplied by its respective value component when predicting the direct attitude, subjective norm, and perceived behavioral control measures. The probability and value components ensure that the relative importance of each belief to the target behavior is accounted for in the prediction. The multiplicative composites of the belief-value are expected to account for substantial variance in their respective direct measures.

Tests of the key predictions of the theory often adopt prospective correlational designs, with the intention, attitude, subjective norm, and perceived behavioral control constructs measured at an initial time point with follow-up measures of behavior (Ajzen, 1991; Conner & Sparks, 2015). Constructs are assessed using multi-item psychometric scales with close correspondence in the content of the measures (Ajzen, 2002). Behavior is measured using suitable means to observe behavior, or via self-report. Correspondence in measurement between the measure of the theory constructs and measures of intention and behavior are a pre-requisite for effective prediction (Ajzen, 1991). Measures of the constructs and behavior should correspond in terms of the target toward which the action is directed, the action to be performed, the context in which the action is to be performed, and the time frame in which the behavior will be performed in the future. Research testing the theory frequently adopt confirmatory analytic approaches such as path analysis and structural equation

modeling, which enables simultaneous tests of the predicted direct and indirect effects among the theory constructs (Bamberg, Ajzen, & Schmidt, 2003; Godin, Valois, Shephard, & Desharnais, 1987), and has also enable tests of alternative formulations of the models, such as the use of formative and reflective indicators (Hagger & Chatzisarantis, 2005; Heiny, Ajzen, Schmidt, & Leonhäuser, in press; Rhodes, Blanchard, & Matheson, 2006).

The TPB has been applied to predict a wide range of behaviors in multiple populations and contexts, and the empirical findings have been synthesized in numerous meta-analyses across multiple behaviors and contexts (Armitage & Conner, 2001b), as well as for specific behaviors and domains such as health behavior (McEachan, Conner, Taylor, & Lawton, 2011), physical activity (Hagger, Chatzisarantis, & Biddle, 2002; Symons Downs & Hausenblas, 2005a), condom use (Albarracín, Johnson, Fishbein, & Muellerleile, 2001), alcohol consumption (Cooke, Dahdah, Norman, & French, 2016), and eating behaviors (McDermott, Oliver, Iverson, & Sharma, 2016). Many of these meta-analyses have adopted confirmatory analytic approaches using the synthesized relations among the theory constructs enabling tests of theory predictions across multiple studies, such as meta-analytic path analyses or structural equation modeling (Albarracín et al., 2001; Hagger, Chan, Protogerou, & Chatzisarantis, 2016; Hagger et al., 2002; Hagger, Polet, & Lintunen, 2018; McEachan et al., 2016). Such tests provide evidence for the relative strength or effect size of the relations among the theory constructs and the prediction of behavior, and also enables estimation of the true variability (after correction for attenuation due to measurement error) in these predicted effects across the literature. Research adopting these approaches have demonstrated substantive, non-zero effect sizes for the effects of intentions on behavior, effects of the attitude, subjective norm, and perceived behavioral control constructs on intention, and the indirect effects of these constructs on behavior mediated by intentions (Albarracín et al., 2001; Hagger, Chan, et al., 2016; Hagger et al., 2002). Research has also demonstrated the contribution of belief-based indirect measures of attitudes, subjective norms, and perceived behavioral control on the direct measures of these constructs (Armitage & Conner, 2001b). Taken together, these analyses have provided support for theory predictions across multiple studies for different behaviors, contexts, and populations.

Despite the support offered by syntheses of tests of theory predictions across multiple studies, a number of outstanding issues that may limit the generalizability of the findings have been identified. All of the analyses have shown substantive heterogeneity in the size of the effects among theory constructs (Albarracín et al., 2001; Hagger, Chan, et al., 2016; Hagger et al., 2002; McEachan et al., 2011). While the analyses provide important information on the expected effect sizes among theory variables that would be expected in the ‘average’ study, and that the effects are non-zero, the high heterogeneity means that the actual effects could vary substantially. Indeed, the theory posits that the relative contribution of the attitude, subjective norm, and perceived behavioral control constructs to the prediction of intention will vary across behaviors and contexts, but it does not make specific predictions. Empirically, it has been found that the relative contribution of constructs depends on a number of moderator variables. For example, research has demonstrated that subjective norms are more likely to account for variance in intentions for certain behaviors such as bone marrow donation (Bagozzi, Lee, & Van Loo, 2001), risk behaviors (McEachan et al., 2011; Park, Klein, Smith, & Martell, 2009), and safe sex behaviors (McEachan et al., 2011), while attitudes are likely to be the predominant predictor for behaviors like

physical activity (Hagger et al., 2002) and dietary behaviors (McDermott et al., 2015). Therefore, the heterogeneity observed in the average effect size of theory constructs on intentions in meta-analyses is likely to be due to moderator variables, including the nature of the target behavior. Even meta-analyses of studies on the same target behavior demonstrate considerable heterogeneity, and this may be due to other moderators but may also be due to variations of types of behavior within the behavioral category. For example, physical activity comprises many different behaviors such as formal exercise or sports, informal or incidental activities like walking or occupational physical activity. Such analyses seldom account for these micro-level variations, but they may have substantive impact on effects among theory constructs.

There is also likely to be variability in the degree of control individuals perceive they have over performing the target behavior. In cases where individuals have full actual and perceived control over the behavior, the theory should, strictly speaking, reduce to the theory of reasoned action, the predecessor of the theory of planned behavior. However, research demonstrates that individuals seldom perceive they have complete control over their behavior, and as with attitudes, effects of perceived behavioral control on intentions often vary across behaviors and contexts (Giles & Cairns, 1995; Kraft, Rise, Sutton, & Røysamb, 2005; Rich, Brandes, Mullan, & Hagger, 2015). Similarly, the direct effect of perceived behavioral control on behavior often differs across behaviors and populations, suggesting that the extent to which measures of perceived control reflect actual control over behavior varies (Hagger et al., 2002; McEachan et al., 2011; Rich et al., 2015). However, verifying the extent to which perceived behavioral control reflects actual control is quite difficult in observational studies. Furthermore, improving participants' precision in estimating their actual control is also difficult, as their estimates may be subjectively accurate with respect to their personal capabilities, but may not reflect genuine external constraints.

