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Author(s): Hagger, Martin S.; Hamilton, Kyra

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Social cognition theories and behavior change in COVID-19: A conceptual review

Martin S. Hagger^{a,b,c,d,*}, Kyra Hamilton^{b,d,e}

^a Department of Psychological Sciences, University of California, Merced, 5200 N. Lake Rd., Merced, CA, 95343, USA

^b Health Sciences Research Institute, University of California, Merced, 5200 N. Lake Rd., Merced, CA, 95343, USA

^c Faculty of Sport and Health Sciences, University of Jyväskylä, PO Box 35, FI-40014, Jyväskylä, Finland

^d School of Applied Psychology, Griffith University, Mt. Gravatt Campus, 176 Messines Ridge Rd, Mt. Gravatt, QLD, 4122, Australia

^e Menzies Health Institute Queensland, Griffith University, G40 Griffith Health Centre, Level 8.86, Gold Coast Campus, QLD, 4222, Australia

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ABSTRACT

The COVID-19 pandemic has had unprecedented health, economic, and social consequences worldwide. Although contact reductions and wearing face coverings have reduced infection rates, and vaccines have reduced illness severity, emergence of new variants of the coronavirus that causes COVID-19, and the shift from pandemic to endemic patterns of infection, highlights the importance of ongoing preventive behavior adherence to manage future outbreaks. Research applying social cognition theories may assist in explaining variance in these behaviors and inform the development of efficacious behavior change interventions to promote adherence. In the present article, we summarize research applying these theories to identify modifiable determinants of COVID-19 preventive behaviors and the mechanisms involved, and their utility in informing interventions. We identify limitations of these applications (e.g., overreliance on correlational data, lack of long-term behavioral follow-up), and suggest how they can be addressed. We demonstrate the virtue of augmenting theories with additional constructs (e.g., moral norms, anticipated regret) and processes (e.g., multiple action phases, automatic processes) to provide comprehensive, parsimonious behavioral explanations. We also outline how the theories contribute to testing mechanisms of action of behavioral interventions. Finally, we recommend future studies applying these theories to inform and test interventions to promote COVID-19 preventive behavior adherence.

1. Introduction

Since the COVID-19 outbreak was declared a global pandemic in March 2020 (WHO, 2020), the disease has contributed substantially to excess deaths globally (CDC, 2021b), resulted in damaging economic outcomes (e.g., unemployment and redundancy, increased numbers of people falling below the poverty line, business bankruptcy and closure; Jackson et al., 2021), placed immense strain on healthcare services (e.g., reduced capacity to provide elective services and long-term care, increased stress on staff, elevated health risks for frontline workers; Bartsch et al., 2020), and led to deleterious social consequences (e.g., increased incidence of mental health difficulties including depression, suicidality, loneliness, and isolation; Holmes et al., 2020). Lockdown and other legislated mitigation procedures together with the rapid development and administration of vaccines have made important

contributions to curbing infection rates, particularly severe cases, as well reducing economic, healthcare, and social strains, such that people worldwide have begun to envision a post-pandemic world (Kashte, Gulbake, El-Amin, & Gupta, 2021). However, the emergent threat of new highly-virulent variants of the coronavirus that causes COVID-19 infections, such as the *delta* and *omicron* variants, highlights the reality that the pandemic is far from over, and that there will likely be need to maintain mitigation and management procedures for some time in the future to bring infection rates under control (Wu et al., 2021). Furthermore, even if mitigation procedures lead to COVID-19 infection rates to fall below pandemic levels, complete eradication of the virus is unlikely (Phillips, 2021). Rather, it is more likely to become endemic, similar to other viral infections such as influenza and the common cold. This means that people worldwide may need to be prepared to manage localized and seasonal outbreaks in future (Phillips, 2021).

* Corresponding author. Department of Psychological Sciences and Health Sciences Research Institute, University of California, Merced, 5200 N. Lake Rd., Merced, CA, 95343, USA.

E-mail address: mhagger@ucmerced.edu (M.S. Hagger).

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Throughout the pandemic, behavior change has been central to the effective management of COVID-19 infection rates (Michie, 2020; West, Michie, Rubin, & Amlôt, 2020). Populations worldwide have become eminently familiar with a raft of COVID-19 preventive behaviors including physical distancing, wearing face coverings, avoiding large gatherings particularly indoors, hand sanitization, and adherence to transmission prevention guidelines (e.g., self-isolation, quarantine). Further key preventive behaviors have also become cornerstone in the mitigation of coronavirus transmission and minimizing infection severity, including uptake of COVID-19 vaccines and booster shots (Bar-On et al., 2021; CDC, 2021a; JVCI, 2021) and rapid antigen testing (Crozier, Rajan, Buchan, & McKee, 2021). However, despite extensive messaging and advocacy of these COVID-19 preventive behaviors by government agencies and public health services, engagement in these behaviors has been highly variable, and often falls short of the levels necessary to bring infection rates under control, particularly when they are at their peak (Mathieu et al., 2021). This has particularly been the case for vaccine uptake, where adherence rates vary considerably but often fall below those necessary to attain the widespread immunity to halt subsequent waves of infection (Mathieu et al., 2021). Further, increased documentation of ‘breakthrough’ infections among the vaccinated population (Bergwerk et al., 2021), and the need to offer protection to those vulnerable to serious cases of COVID-19 (e.g., vaccine allergic individuals, individuals with underlying conditions, and the immunosuppressed), means that other COVID-19 preventive behaviors such as physical distancing and wearing face coverings are still necessary even among those who have been vaccinated.