Relatively little research has tested the moderating effects of perceived behavioral control on the intention-behavior relationship (e.g., Ajzen, 1991; Armitage & Conner, 2001b; Steinmetz, Davidov, & Schmidt, 2011; Yang-Wallentin, Schmidt, Davidov, & Bamberg, 2004). For example, Armitage and Conner indicated that fewer than 30% of the studies in their meta-analysis tested the interaction effect. Summaries of research have demonstrated inconsistent findings, with some studies finding statistically significant interaction effects and others no effects or even negative effects (Armitage & Conner, 2001a; Yang-Wallentin et al., 2004). Yang-Wallentin suggested that the inconsistencies could be attributed to the type of analysis used and that among studies that used analyses correcting for attenuation due to measurement error, the interaction effect was positive and statistically significant. However, to date research syntheses of the interaction effects have relied on a 'vote count' method, which may bias interpretations because it does not correct for methodological artifacts and relies on statistical significance (Hunter & Schmidt, 2004). There is currently no meta-analytic synthesis of research examining the interaction effect. A possible reason for this lack of analysis is that testing interaction effects using meta-analytic techniques requires access to the zero-order effects of the interaction terms used in regression analyses. Such data are almost never presented in research articles testing interaction effects. The meta-analyst would, therefore, require access to the raw data for these studies in order to compute the required interaction terms. Gaining access to these data sets through requests to the original authors may yield access to some datasets, but this may be a relatively small sample of studies relative to the

number of tests and may not be sufficient to enable a high-powered test of the interaction effects in meta-analytic synthesis. This therefore presents a considerable challenge to researchers aiming to provide an estimate of the size and variability of the predicted interaction effects among theory constructs. Accrual of a large number of data sets testing the intention x perceived behavioral control interaction would permit such an analysis and afford the opportunity to compute an unbiased test of the interaction effect using meta-analytic synthesis.

Other methodological factors may also determine the strength of effects among constructs in the theory across studies. For example, imprecision and level of compatibility in the measures of theory constructs are two critical moderators that are likely to affect the relative strength of the predicted effects. Ajzen (1991, 2002) highlighted the imperative of compatibility in measures of the attitude, subjective norm, perceived behavioral control, and intention constructs, and measures of behavior, in the initial formulation of the model. Standardized guidelines exist outlining how to develop measures of the theory constructs that correspond in terms of target, action, context, and time (Ajzen, 2002). Although some behaviors do no permit compatibility for all of these elements, fulfilling the requirement is likely to enhance behavioral prediction. Indeed, limited research has demonstrated that greater compatibility leads to larger effects, consistent with Ajzen's contention (Courneya, 1994). Ensuring full correspondence in measures used will minimize method variance in studies and maximize precision in estimates of effects among theory variables.

A related issue is the observed variability in the effect sizes of the belief-based, indirect measures of attitudes, subjective norms, and perceived behavioral control on their respective direct measures. Again, degree of correspondence between the direct and indirect measures is likely to be a salient moderator. The issue is made more complex by the possibility that value estimates such as outcome evaluations, motivation to comply, and power of control factors are likely to vary as well as the expectancy component, exacerbating variability. In addition, the content of the beliefs identified is also a critical determinant of the size of the effects of indirect on direct measures. Ajzen (2002) advocates eliciting the readily accessible beliefs, referents, and control factors pertinent to the behavior and sample of interest using an open-ended belief-elicitation procedure. Belief measures are subsequently developed from the most frequently elicited responses. This ensures that the measures of beliefs with respect to the target behavior are likely to closely correspond to those held by the target population. While there is some potential for unique, idiosyncratic beliefs to be identified, use of the modal beliefs will encompass the beliefs relevant to a large proportion of the population. Examining behavior as a potential moderating factor of the effects of the indirect measures on direct measures may assist in explaining some of the variability in these relations across studies, but variability in the salient beliefs used may vary across studies even within a particular behavior. A resolution might be to develop indirect measures based on belief elicitation across multiple samples. Such an approach will likely identify the salient beliefs that are common to most populations. This will facilitate greater precision in the indirect measures and may reduce variability in effects of these measures on the direct measures.

In addition to variability in the effect sizes of the predicted relations among the theory constructs associated with different behaviors and contexts, variability may also be attributed to sample-specific characteristics. Although large-scale tests of the theory on randomly-selected samples have been conducted (e.g., Wankel, Mummery,

Stephens, & Craig, 1994), most research examining theory hypotheses have tended to be conducted in 'convenience' samples that are neither randomly selected nor stratified according to key demographic characteristics. However, there is also research suggesting that the cultural norms endorsed by particular groups, within and across national boundaries, may moderate effects among theory components. For example, research has suggested that the relative contribution of attitudes and subjective norms to the prediction of intention varies, depending on the cultural norms or orientations of the sample. Groups endorsing an interdependent or collectivist orientation, where group goals tend to be prioritized above those of the individual, tend to exhibit larger effects of subjective norms on intentions, relative to attitudes (Bagozzi et al., 2001; Heiny et al., in press; Van Hooft & De Jong, 2009), while attitudes have larger effects on intentions among those endorsing an independent or individualist orientation relative to subjective norms. Similarly, research has suggested that a significant minority of individuals tend to base their intentions on subjective norms (Trafimow & Finlay, 1996). Taken together, it would be important to account for variability in these orientations when estimating the relative contribution of the theory of planned behavior constructs on intentions.

There is likely to be variability in the measures used and means adopted to collect data on the TPB constructs. For example, there is considerable variability in the numbers of items used, the extent to which items correspond with measures of intentions and behavior, the format of the response scales used, and wording and phrasing of the items. These variations present challenges when attempting to evaluate the extent to which variability in theory effect sizes can be attributed to methodological artefacts or attributed to systematic differences due to moderator variables. Standardization of methods and collection of data from samples with demographic profiles that are more closely matched with those of the general population may yield more precise, less variable estimates of effects among theory constructs.

A final issue that has not been sufficiently explored within the TPB is the extent to which causal effects posited by the theory are in the predicted direction, i.e. attitudes, subjective norms, and perceived behavioral control determine intentions, and intentions produce the observed behavior. A further issue is the importance of examining long-term prediction while modeling change in the theory constructs. Some researchers have suggested, for example, that just as attitudes may determine intentions, forming and holding intentions toward a target behavior may have the function of informing subsequent attitudes. Previous research has identified reciprocal effects among the theory constructs (Liska, 1984), while others have supported the directional effects and found only reciprocal relations among the determinants of intentions, e.g., perceived behavioral control correlating with attitudes (Hagger, Chatzisarantis, Biddle, & Orbell, 2001). Furthermore, researchers have demonstrated that model predictions hold even after controlling for stability in longitudinal designs measuring all theory constructs at two or more points in time (Hagger et al., 2001; Reinecke, Schmidt, & Ajzen, 1996). The current study enables a unique large-scale test of these relations by collecting data on the key theory constructs at two points in time.

Present Study

Primary and meta-analytic research has demonstrated that the theory of planned behavior is effective in predicting intention and behavior across multiple behaviors, contexts, and populations. However, research syntheses testing theory relations have identified considerable heterogeneity in the effect sizes of model relationships. Furthermore, previous research syntheses have not tested the moderating effects of perceived behavioral control on theory relations, particularly the intention-behavior relationship, due to the lack of previous research testing these effects and the inherent problems presented in computing the interaction terms necessary to test these effects through research synthesis. In addition, there is also considerable variability in the relative contribution of the indirect measures of the theory constructs on their direct measures. The present study will address these research gaps by conducting a large-scale multi-sample replication of the theory of planned behavior. We aim to keep a number of potential contextual- and sample-related moderating factors constant by focusing on a single behavior: participation in vigorous physical activity according to the definition provided by the World Health Organization (2010), and by conducting the research in a sample with demographic characteristics that closely match those of the general population, as well as in undergraduate university student samples with strict inclusion criteria. In addition, we also aim to evaluate the effects of cultural orientation on relations among the theory constructs by including a measure of independent and interdependent orientations (Singelis, 1994).

The research will adopt an identical research protocol based on the procedures for developing direct and indirect measures of the theory variables recommended by Fishbein and Ajzen (2010). Specifically, the research will be conducted in two stages: (1) Belief elicitation using an open-ended procedure to identify the salient behavior-specific beliefs from the target population for the development of indirect measures of the theory constructs, and selection of reflective items for the direct measures; (2) Administration of standardized indirect and direct measures of the theory constructs: attitudes, subjective norms, and perceived behavioral control, and intentions, with follow-up measures of the target behavior, vigorous physical activity, taken five weeks later, to test behavioral prediction across a time frame that exceeds the median of four weeks identified in previous meta-analyses (McEachan et al., 2011; McEachan et al., 2016) – the TPB constructs have been shown to have good stability over this time frame (Armitage & Conner, 2001b; Hagger et al., 2001; McEachan et al., 2011); and (3) Measures of the direct measures of the theory constructs: attitudes, subjective norms, and perceived behavioral control, and intentions will also be taken at the follow-up time point to test longitudinal and reciprocal effects among the theory constructs, with measures taken after the measure of behavior in order to preserve the typical two-wave prospective design typically used to test the theory.

Data will be collected from an online panel of research participants. In addition, self-nominated research teams consenting to participate in the replication will collect data from existing undergraduate cohorts with strict eligibility criteria. Participating research teams will be required to pre-register their protocol and their predictions, follow the research protocol precisely and log any deviations, and submit their data to the principal investigators of the replication (Hagger, Hamilton, Bosnjak, Ajzen, Schmidt) for analysis. The resulting data sets will be used to test the following predictions of the theory using meta-analytic structural equation modeling using a random effects model. As the sample size will be substantial, our predictions will be based on the sizes of the predicted effects and confidence intervals about each effect

and not statistical significance, as most effects will likely be statistically significant. Guidance will be provided by previous meta-analytic findings in the physical activity domain (Hagger et al., 2002; Symons Downs & Hausenblas, 2005b). Effect sizes will be evaluated on Cohen's suggested guidelines for small (β = .20), medium (β = .50), and large (β = .70) effect sizes for multiple regression coefficients. All effects are predicted to have a positive sign. Predictions are consistent with those proposed in the original conceptualization of the theory and effect size estimates are based on previous meta-analyses of the theory of planned behavior (Armitage & Conner, 2001b; Hagger et al., 2002; McEachan et al., 2011).

1. Direct measures of attitude (H1a), subjective norms (H1b), and perceived behavioral control (H1c) will have non-zero effects on intentions, with medium effect sizes expected for H1a and H1c and small effect sizes for H1b.

2. Intentions (H2a) and the direct measure of perceived behavioral control (H2b) will have non-zero effects on prospectively-measured vigorous physical activity (H2), with a medium-sized effect.

3. Composite indirect measures of attitude (H4a), subjective norms (H4b), and perceived behavioral control (H4c), based on the belief and value components, will have non-zero effects on their respective direct measures, with medium effect sizes.

4. Direct measures of attitude (H3a), subjective norms (H3b), and perceived behavioral control (H3c) will have non-zero indirect (mediated) effects on prospectively-measured vigorous physical activity via intentions, with small effect sizes.

5. There will be non-zero interactive effects of intentions and perceived behavioral control on prospectively-measured vigorous physical activity, with larger effects of intentions on vigorous physical activity expected among individuals with higher levels of perceived behavioral control (H5).

6. There will be non-zero interactive effects of perceived behavioral control and attitudes, and perceived behavioral control and subjective norms on intention, with larger effects of attitude and subjective norms on vigorous physical activity expected among individuals with higher levels of perceived behavioral control.

7. There will be non-zero interactive effects of self-construals on the effects of attitudes and subjective norms on intentions. The effect size of direct measures of attitudes on intentions is predicted to be larger in participants that strongly endorse independent self-construals (H6a), and the effect size of direct measures of subjective norms on intentions is predicted to be larger among individuals that strongly endorse interdependent self-construals (H6b).

8. We will also estimate the covariance stability (autoregressive effects) of each of the direct measures of theory constructs (attitudes, subjective norms, perceived behavioral control, intentions) and behavior in a panel design. In addition, we will test reciprocal effects among the theory variables. There will be non-zero effects of direct measures of attitude (H7a), subjective norms (H7b), and perceived behavioral control (H7c) on intentions with small-to-medium effect sizes after controlling for covariance stability. There will also be non-zero effects of physical activity behavior measured at

an initial point in time on attitude (H7d), subjective norms (H7e), and perceived behavioral control (H7f), and intentions (H7g) with small-to-medium effect sizes. We will also test reciprocal (cross-lagged) relations among direct measures of theory constructs over time and expect predicted causal directions among theory constructs to hold.