Given the ongoing pandemic and its future management necessitates continuity of interventions promoting uptake and maintenance of COVID-19 preventive behaviors, the need for effective messaging and health communication has come to the fore. Governmental and public health agencies have turned to behavioral science to identify strategies that will promote attention to, assimilation of, and responsivity to messaging interventions around COVID-preventive behaviors (Albarracín & Jung, 2021; Bonell et al., 2020; Michie, Rubin, & Amlôt, 2020; Michie et al., 2020; West et al., 2020). Importantly, drawing from a substantive body of prior research on behavior change, behavioral scientists have highlighted the imperative for messaging interventions to be based on a fundamental understanding of human behavior (Hagger, Cameron, et al., 2020; Michie et al., 2018). Central to this understanding is the need to base interventions on behavioral theory (Hagger, Moyers, McAnally, & McKinley, 2020; Prestwich, Webb, & Conner, 2015), a contention predicated on evidence that theory-based behavioral interventions demonstrate greater efficacy and efficiency (Hagger & Weed, 2019; McEwan et al., 2019; Prestwich et al., 2014). Theory provides a basis for providing a priori predictions on how interventions work, that is, the extent to which the intervention is expected to change behavior and the mechanisms involved, and provides a means to falsify predictions relating to efficacy and mechanism against observation (Rothman, Klein, & Sheeran, 2020; Sheeran, Klein, & Rothman, 2017). In addition, basing interventions on theory enables specification of the inter- and intra-personal, socio-structural, and contextual conditions that are expected to enhance or mitigate their efficacy (Hagger, Gucciardi, & Chatzisarantis, 2017; Rothman & Sheeran, 2020; Trafimow, 2012).

Social cognition theories feature prominently among theories that have been applied to predict behavior and behavior change, and have made important contributions to identifying health behavior determinants and the mechanisms involved (Conner & Norman, 2015a, 2015b; Fishbein et al., 2001). Social cognition theories adopt a reasoned action approach, assuming that engagement in a given target behavior is a function of individuals’ beliefs or judgements with respect to their future performance of the behavior (Fishbein & Ajzen, 2010). Importantly, the beliefs are considered potentially modifiable through information-provision strategies presented in behavioral interventions (e.g., messages highlighting the utility of, available support for, and

personal capacity to perform the behavior; Ajzen & Schmidt, 2020; Hamilton & Johnson, 2020). The theories also specify the processes by which these strategies ‘work’ to change behavior, known as *mechanisms of action* (Hagger, Cameron, et al., 2020; Hagger, Moyers, et al., 2020; Sheeran et al., 2017). A large corpus of research applying social cognition approaches in health contexts has supported their predictions and demonstrated that their constructs account for non-trivial variance in behavior (e.g., Carpenter, 2010; McEachan, Conner, Taylor, & Lawton, 2011; Milne, Sheeran, & Orbell, 2000). In the context of the COVID-19 pandemic, social cognition theories have featured prominently in studies predicting COVID-19 preventive behaviors (for a review see Albarracín & Jung, 2021). These studies have been successful in accounting for unique variance in behavior, and have assisted in identifying relevant processes (e.g., Bogg & Milad, 2020; Chu & Liu, 2021; Hagger, Smith, Keech, Moyers, & Hamilton, 2020; Hamilton, Smith, Keech, Moyers, & Hagger, 2020; Jang, Kim, & Kwon, 2021; Norman, Wilding, & Conner, 2020; Tong, He, Wu, Dang, & Chen, 2021). In addition, their application has also demonstrated utility in informing the development of behavioral interventions in this context – interventions based on these theories have demonstrated efficacy in changing behavior (e.g., Ahn, Hu, & Vega, 2021; Keller et al., 2021; Okuhara, Okada, & Kiuchi, 2020; Smith, Hagger, Keech, Moyers, & Hamilton, 2021).