Materials

The protocol for the proposed replication study will develop standardized direct measures of the theory constructs based on previously published guidelines. In addition, measures of behavioral beliefs, normative beliefs, and control beliefs will be developed from belief elicitation research and used alongside standardized measures of outcome expectancies, motivation to comply, and control belief power to produce indirect measures of the attitude, subjective norm, and perceived behavioral control constructs. The materials for the experiment include:

1. Standardized direct measures of theory of planned behavior constructs, namely, attitudes, subjective norms, perceived behavioral control, and intentions, and self-report measures of behavior, made available as part of an online survey administered by the online survey software.

2. Standardized open-ended belief-elicitation questionnaire administered using the online survey software, for use in the first phase of the study.

3. Standardized indirect measures of attitude, subjective norms, and perceived behavioral control for use in all samples, developed based on the beliefs identified in the elicitation questionnaire administered across all samples in the first phase of the study.

4. Information statements, consent forms and debrief statements made available as part of the online survey delivered by the online survey software.

5. Items for participants to self-report salient demographic variables as part of the online survey including gender, age, education, parental education, household income (if applicable), and ethnicity.

All materials are available on the Open Science Framework project page and PsychArchives.org for the registered replication study.

Important: Participating research teams will be provided with access to the questionnaire using an online questionnaire tool and will have direct access to the survey responses from their participants.

Methods

Design. Phase one of the study will comprise a brief belief elicitation survey and will adopt a single-wave design using surveys with open-ended response options. Phase two of the study will adopt a two-wave correlational, prospective design using surveys containing multi-item scaled measures of study constructs. Direct and indirect measures of theory variables will be administered to participants on an initial data collection occasion, and a self-reported measure of vigorous physical activity

administered to the same participants on a second occasion five weeks later. The adoption of standardized measures and use of online survey software are design features aimed at minimizing variability in data collection. Each of the surveys will be piloted among native speakers of the survey language (English for the initial panel survey, see below) to provide precise completion time estimates.

Procedure: Phase 1 Belief Elicitation Survey. Participants will be recruited from two sources. The first source is an online panel of research participants. Specifically, UK-based participants will be recruited via PsychLab online operated by the ZPID. The second will be undergraduate participants in their first year at University aged 18 to 25 years. In the first phase, participants will be sent an email inviting them to participate in “a brief survey on physical activity”. The email will contain brief information and an internet address (URL) directing participants to a ‘landing’ web page controlled by the online survey software. The landing page will comprise a brief study information statement and a consent form. Participants will be required to agree that they have read the information statement and provide consent to participate in the survey before they can navigate further. Participants declining to participate will be directed to an exit web page. Consenting participants will be able to navigate to the first page of the survey, which provides information on how to complete the open-ended questions for the belief-elicitation procedure. Participants’ responses will be logged by the online survey software and stored on a cloud-based, password protected repository accessible only to the principal investigators.

Procedure: Phase 2 Main Survey. Participants will be sent an invitation to participate in “a survey on attitudes and beliefs towards physical activity” via email. The email will contain brief information about the study with a URL directing participants to the study ‘landing page’ hosted by the online survey software. The ‘landing page’ will comprise an information statement providing details of study requirements and expectations, a statement on their rights as a participant, and a consent form, which includes consent to be contacted for the follow-up survey. Participants will be required to confirm their consent before they can navigate further, participants declining to participate will be directed to an exit page. Consenting participants will be directed to the first page of the survey, which provides brief instructions on how to complete the survey items and a definition of the target behavior: vigorous physical activity. Participants are then prompted to complete the survey items, segregated into brief sections. To minimize data loss, a forced response procedure will be used: participants will be required to respond to all items on each page of the survey before they are able to advance to the next page. Responses to each item are logged by the survey software. After completing the survey, participants will be directed to an exit page thanking them for their participation and reminding them that they will be contacted by email to complete the follow-up survey. Participants’ anonymity will be protected by assigning each participant with a unique code number will be used to match questionnaires across the two data collection occasions.

Participants completing the survey on the first data collection occasion will be sent a second email inviting them to participate in the follow-up survey. The email will direct them to the landing page of the follow-up survey hosted by the online survey software. The page will provide a brief information statement and a reminder of their participant rights. Participants will then be directed to the first page of the survey. On completion participants will be directed to an exit page thanking them for their

participation and provided with a plain-language debrief statement outlining the purpose of the research and expected outcomes.

Data Analyses and Predictions

The pre-registered predicted effects among the theory constructs will be estimated using meta-analytic structural equation modeling with a random effects model using the data sets collected from the ZPID panel survey and data collected from all participating research teams (Cheung, 2015; Cheung & Hong, 2017). The analysis allows for the simultaneous estimation of each effect using standardized parameter estimates with likelihood-based confidence intervals, estimation of the overall fit of the proposed model with the data, and estimation of the degree of heterogeneity associated with the effects and the true variability after correcting for methodological artefacts using random-effects meta-analysis. In terms of specific hypothesis tests, we will estimate three separate models: (1) a model testing the proposed direct and indirect (mediated effects) among measures of attitude, subjective norm, perceived behavioral control, intentions, and behavior; (2) an identical model including effects of past behavior; (3) a model in which proposed interaction effects are tested: interactions of attitudes and subjective norms with perceived behavioral control on intention, and the interaction of perceived behavioral control with intention on behavior; and (4) an autoregressive panel model testing model effects while controlling for covariance stability and also testing lagged effects for direct measures of theory constructs, this model will not include interaction effects. In addition, we will also test the measurement and factor structures of the models in the full sample including data from both the ZPID panel and student participants, and separately, using conventional and multi-sample confirmatory factor analyses and structural equation modeling. In the event that the factor structure of the measures in the current study do not exhibit good fit with the data in one or more samples, exploratory analyses will be conducted to identify the source of the misspecification, and the discrepancies logged prior to proceeding with hypothesis tests. The multi-sample analysis may provide information on the extent to which effects vary according to the background of particular samples. Finally, we plan on pooling the general population samples and conducting an analysis using Bayes factors for model effects under the null hypothesis i.e. no effect, and specific hypotheses based on effect size estimates and distributions from the most recent meta-analysis applying the TPB to physical activity (McEachan et al., 2011, Table 3). Demographic variables will be used as covariance in the main analyses.

Sample size

Phase one data collection will be conducted on small samples drawn from the population of interest. In the case of the ZPID panel sample, this will be a pilot sample drawn from the panel, and in the case of the student samples this will be a pilot sample drawn from each student sample. Previous research has demonstrated that samples of this size are sufficient to elicit modal beliefs for the development of indirect measures (Hamilton, Kirkpatrick, Rebar, White, & Hagger, 2017; Hamilton et al., 2012). The phase one samples will be independent of the sample used in phase two.