Despite these successful applications, numerous limitations and knowledge gaps remain in the application of these theories in this context such as a preponderance of evidence based on cross-sectional and correlational data; a lack of behavioral data and, particularly, data on long-term behavioral prediction and the prediction of *change* in behavior; a lack of experimental and intervention research; and few tests of the theory-based mechanisms by which the interventions change behavior. In this article, we aim to summarize the contribution of research applying social cognition theories to predict and change behavior in the context of COVID-19. Specifically, we outline the value of social cognition theories in identifying the determinants and possible targets for intervention in health behavior, focusing on COVID-19 preventive behaviors (e.g., maintaining physical distancing, wearing face coverings, avoiding group gatherings; getting vaccinated, participating in rapid testing); provide a critique of the application of these theories including identifying some of their prominent limitations and boundary conditions (e.g., prediction of intentions rather than behavior, confinement to short term prediction, lack of specificity in beliefs, overuse of correlational designs), and their implications for COVID-19 prevention; summarize some emergent innovations in the research in this context (e.g., integration of other constructs, testing of mechanisms of action) that seek to address these limitations and advance knowledge on behavioral determinants and behavior change in this context; and identify evidence gaps (e.g., the transition from pandemic to endemic illness management, accounting for disparities and inequality in health behavior, dealing with traits and individual differences) and provide some suggested future advancements that may contribute to addressing these gaps.

2. Social cognition theories and COVID-19 preventive behaviors

2.1. Social cognition theories: basic assumptions and supporting evidence

Social cognition theories have their origins in reasoned action approaches that assume individuals’ decisions on whether or not to engage in a given target behavior are based on their processing of the available information relating to the behavior and their evaluation of it (Ajzen, 1991; Conner, 2015; Fishbein & Ajzen, 2010; Fishbein et al., 2001). Specifically, the theories predict that individuals form belief-based judgements or expectations that represent or summarize information about the behavior and make their decisions on action accordingly. Social cognitive theory (Bandura, 1986), the health belief model (Rosenstock, 1974), protection motivation theory (Rogers, 1975), and the theories of reasoned action (Ajzen & Fishbein, 1980) and planned

behavior (Ajzen, 1991) are leading examples of social cognition theories, and they have been widely applied.

The belief-based behavioral determinants specified in social cognition theories are summarized in sets of constructs. Common to many of these theories are constructs that represent beliefs regarding the value or utility of the behavior in producing outcomes (e.g., outcome evaluations in social cognitive theory, perceived benefits in the health belief model, response efficacy in protection motivation theory, attitudes in the theories of reasoned action and planned behavior); risk perceptions (e.g., threat appraisals in the health belief model and protection motivation theory); capacity beliefs (e.g., self-efficacy beliefs in social cognitive theory and protection motivation theory, perceived behavioral control in the theory of planned behavior), and social norms (e.g., subjective norms in the theories of reasoned action and planned behavior). A number of theories also specify dispositions to act (e.g., intention in the theories of reasoned action and planned behavior, protection motivation in protection motivation theory), which reflect a readiness to act and willingness to invest effort to pursue the behavior in future, often operationalized as a mediator of effects of belief-based constructs on behavior, a mechanistic prediction (Ajzen, 1991; Fishbein & Ajzen, 2010; Rogers, 1975; Fishbein et al., 2001; McMillan & Conner, 2007). For example, a prototypical social cognition theory, the theory of planned behavior, predicts that effects of attitudes, subjective norms, and perceived behavioral control with respect to future performance of the target behavior on behavior are mediated by intentions (Ajzen, 1991).

The basic premises of social cognition theories in the context of health behaviors has been supported in multiple predictive studies (e.g., Carpenter, 2010; McEachan et al., 2011; Milne et al., 2000). Studies typically tap the belief-based constructs from the theories using validated psychometric instruments in which individuals from a target population are prompted to estimate their beliefs with respect to performing a target behavior at some specified time in the future. Valid tests of the theories necessitate subsequent collection of behavior measures within the specified timeframe, and evaluate the extent to which the belief-based constructs predict the behavior using a prospective design. Studies adopting such designs have provided consistent support for the theories in explaining variance in behavior in multiple health behaviors, populations, and contexts. For example, meta-analytic syntheses of these studies demonstrate small-to-medium sized effects of theory constructs on action dispositions and behavior, and have also supported key mechanistic predictions, such as the mediation of the effects of belief-based constructs on behavior by dispositions to act (e.g., Albaracín, Johnson, Fishbein, & Muellerleile, 2001; Hamilton, van Dongen, & Hagger, 2020; McEachan et al., 2011). This meta-analytic research has also been extended to account for other important predictions and auxiliary assumptions of these theories such as the capacity of the theory to account for unique variance in behavior when controlling for past behavior (e.g., Chatzisarantis, Hagger, Smith, & Phoenix, 2004; Hagger, Polet, & Lintunen, 2018), a test of theory *sufficiency*, and also for moderator effects among the constructs themselves, such as the moderation of the intention-behavior relationship by perceived behavioral control (Hagger, Cheung, Ajzen, & Hamilton, 2022) or the properties of attitudes (Cooke & Sheeran, 2004) in the theory of planned behavior. Taken together, research has provided basic evidence in support of theory hypotheses with regard to the prediction of behavior and some key proposed mechanisms within the theories.