Two approaches to estimating required sample size for phase two were used, one for each replication. The first estimate was based on expected individual effects in

the proposed model, and the second on the overall estimate of the final structural model based on model fit.

Individual effect sizes. Previous meta-analytic research testing effects among theory of planned behavior variables in physical activity contexts has indicated medium-sized effects for attitude-intention, perceived behavioral control-intention, and intention-behavior relations, with small-to-medium sized effects for the subjective norm-intention and perceived behavioral control-behavior relations. For the sake of conservatism, we therefore assumed a small-to-medium effect size for all model parameters (f^2= .10). We estimate a minimum sample size for a linear multiple regression analysis with statistical power set at .90, alpha set at .01 for a regression model with five predictor variables, including effects on intentions and behavior using the G*Power tool (Faul, Erdfelder, Lang, & Buchner, 2007). This provides a projected minimum sample size of 228 participants matched across data collection points. Given an estimated 20% dropout rate, research teams are recommended to collect data from 274 participants in their initial data collection occasion. Data from research teams that fall short of the required number will be included in the final cumulative data analysis using meta-analytic structural equation modeling, such data will be assigned less weight in the analysis. However, we will also conduct sensitivity analyses excluding data from research teams that fail to achieve reach the requisite sample size, to check whether the smaller sample size affects conclusions in hypothesis tests.

Model fit. An alternative approach to statistical power is based on overall model fit based on the procedures outlined by MacCallum et al. (1996). This approach assumes that overall fit of the proposed model with the data is indicative of precision of the estimates of the individual effect sizes of the parameters in the model with lack of precision penalized through poorer fit. Using this approach to compute the projected sample size for a meta-analytic structural equation model, computing the desired sample size using RMSEA fit index values from previous meta-analytic structural equation models (Hagger et al., 2018). We used the WebPower analytic tool (Zhang & Yuan, 2018) to calculate power using the MacCallum et al. (1996) method. We specified parameters based on a recent model for the reasoned action approach using meta-analytic structural equation modeling, the selected analytic approach for the current research. The model was estimated based on and RMSEA of 0 for the baseline model and RMSEA of 0.06 for the predicted model, with power set at .90 and alpha set at .01, and 3 degrees of freedom (Hagger et al., 2018). The calculated predicted sample size was 1783 for the meta-analytic structural equation modeling.

Sample Demographics

ZPID Panel sample. The demographic profile of recruited participants can be specified by the research team a priori. We will recruit general population samples (approximate N = 1000 matched across time points) of panel members with characteristics that match national averages for gender distribution, income, and education. The recruited samples will, therefore, have demographic profiles that closely match those of the general population, although the samples will not be randomly selected. As the target behavior is vigorous physical activity, participants with physical disabilities, or chronic or acute illnesses or conditions, that prevent them from participating in vigorous physical will not be eligible for inclusion. All participants must be 18 years or older at the time of participation.

Student sample. Participating research teams will be required to recruit participants from first-year undergraduate students aged 18-25 years on the day of participation with approximately equal gender distribution. Our aim was to keep the demographic profile relatively narrow in order to provide a level of control over potential demographic moderators. Identical restrictions on eligibility for participation regarding disabilities and illnesses and conditions for the panel sample will also apply to the student sample.

Demographic information. Participants will also complete measures of key demographic variables including age, gender, highest educational level, household income (if applicable), and ethnicity.

Language. As data will be collected in multiple countries, study measures will need to be translated into participants' native language. Survey measures and materials will be developed in English and will need to be translated into the requisite language by fluent bi-lingual translators for data collection. Translation will be conducted using a standardized iterative translation procedure involving a combination of forward- and back-translation procedures in consultation with the principal investigators. The translated versions will be held as separate versions of the survey on the online survey software. These versions will be available for participating research teams collecting student data in these languages. Teams that aim to collect data in other languages will need to translate the materials into the required language using an identical back-translation procedure. These surveys will be stored as separate versions of the survey on the online survey software. Translation procedures will follow recommended guidelines: https://www.sciencedirect.com/science/article/pii/S0020748912000600?via%3Dihub

Participating Research Team Expertise

Participating research teams are expected to have experience in conducting survey research and have access to a relevant pool of participants that can be contacted by email. They will also be required to secure ethical clearance for their data collection from an appropriate ethical committee or institutional review board. Specific knowledge of the theory of planned behavior and its predictions are desirable but not required. Participating teams are also expected to pre-register their replication using a standardized form on the OSF. Each pre-registration will be expected to follow the central pre-registration, but will also enable each time to provide a list of predictions for their particular replication, independent of the predictions provided by the principal investigators in the main pre-registration. Each of these pre-registrations will be a 'fork' form the main OSF page for the project. This approach is consistent with previous registered replication reports (e.g., Alogna et al., 2014; Eerland et al., 2016; Hagger, Chatzisarantis, et al., 2016).

Exclusions

Data from participants will be excluded from the final data set if they do not meet inclusion criteria, if they drop out of the study between the first and second data collection occasions, if they fail to complete the survey, or their response profile suggests they did not pay attention to the survey questions, according to attention check questions embedded in the survey. Data from participants dropping out of the study across data collection occasions will be retained for analysis of attrition bias.

Participant exclusions and reasons for exclusion will be clearly identified and logged on the OSF page.

Data Collation and Statistical Analyses

The principal investigators will be responsible for collating the collected data and for data analysis.

Data from the initial belief elicitation stage for each sample will be downloaded and stored as numeric spreadsheets. The principal investigators will then identify the modal responses for the behavioral, normative, and control beliefs, and develop indirect belief-based measures according to guidelines. Beliefs identified by more than 25-30% of participants in the pilot sample will be considered modal and eligible for inclusion (Ajzen & Schmidt, 2020).

Data from the second phase panel and student replications will downloaded as numeric spreadsheets. Data will be analyzed using the *psych* (Revelle, 2018), *lavaan* (Rosseel, 2012), Mplus (Muthén & Muthén, 2015) and *metaSEM* (Cheung, 2015) packages in R. As the surveys will use a forced response procedure, there should be no missing data.

Data will be screened for responses indicating that participants had not read or paid sufficient attention to the survey. Basic descriptive statistics for each item in each data set will be generated including estimates of skewness and kurtosis.

Effects of attrition on study variables across data collection occasions in each data set will be tested using MANOVAs with study constructs as multiple dependent variables and attrition status (dropped out vs. remained in the study at follow up) as the single independent variable. Statistically significant overall attrition effects with non-trivial effect sizes will be followed up with univariate follow-up *F*-tests.