2.2. Applying social cognition theories in COVID-19

The demonstrated efficacy of social cognition theories in accounting for behavior provides impetus for their application to predict COVID-19 preventive behaviors. Specifically, leading social cognition theories have been adopted to predict intention toward, and actual participation in, general COVID-19 preventive behaviors (e.g., Clark, Davila, Regis, & Kraus, 2020; Norman et al., 2020; Peterson, Helweg-Larsen, &

DiMuccio, 2021; Rabin & Dutra, 2021), or specific preventive behaviors such as social or physical distancing (Adiyoso & Wilopo, 2021; Das, Abdul Kader Jilani, Uddin, Uddin, & Ghosh, 2021; Gibson, Magnan, Kramer, & Bryan, 2021; Yu, Lau, & Lau, 2021), wearing face coverings (e.g., Barile et al., 2020; Irfan et al., 2021), hand hygiene (e.g., Derksen, Keller, & Lippke, 2020; Luszczynska et al., 2021), and COVID-19 testing adherence (e.g., McElfish, Purvis, James, Willis, & Andersen, 2021; Vandrevala, Montague, Terry, & Fielder, 2022). General trends from this research suggest that beliefs about utility such as attitudes and response efficacy (e.g., Clark et al., 2020; Rabin & Dutra, 2021; Yu et al., 2021), normative beliefs such as subjective and descriptive norms (e.g., Das et al., 2021; Gibson et al., 2021; Peterson et al., 2021), and beliefs about capacity such as self-efficacy and perceived behavioral control (e.g., Adiyoso & Wilopo, 2021; Das et al., 2021; Norman et al., 2020) account for unique variance in intentions or behavior in these behavioral contexts. Beliefs about threat or risk from COVID-19, such as risk perceptions or perceived severity and susceptibility, have also been shown to have unique effects on intentions and behavior for these behaviors (e.g., Betsch et al., 2021; Vandrevala et al., 2022), but effect sizes tend to be modest by comparison, or even non-significant, when included as predictors in parallel other theory constructs (Adiyoso & Wilopo, 2021; Derksen et al., 2020; Hamilton, Smith, et al., 2020; Rabin & Dutra, 2021). This is consistent with research indicating that beliefs reflecting behavioral engagement tend to account for substantially more variance in intention and behavior than beliefs about risk from the conditions they are purported to prevent (Hagger & Orbell, 2021) – likely a consequence of the close correspondence between the measures of the beliefs and the behavior, but also because decisions to engage in these preventive behaviors are seldom focused solely on risk reduction.

The theories have also been applied to predict COVID-19 vaccine intentions (e.g., Chu & Liu, 2021; Matute, Palau-Saumell, Meyer, Derqui, & Jiménez-Asenjo, 2021; Sherman et al., 2021; Shiloh, Peleg, & Nudelman, 2021). Similar patterns of effects for key social cognition constructs on vaccine intentions have been observed as those found for other COVID-19 preventive behaviors. In a marked deviation, however, trends across these studies suggest that beliefs about the risks of the vaccines themselves and concerns about general vaccine administration such as injections, rather than risks related to COVID-19, are key correlates of vaccine intentions (Chu & Liu, 2021; Hamilton & Hagger, 2022; Matute et al., 2021; Sherman et al., 2021). However, to date, no research has provided a formal comparison of the relative effects of risk perceptions related to COVID-19 and risk perceptions relating to the vaccine itself on COVID-19 vaccination intentions. Furthermore, there is a dearth of research on the social cognition correlates of actual vaccine uptake (Shiloh et al., 2021). Taken together, application of social cognition theories has provided initial evidence of the belief-based correlates of COVID-19 preventive behaviors and contribute to an initial evidence base of potentially modifiable constructs that may be targeted in interventions.

2.3. Social cognition theories in COVID-19: limitations and solutions

Studies applying social cognition theories have provided evidence of the constructs associated with COVID-19 preventive behaviors and the mechanisms involved. However, this growing but relatively new research literature has a number of prominent limitations that restrict the extent to which inferences can be drawn from their findings and the degree to which they can be generalized broadly. The limitations include a focus on COVID-19 preventive behavioral intentions rather than behavior itself, with few studies adopting long-term behavioral follow up; a focus on direct or global measures of social cognition constructs, which neglects measures of specific sets of beliefs relevant to COVID-19 preventive behaviors; an over-reliance on cross-sectional, correlational design studies which limit inference of directionality, causality, and change in constructs, particularly behavior, over time; and an exclusive focus on the individual which eschews effects of broader socio-structural

factors and environmental context on behavior. In this section we outline the ramifications of these limitations and outline current and future research that may address these limitations.

2.3.1. A focus on intention and short-term prediction

Many studies applying social cognition theories in the context of COVID-19 preventive behaviors have focused on the prediction of intention, with relatively few providing follow-up measures of behavior (e.g., Clark et al., 2020; Das et al., 2021; Derksen et al., 2020). This is particularly the case for vaccine behavior, likely due to the challenges of collecting behavioral data and the relatively short time vaccines have been made available (for an exception, see Shiloh et al., 2021). A sole focus on intention is problematic because although intentions are an important theoretical antecedent of behavior, and are often closely associated with behavior in research on social cognition theories (e.g., Carpenter, 2010; McEachan et al., 2011; Milne et al., 2000), the relationship is far from perfect with modest effect sizes observed across studies (Sheeran & Webb, 2016). This intention-behavior ‘gap’ indicates that, for many individuals, intentions may be a necessary but not sufficient condition for behavioral enactment. Including a behavioral follow up in research applying social cognition constructs to predict COVID-19 preventive behaviors is, therefore, important as it not only permits measurement of the variance in behavior accounted for by the theory constructs, but also allows tests of the extent to which social cognition constructs of the theory are mediated by intention and the extent of intention-behavior gap.