Main hypotheses in the three proposed models within each sample will be estimated. A maximum likelihood method will be used with overall model fit evaluated using incremental fit indexes: the comparative fit index (CFI) and the non-normed fit index (NNFI), the standardized root mean square residuals (SRMSR), and the root mean square error of approximation (RMSEA). Cut-off values of .90 for the CFI and NNFI, and .08 and .05 for the SRMSR and RMSEA, respectively, will indicate satisfactory model fit. Solution estimates for each latent variable representing a study construct will also be estimated, with factor loadings expected to exceed .70 and average variance extracted for each factor expected to exceed .50. Reliability of measures will be estimated using composite reliability coefficients based on the factor loadings. Interaction effects in the third model will be tested using interaction terms computed using the residual centering approach (Steinmetz et al., 2011).

Main hypotheses in the three proposed models across the samples will be tested using meta-analytic structural equation modeling (MASEM) using the metaSEM package. The MASEM analysis is conducted in two stages. In the first stage, correlation matrices among the TPB items from individual studies are pooled to form a common covariance matrix using random effects meta-analysis. The analysis produces a pooled matrix representing the average covariance matrix among study variables in the population, with a sampling variance-covariance matrix that represents

the known precision estimates of each correlation in the pooled matrix. The first stage yields zero-order correlations corrected for bias using a random effects meta-analytic model among study constructs across studies with 95% likelihood-based confidence intervals. In addition, statistics to evaluate heterogeneity in the effect sizes are also provided: the τ^2 statistic representing the true variability in the effect across studies, and the *Q* statistic, and the I^2 statistic and its 95% confidence interval which indicate the level of heterogeneity in the effect across studies. In the second stage of the analysis, the pooled correlation matrix is used to estimate the proposed model. As with the single-sample analyses, model fit is evaluated using multiple criteria for goodness of fit: CFI, NNFI, SRMSR, and RMSEA. The model also allows for the computation of indirect effects specified a priori and their 95% likelihood-based confidence intervals. Models testing the proposed direct and indirect effects among theory variables will be tested using the full latent variable approach consistent with the univariate models. However, as interaction effects using latent variables are difficult to compute using MASEM, we will use mean-centered interaction terms based on composite (averaged) variables.

Procedure

(1) Research teams will be invited to participate in the study via advertisements on listservs and circular email lists. The invitation will provide a brief outline of the main purpose of the study, and provide information requirements for following study protocol, participant recruitment, and data collection. Interested teams will be asked to follow a url to the recruitment web page, which will provide further details and requirements, and a brief application form. Expressions of interest will be vetted by the principal investigators to ensure applicants have sufficient experience and resources to follow the protocol and collect data before the specified deadline. Accepted applicants will be provided with full study protocol and materials and asked to liaise via email or voip conversations with the principal investigators on their progress. Participating teams will be required to develop a page for their replication on the OSF forked to the main OSF page for the project following a standard template and pre-register their predictions. Members of teams completing data collection will be included as co-authors on the final research report and peer-reviewed articles arising from the project (maximum of three co-authors per team).

(2) Study measures will be translated for use in non-English speaking countries using the stipulated translation procedure. Research teams collecting data other languages will be required to conduct their own translations using the stipulated procedure and make the measures available via the OSF project page for their replication and upload it to the online survey software.

(3) Each research team will identify an initial sample N ~ 50 of participants from the target population and collect data for the first phase of the study using the belief elicitation survey. A unique url for access to the survey will be provided for each participating research team. Once data collection is complete, the principal investigators will develop indirect measures of theory of planned behavior constructs based on the elicited modal beliefs. This will be done by coding the open ended responses to the elicitation survey into categories of beliefs and values for each TPB construct: attitudes (behavioral beliefs), subjective norm (normative beliefs), and perceived behavioral control (control beliefs). Beliefs identified by at least 25-30% of the initial sample will be used (Ajzen & Schmidt, 2020). Separate sets of beliefs will be

elicited for the panel and student surveys for use in the final questionnaires. The core team will also oversee the translation processes for the materials for non-English speaking participant groups. These will be incorporated into the online survey software. These will be incorporated into the online survey. Participating research teams conducting the replication in other languages will also be required to conduct the translation using the stipulated procedure and provide the final set of indirect measures to the principal investigators for inclusion in the online survey. As differences in the sets of salient beliefs for the target behavior identified in the panel sample and student samples are expected, belief measures will be developed separately for each.

(4) Research teams will then proceed with collecting data on the initial survey in phase two. Collection of phase two data from the ZPID panel will be managed by the principal investigators. Participating research teams will be required to recruit participants by directing them to the study url. Participating teams will be able to keep track of recruited numbers of participants via the online survey software.

(5) After recruiting sufficient numbers of participants for the initial survey, participating research teams will collect follow-up responses from the same participants five weeks later. Numbers of follow-up responses will be monitored in the same way as previously.

(6) The principal investigators will collate responses to the surveys centrally and provide participating research teams with the final data set downloaded from the online survey software. Data analysis will be conducted by the principal investigators and individual and groups results sent to the participating research teams for verification. All data files will be stored on the PsychArchives repository and made available to researchers on request in a GDPR-compliant form.

(7) The final report detailing results from the hypothesis test from the full samples will be developed by the principal investigators. All participating research teams will be given the opportunity to comment on the report prior to publication. All teams will have full access to their own data and the data collected by other participants. The final data sets will be a publicly available resource for testing additional hypotheses and research questions.

References

Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes, 50*, 179-211. doi: 10.1016/0749-5978(91)90020-T

Ajzen, I. (2002). Constructing a TPB questionnaire: Conceptual and methodological considerations. (September 1, 2002). http://people.umass.edu/~aizen/pdf/tpb.measurement.pdf

Ajzen, I., & Schmidt, P. (2020). Changing behavior using the theory of planned behavior. In M. S. Hagger, L. D. Cameron, K. Hamilton, N. Hankonen & T. Lintunen (Eds.), *The Handbook of Behavior Change*. New York, NY: Cambridge University Press.

Albarracín, D., & Johnson, B. T. (2019). *Handbook of Attitudes* (2nd ed.). New York, NY: Psychology Press.