In addition, few studies applying social cognition theories have provided long-term follow-up of behavior for any COVID-19 preventive behavior. To date, no study in this context has predicted behavior beyond a few months. This is a substantive evidence gap considering the importance of identifying the determinants of sustained participation in preventive behaviors to minimizing infection rates in the long-term. As a consequence, there is an urgent need for studies that predict behavior over time, and test the extent to which social cognition theories are able to account for sustained engagement in COVID-19 behaviors. Such research should consider adoption of multiple measures of behavior at follow-up and over time periods that extend to a year or more rather than a few weeks. Such predictive studies would have important implications for the potential sustainability of messaging interventions that target change in these beliefs.

2.3.2. Specific beliefs

A further limitation of research applying social cognition theories to COVID-19 behaviors is that they have tended not to account for specific beliefs relating for COVID-19. For example, few studies have investigated specific sets of behavioral, normative, and control beliefs purported to underpin social cognition constructs such as attitudes, subjective norms, and perceived behavioral control in the theory of planned behavior (Ajzen, 1991), or examined specific outcome expectancies or self-efficacy in the face of specific barriers in social cognitive theory (Bandura, 1986). Similarly, there is relatively little of research focusing on self-efficacy beliefs in the face of specific barriers or facilitating factors to the targeted COVID-19 preventive behavior, or specific expected outcomes with respect to performing the behavior, versions of the self-efficacy and outcome expectancy constructs identified as most potent in accounting for variance in future behavior in the original conceptualization of social cognitive theory (Bandura, 1986). This is problematic given that strategies to change behavior applying the theory necessitates forming persuasive communications that target specific beliefs with respect to the target behavior (Ajzen & Schmidt, 2020; Fishbein & Ajzen, 2010; Hamilton & Johnson, 2020).

Resolution lies in performing the necessary belief elicitation research to develop expectancy-value indirect measures of constructs in the case of the theory of planned behavior (Ajzen, 1991), or identification of salient outcomes and barriers or facilitating factors in the case of social cognitive theory (see DuCharme & Brawley, 1995), and include them as

unique predictors of COVID-19 preventive behaviors in predictive studies. Research aimed at identifying specific beliefs in research on COVID-19 preventive behaviors is being conducted, including formal elicitation of beliefs based on social cognition theory guidelines (e.g., Varol et al., 2021). In addition, researchers have included additional measures in predictive studies that encompass some specific beliefs. For example, recognition of the moral imperative for engaging in COVID-19 behaviors to protect others from infection, particularly those vulnerable to serious infection such as the elderly and immunocompromised, researchers have included moral norms as an additional predictor alongside other social cognition constructs in predictive studies. While subjective norms reflect perceived social pressure from significant others to perform a COVID-19 preventive behavior, moral norms reflect beliefs that performing the behavior is the socially responsible course of action. Results indicate an important role for this construct as an additional predictor of physical distancing intentions and behavior (e.g., Hagger, Smith, et al., 2020; Hagger, Smith, Keech, Moyers, & Hamilton, 2021) and general COVID-19 preventive behaviors (Kojan, Burbach, Ziefle, & Calero Valdez, 2021), intention to avoid COVID-19 (Raza, Ali, & Hussain, 2021), and COVID-19 vaccination intentions (Matute et al., 2021) and behavior (Shiloh et al., 2021). These studies have progressed knowledge on the social cognition correlates of COVID-19 preventive behaviors, and we look to future research that further elicits specific beliefs concerning COVID-19 prevention and examines their effects on preventive behaviors.

2.3.3. Study design and inferences

A further limitation is an overreliance on studies adopting cross-sectional and correlational designs to test the predictive validity of these theories in the context of COVID-19 preventive behaviors. Such designs are limited because they do not model change in the theory constructs and in behavior, and preclude inference of causality (Weinstein, 2007). While proposed models specifying the proposed effects of a given social cognition theory may fit well with cross-sectional data measuring theory constructs, equally plausible models that specify a different pattern of effects may fit the data equally well, even if such models may be contraindicated theoretically. In addition, such tests do not rule out that the estimated relations among the constructs on a model could be accounted for by other, unmeasured variables (e.g., other social cognition constructs such as moral norms and anticipated regret, implicit attitudes and motives, dispositional and individual difference constructs). Including a follow-up measure of behavior so as to model past behavior effects on future behavior alongside theory constructs may provide a test of theory sufficiency (Ajzen, 1991; Chatzisarantis et al., 2004), but is not informative of these extraneous factors because past behavior is not a psychological construct (Hagger et al., 2018; Ouellette & Wood, 1998). As a consequence, predictive studies of this kind provide limited evidence as means to test theoretical predictions, and additional evidence is required to permit more elaborate inferences.