Albarracín, D., Johnson, B. T., Fishbein, M., & Muellerleile, P. A. (2001). Theories of reasoned action and planned behavior as models of condom use: A meta-

analysis. *Psychological Bulletin, 127*, 142-161. doi: 10.1037/0033-2909.127.1.142

Alogna, V. K., Attaya, M. K., Aucoin, P., Bahník, Š., Birch, S., Birt, A. R., . . . Zwaan, R. A. (2014). Registered Replication Report: Schooler and Engstler-Schooler (1990). *Perspectives on Psychological Science, 9*, 556-578. doi: 10.1177/1745691614545653

Armitage, C. J., & Conner, M. (2001a). Efficacy of a minimal intervention to reduce fat intake. *Social Science and Medicine, 52*, 1517-1524. doi: 10.1016/S0277-9536(00)00265-3

Armitage, C. J., & Conner, M. (2001b). Efficacy of the theory of planned behaviour: A meta-analytic review. *British Journal of Social Psychology, 40*, 471-499. doi: 10.1348/014466601164939

Bagozzi, R. P., Lee, H.-M., & Van Loo, M. F. (2001). Decisions to donate bone marrow: The role of attitudes and subjective norms across cultures. *Psychology and Health, 16*, 29-56. doi: 10.1080/08870440108405488

Bamberg, S., Ajzen, I., & Schmidt, P. (2003). Choice of travel mode in the theory of planned behavior: The roles of past behavior, habit, and reasoned action. *Basic and Applied Social Psychology, 25*, 175-187. doi: 10.1207/S15324834BASP2503_01

Cheung, M. W. L. (2015). metaSEM: an R package for meta-analysis using structural equation modeling. *Frontiers in Psychology, 5*, 1521. doi: 10.3389/fpsyg.2014.01521

Cheung, M. W. L., & Hong, R. Y. (2017). Applications of meta-analytic structural equation modeling in health psychology: Examples, issues, and recommendations. *Health Psychology Review, 11*, 265-279. doi: 10.1080/17437199.2017.1343678

Conner, M. T., & Sparks, P. (2015). The theory of planned behavior and reasoned action approach. In M. T. Conner & P. Norman (Eds.), *Predicting and changing health behaviour: Research and practice with social cognition models* (3rd ed., pp. 142-188). Maidenhead, UK: Open University Press.

Cooke, R., Dahdah, M., Norman, P., & French, D. P. (2016). How well does the theory of planned behaviour predict alcohol consumption? A systematic review and meta-analysis. *Health Psychology Review, 10*, 148-167. doi: 10.1080/17437199.2014.947547

Courneya, K. S. (1994). Predicting repeated behavior from intention: The issue of scale correspondence. *Journal of Applied Social Psychology, 24*, 580-594. doi: 10.1111/j.1559-1816.1994.tb00601.x

Eagly, A. H., & Chaiken, S. (1993). *The psychology of attitudes*. San Diego, CA: Harcourt, Brace and Jonanovich.

Eerland, A., Sherrill, A. M., Magliano, J. P., Zwaan, R. A., Arnal, J. D., Aucoin, P., . . . Prenoveau, J. M. (2016). Registered replication report: Hart & Albarracín (2011). *Perspectives on Psychological Science, 11*, 158-171. doi: 10.1177/1745691615605826

Faul, F., Erdfelder, E., Lang, A.-G., & Buchner, A. (2007). G*Power 3: A flexible statistical power analysis program for the social, behavioral, and biomedical sciences. *Behavior Research Methods, 39*, 175-191. doi: 10.3758/bf03193146

Fishbein, M. (1967). Attitude and the prediction of behavior. In M. Fishbein (Ed.), *Readings in attitude theory and measurement* (pp. 477-492). London, UK: Wiley.

Fishbein, M., & Ajzen, I. (2010). *Predicting and changing behavior: The reasoned action approach*. New York, NY: Psychology Press.

Giles, M., & Cairns, E. (1995). Blood donation and Ajzen's theory of planned behaviour: An examination of perceived behavioural control. *British Journal of Social Psychology, 34*, 173 - 188. doi: 10.1111/j.2044-8309.1995.tb01056.x

Godin, G., Valois, P., Shephard, R. J., & Desharnais, R. (1987). Prediction of leisure-time exercise behavior - A path analysis (LISREL V) model. *Journal of Behavioral Medicine, 10*, 145-158. doi: 10.1007/BF00846423

Hagger, M. S., Chan, D. K. C., Protogerou, C., & Chatzisarantis, N. L. D. (2016). Using meta-analytic path analysis to test theoretical predictions in health behavior: An illustration based on meta-analyses of the theory of planned behavior. *Preventive Medicine, 89*, 154-161. doi: 10.1016/j.ypmed.2016.05.020

Hagger, M. S., & Chatzisarantis, N. L. D. (2005). First- and higher-order models of attitudes, normative influence, and perceived behavioural control in the Theory of Planned Behaviour. *British Journal of Social Psychology, 44*, 513-535. doi: 10.1348/014466604X16219

Hagger, M. S., Chatzisarantis, N. L. D., Alberts, H., Angonno, C. O., Batailler, C., Birt, A., . . . Zwienenberg, M. (2016). A multi-lab pre-registered replication of the ego-depletion effect. *Perspectives on Psychological Science, 11*, 546-573. doi: 10.1177/1745691616652873

Hagger, M. S., Chatzisarantis, N. L. D., & Biddle, S. J. H. (2002). A meta-analytic review of the theories of reasoned action and planned behavior in physical activity: Predictive validity and the contribution of additional variables. *Journal of Sport and Exercise Psychology, 24*, 3-32. doi: 10.1123/jsep.24.1.3

Hagger, M. S., Chatzisarantis, N. L. D., Biddle, S. J. H., & Orbell, S. (2001). Antecedents of children's physical activity intentions and behaviour: Predictive validity and longitudinal effects. *Psychology and Health, 16*, 391-407. doi: 10.1080/08870440108405515

Hagger, M. S., Polet, J., & Lintunen, T. (2018). The reasoned action approach applied to health behavior: Role of past behavior and test of some key moderators using meta-analytic structural equation modeling. *Social Science & Medicine, 213*, 85-94. doi: 10.1016/j.socscimed.2018.07.038

Hamilton, K., Kirkpatrick, A., Rebar, A., White, K. M., & Hagger, M. S. (2017). Protecting young children against skin cancer: Parental beliefs, roles, and regret. *Psycho-Oncology, 26*, 2135–2141. doi: 10.1002/pon.4434

Hamilton, K., White, K. M., McD. Young, R., Hawkes, A. L., Starfelt, L. C., & Leske, S. (2012). Identifying critical sun-protective beliefs among Australian adults. *Health Education Research, 27*, 834-843. doi: 10.1093/her/cys093

Heiny, J., Ajzen, I., Schmidt, P., & Leonhäuser, I.-U. (in press). Intentions to enhance tourism in private households: Its explanation and mediated effects of experience. *Journal of Entrepreneurship and Innovation in Emerging Economies.*

Hunter, J. E., & Schmidt, F. L. (2004). *Methods of meta-analysis: Correcting error and bias in research findings* (2nd ed.). Newbury Park, CA: Sage.