The adoption of cross-lagged panel designs – longitudinal studies in which all constructs and outcomes are measured simultaneously across multiple time points – yield data that permit more elaborate inferences (e.g., Gollob & Reichardt, 1987; Liska, Felson, Chamlin, & Baccagliani, 1984). Such data allow researchers to control for a certain type of change in constructs over time, called covariance stability, and the extent to which relations among constructs at any given time points vary over time, known as stationarity. These models also enable examination of reciprocal effects among theory constructs, which permits inference of whether constructs predict outcomes, or whether the relationship occurs in the opposite direction, or in both directions over time, for example the effects of behavior on attitudes in addition to the effects of attitudes on behavior (Albarracín, 2021). Research in the context of COVID-19 preventive has demonstrated consistency of effects on social cognition constructs over time (e.g., Hagger et al., 2021). However more research is needed, which also needs to take the important step of

controlling for effects of localized restrictions, which may affect individuals' beliefs. For example, individuals' norms or outcome expectancies may vary depending on whether or not mitigation behaviors like wearing face coverings is required – they might feel confident and secure in wearing masks when it is mandated to do so, but might be embarrassed or afraid to do so when restrictions have been dropped. In addition, researchers should also heed calls to adopt optimal approaches to analyzing panel designs (Usami, 2021). In sum, longitudinal panel designs have advantages over cross-sectional or prospective designs by permitting inference on the direction of predicted effects in a theory, and the extent to which it accounts for temporal change in behavior or other outcomes over time.

However, panel designs still do not permit inference of causal effects. An effective means to evaluate causality is to adopt experimental or randomized controlled intervention designs in which the effect of change in a social cognition theory construct as a result of a manipulation of intervention strategy (e.g., provision of information on the benefits or advantages of physical distancing using a persuasive communication to target attitude change) on change in a target behavioral outcome is evaluated (Imai, Keele, Tingley, & Yamamoto, 2011). In such designs, groups of individuals from the target population are randomized to receive the intervention, while groups of individuals randomized in a comparison or control group do not receive the intervention. Intervention effects are evaluated through observed differences in the behavior measured post-intervention across the two groups while simultaneously accounting for pre-intervention variation in behavior across the two groups. Such designs better allow for causal inferences, assuming that randomization was effective and the intervention strategy or method activated change in the targeted theory construct.

There are relatively few studies that have adopted experimental and intervention research to test predictions of social cognition theories in the context of COVID-19 predictive behaviors, which is consistent with research applying social cognition theories more broadly, a trend likely attributable to the greater financial and time cost of research adopting these designs (Hagger, Cameron, et al., 2020). However, there are examples of studies demonstrating that intervention strategies targeting social cognition constructs (e.g., persuasive communication, information provision) have changed intentions toward, and actual participation in, hand hygiene behaviors and staying at home during lockdown (e.g., Capasso, Caso, & Conner, 2021; Okuhara et al., 2020; Smith et al., 2021). These studies provide preliminary evidence that persuasive communications targeting key constructs in social cognition theories lead to changes in preventive behaviors, and consistent with results of intervention studies observed for other health behaviors (Ajzen & Schmidt, 2020; Norman et al., 2018; Sheeran et al., 2016). However, the literature applying these designs is under developed, with few studies systematically demonstrating concomitant change in social cognition theory constructs and behavior, and/or utilizing such designs to verify theoretical predictions, highlighting the need for further research in the area.

2.3.4. An exclusive focus on the individual

A further critique leveled at social cognition theories concerns the almost exclusive focus on individuals' beliefs and how they impact decision making and subsequent behavior. By contrast, relatively little consideration is given to group influences, and the socio-structural and socio-environmental constructs that may also serve to line-up individuals' behavior. This is an important omission considering that individuals' behavior is not merely a function of behavioral beliefs, but also responses to salient others and group influences (e.g., the pervasiveness of normative influences), and the social environment and context in which the behavior is performed. This is highly pertinent in the context of COVID-19 given that many preventive behaviors are dependent on extraneous factors, such as the presence of lockdown and mask-wearing mandates, availability of face coverings, or layout and available space for physical distancing in indoor areas.

Although there have been attempts to account for the effects of these extraneous factors in tests of social cognition theories by specifying and measuring constructs that reflect individuals' belief-based responses to their social and physical environment, such as norms, these still reflect individuals' beliefs rather than specific group processes that may alter behavioral responses or the extent to which the context places actual constraints on behavior, both of which may not be sufficiently reflected in individuals' beliefs (Albarracín, 2021). This is in contrast to other theoretical perspectives, such as ecological models of health behavior, which explicitly outline how behavior is a function of factors that operate at multiple levels including the individual, social, and environmental levels (Sallis, Owen, & Fisher, 2015; Salmon, Hesketh, Arundell, Downing, & Biddle, 2020). While such models have been widely applied in multiple health behavior contexts, there have been few applications in the context of COVID-19 preventive behaviors with considerable scope for their adoption in future research in this context (e.g., Latkin et al., 2021). In addition, there have been attempts to integrate constructs and predictions from social cognition theories with the broader factors derived from ecological models to provide more comprehensive explanations of health behavior and the process involved (e.g., Rhodes, Saelens, & Sauvage-Mar, 2018). We return to integrated approaches that incorporate socio-structural variables within social cognition theories and highlight their value in the context of COVID-19 prevention later in the article.

3. Integrated theories: developing comprehensive but parsimonious models

There is general acknowledgment within the behavioral science community that social cognition theories have boundary conditions that delimit the extent to which their inferences apply. As a consequence, theorists and researchers have sought to augment or further develop the theories to expand their range of prediction and increase the comprehensiveness of the behavior explanations they offer (Hagger, 2009; Montaña & Kasprzyk, 2015). Foremost among these efforts has been the development of integrated theories that draw constructs and processes from multiple theories and models of human behavior and aim to address boundary conditions of unitary theories. Integrated theories offer two important advances on existing theory: They provide a means to highlight and eliminate redundancy in the constructs and processes used across theories toward the goal of identifying a core set of constructs that have optimal distinctiveness conceptually, and demonstrable discriminant and predictive validity empirically; and they enable the introduction of additional constructs and processes that assist in addressing the boundary conditions that delimit the explanations offered by existing theories (Hagger, 2009; Hagger & Hamilton, 2020). Integrated theories, therefore, provide the opportunity to expand the range of falsifiable predictions of existing social cognition theories while retaining optimal parsimony, two key features of a 'good' or 'strong' theory (Davis, Campbell, Hildon, Hobbs, & Michie, 2015).

3.1. Theory integration: a rationale

A primary goal of theory integration is to promote theory parsimony by identifying a core set of constructs that are sufficiently unique, conceptually and empirically, that form the basis of theory predictions. This has value to those interested in changing behavior by assisting in identifying a core set of psychological constructs that optimally capture the mental processes central to decision making (McMillan & Conner, 2007), and can be activated or changed through intervention (Avishai, Brewer, Mendel, & Sheeran, 2021). However, considerable redundancy has been observed in the definition, conceptualization, operationalization, and measurement of the vast array of social cognition constructs across theories. This is not a new phenomenon, and it has been recognized as a perennial problem in psychology, often referred to as a 'jangle' fallacy: multiple constructs with similar content but differing

labels (Block, 1995; Hagger, 2014; Kelley, 1927). Theorists wary of this fallacy have sought to develop means to address this redundancy by developing schemes to analyze the content of constructs across theories in order to identify commonalities and redundancy. In the context of social cognition theories applied in health contexts, researchers have developed similar schemes and have identified core constructs (e.g., McMillan & Conner, 2007; Protogerou, Johnson, & Hagger, 2018). For example, McMillan and Conner (2007) identified five core constructs across an analysis of multiple social cognition theories: dispositions to act (e.g., protection motivation, intentions), attitudes (e.g., outcome expectancies, affective attitudes), norms (e.g., subjective norms, social support), self-perceptions (e.g., self-esteem), and control (e.g., self-efficacy, perceived behavioral control). These methods are exemplary of an important process that is necessary when integrating theories to minimize redundancy in the constructs adopted and ensure that the constructs represented are likely unique and, therefore, are adequate in capturing the constructs likely to account for variance in behavior.

The major contribution of theory integration to advancing knowledge on individuals' behavior, however, is the introduction of additional processes that address the boundary conditions of extant theories (Hagger, 2009; Hagger & Hamilton, 2020; Jacobs, Hagger, Streukens, De Bourdeaudhuij, & Claes, 2011). The integrated theories aim to provide more comprehensive behavioral explanations in terms of the mechanisms involved or account for more variance in behavior, and may also pave the way for theory-based interventions that have greater efficacy and efficiency in changing behavior or greater scope in changing behavior across contexts or populations. Of course, development of these integrated approaches needs to be tested against observation in studies adopting appropriate designs to test the predictions of the 'new' theory (Hagger, Gucciardi, & Chatzisarantis, 2017). Next, we outline two prominent examples of theory integration using social cognition theories applied to health behavior contexts: integration of dual-phase approaches and planning, and integration of dual-process models to account for non-conscious, automatic processes. We illustrate how these examples have yielded more comprehensive theories and better behavioral explanation. We also demonstrate how these integrations have demonstrated utility advancing the prediction of engagement COVID-19 preventive behaviors.