Kraft, P., Rise, J., Sutton, S., & Røysamb, E. (2005). Perceived difficulty in the theory of planned behaviour: Perceived behavioural control or affective attitude? *British Journal of Social Psychology, 44*, 479-496. doi: doi:10.1348/014466604X17533

Liska, A. E. (1984). A critical examination of the causal structure of the Fishbein/Ajzen attitude-behavior model. *Social Psychology Quarterly, 47*, 61-74. doi: 10.2307/3033889

MacCallum, R. C., Browne, M. W., & Sugawara, H. M. (1996). Power analysis and determination of sample size for covariance structure modeling. *Psychological Methods, 1*, 130-149. doi: 10.1037/1082-989X.1.2.130

McDermott, M. S., Oliver, M., Iverson, D., & Sharma, R. (2016). Effective techniques for changing physical activity and healthy eating intentions and behaviour: A systematic review and meta-analysis. *British Journal of Health Psychology, 21*, 827-841. doi: 10.1111/bjhp.12199

McDermott, M. S., Oliver, M., Simnadis, T., Beck, E. J., Coltman, T., Iverson, D., . . . Sharma, R. (2015). The Theory of Planned Behaviour and dietary patterns: A systematic review and meta-analysis. *Preventive Medicine, 81*, 150-156. doi: 10.1016/j.ypmed.2015.08.020

McEachan, R. R. C., Conner, M. T., Taylor, N., & Lawton, R. J. (2011). Prospective prediction of health-related behaviors with the theory of planned behavior: A meta-analysis. *Health Psychology Review, 5*, 97-144. doi: 10.1080/17437199.2010.521684

McEachan, R. R. C., Taylor, N., Harrison, R., Lawton, R., Gardner, P., & Conner, M. T. (2016). Meta-analysis of the reasoned action approach (RAA) to understanding health behaviors. *Annals of Behavioral Medicine, 50*, 592-612. doi: 10.1007/s12160-016-9798-4

Muthén, L. K., & Muthén, B. O. (2015). *MPlus statistical analysis with latent variables: User's guide* (7th ed.). Los Angeles, CA: Muthén & Muthén.

Park, H. S., Klein, K. A., Smith, S., & Martell, D. (2009). Separating subjective norms, university descriptive and injunctive norms, and US descriptive and injunctive norms for drinking behavior intentions. *Health Communication, 24*, 746-751. doi: 10.1080/10410230903265912

Reinecke, J., Schmidt, P., & Ajzen, I. (1996). Application of the theory of planned behavior to adolescents' condom use: A panel study. *Journal of Applied Social Psychology, 26*, 749-772. doi: 10.1111/j.1559-1816.1996.tb01128.x

Revelle, W. (2018). psych: Procedures for psychological, psychometric, and personality research. Retrieved May 6, 2018, from https://cran.r-project.org/web/packages/psych/index.html

Rhodes, R. E., Blanchard, C. M., & Matheson, D. H. (2006). A multi-component model of the theory of planned behaviour. *British Journal of Health Psychology, 11*, 119-137. doi: 10.1348/135910705X52633

Rich, A., Brandes, K., Mullan, B. A., & Hagger, M. S. (2015). Theory of planned behavior and adherence in chronic illness: A meta-analysis. *Journal of Behavioral Medicine, 38*, 673-688. doi: 10.1007/s10865-015-9644-3

Rosseel, Y. (2012). lavaan: An R package for structural equation modeling. *Journal of Statistical Software, 48*, 1-36. doi: 10.18637/jss.v048.i02

Singelis, T. M. (1994). The measurement of independent and interdependent self-construals. *Personality and Social Psychology Bulletin, 20*, 580-591. doi: 10.1177/0146167294205014

Steinmetz, H., Davidov, E., & Schmidt, P. (2011). Three approaches to estimate latent interaction effects: Intention and perceived behavioral control in the theory of planned behavior. *Methodological Innovations Online, 6*, 95-110. doi: 10.4256/mio.2010.0030

Symons Downs, D., & Hausenblas, H. A. (2005a). Elicitation studies and the theory of planned behavior: A systematic review of exercise beliefs. *Psychology of Sport and Exercise, 6*, 1-31. doi: 10.1016/j.psychsport.2003.08.001

964 Symons Downs, D., & Hausenblas, H. A. (2005b). The theories of reasoned action
965 and planned behavior applied to exercise: A meta-analytic update. *Journal of*
966 *Physical Activity and Health, 2*, 76-97. doi: 10.1123/jpah.2.1.76
967 Trafimow, D., & Finlay, K. A. (1996). The importance of subjective norms for a minority
968 of people: Between-subjects and within-subjects effects. *Personality and Social*
969 *Psychology Bulletin, 22*, 820-828. doi: 10.1177/0146167296228005
970 Van Hooft, E. A. J., & De Jong, M. (2009). Predicting job seeking for temporary
971 employment using the theory of planned behaviour: The moderating role of
972 individualism and collectivism. *Journal of Occupational and Organizational*
973 *Psychology, 82*, 295-316. doi: 10.1348/096317908x325322
974 Wankel, L., Mummery, K., Stephens, T., & Craig, C. (1994). Prediction of physical
975 activity intention from social psychological variables: Results from the
976 Campbell's survey of well-being. *Journal of Sport and Exercise Psychology, 16*,
977 56-69. doi: 10.1123/jsep.16.1.56
978 WHO. (2010). *Global recommendations on physical activity for health*. Geneva,
979 Switzerland: World Health Organization.
980 Yang-Wallentin, F., Schmidt, P., Davidov, E., & Bamberg, S. (2004). Is there any
981 interaction effect between intention and perceived behavioral control? *Methods*
982 *of Psychological Research Online, 8*, 127-157.
983 Zhang, Z., & Yuan, K.-H. (2018). *Practical statistical power analysis using WebPower*
984 *and R*. Granger, IN: ISDSA Press.

985