3.2. Augmenting theories to account for action phases

Integrated theories have been instrumental in addressing the intention-behavior 'gap' observed in social cognition theories. The modest association between intention and behavior across social cognition theories applied in health contexts suggests individuals do not necessarily readily act on their intentions (Orbell & Sheeran, 1998; Sheeran & Webb, 2016). Researchers have addressed this problem by integrating processes from other theories on self-regulation (Leventhal, Meyer, & Nerenz, 1980), and, particularly, dual-phase models of action, such as the model of action phases (Heckhausen & Gollwitzer, 1987), into traditional social cognition theories like the theories of reasoned action and planned behavior (Orbell, Hodgkins, & Sheeran, 1997). Dual-phase models propose different phases of action, and, in particular, distinguish between an intentional or *motivational* phase in which intentions to perform a behavior to attain an outcome are formed, and an implemental or *volitional* phase in which intentions are augmented with specific action plans in order to enact the behavior. It is predicted that the extent to which individuals form plans, particularly plans that link the behavior with salient environmental cues that line up the behavior, enhances intention enactment and strengthens the intention-behavior relationship. Some integrated theories, such as the health action process approach (HAPA; Schwarzer, 2008), include multiple phases by design and encompass different types of planning as a conduit between intentions and behavior (for comprehensive descriptions of the HAPA see Schwarzer & Hamilton, 2020; Zhang, Zhang, Schwarzer, & Hagger, 2019).

Tests of social cognition theories that integrate predictions from dual-phase models have demonstrated that planning constructs account for significant variance in intentions (e.g., Zhang et al., 2019), and moderate the intention-behavior association upward (e.g., de Bruijn, Rhodes, & van Osch, 2012). In addition, intervention and experimental studies have shown that individuals prompted to form action plans are more likely to follow-through on their intentions (e.g., Armitage, 2004; Hagger et al., 2012; Orbell et al., 1997). Research illustrates that such planning interventions work by promoting greater recall of the intended action (Orbell et al., 1997), and more efficient or 'automatic' behavioral enactment (Martiny-Huenger, Martiny, Parks-Stamm, Pfeiffer, & Gollwitzer, 2017) – key mechanisms by which plan formation leads to behavior change. Broad support for these planning interventions has been demonstrated in research syntheses (e.g., Gollwitzer & Sheeran, 2006), illustrating the applied value of integrating a dual-phase approach within social cognition theories in the context of behavior change.

Dual-phase approaches have demonstrable applicability in the context of COVID-19 preventive behaviors (Harvey, Armstrong, Callaway, Gumport, & Gasperetti, 2021). Specifically, research adopting the HAPA has demonstrated associations between intention and planning constructs in studies targeting general COVID-19 preventive behaviors (Lin et al., 2020), and physical distancing (Beeckman et al., 2020; Hamilton, Smith, et al., 2020), hand washing (Lao, Li, Zhao, Gou, & Zhou, 2021; Luszczynska et al., 2021), and wearing face coverings (Lao et al., 2021) behaviors. Furthermore, direct effects of planning constructs on behavior were found in some of the studies (Beeckman et al., 2020; Lao et al., 2021; Lin et al., 2020; Luszczynska et al., 2021), and that they mediated intention effects on behavior (Beeckman et al., 2020; Lin et al., 2020; Luszczynska et al., 2021), implicating planning in the process by which intentions are enacted. A specific form of planning, known as implementation intentions or "if-then" plans (Gollwitzer, 1999), has also been proposed as moderator the intention-behavior relationship, suggesting that individuals who plan may be more likely to follow through on their intentions. Studies have indicated that compliance with interventions using if-then plans leads to greater adherence to physical distancing guidelines (Ahn et al., 2021; Bieleke, Martarelli, & Wolff, 2021).

These findings illustrate that integration of planning from dual-phase models in social cognition theories broadens their capacity to explain intention-behavior relations and inform interventions to promote COVID-19 preventive behaviors. However, currently available research applying these integrated approaches is relatively sparse and confined to only a few COVID-19 preventive behaviors. In addition, there are very few studies adopting experimental and randomized-controlled designs examining effects of planning strategies on COVID-19 preventive behaviors. There are also a number of outstanding questions that need to be addressed, such as the specific mechanism by which planning leads to behavioral enactment – a mediating process in which planning forms part of the decision-making process, as specified in the HAPA (Schwarzer, 2008), or a moderating process in which planning promotes intention enactment, an explanation consistent with the model of action phases (Heckhausen & Gollwitzer, 1987). There is also little research examining some of the potential mediators of planning on these behaviors such as recall of the intended behavior and greater accessibility of the behavior when the cue or condition stated in the plan is presented. We therefore call for studies that test planning effects in a broader range of COVID-19 preventive behaviors, adopt intervention or experimental designs, and mediation and moderation effects.

3.3. Augmenting theories to account for automatic processes

A fundamental assumption of social cognition theories is that actions are a function of reasoned, rational decision making based on available information (Conner & Norman, 2015a, 2015b; Fishbein et al., 2001). An alternative, but not incongruous perspective, is offered by theories of

implicit cognition, which outline how stored knowledge structures that link behaviors, contexts, and evaluations lead to behavioral initiation and enactment beyond an individual's awareness (Hagger, 2016; Sheeran, Gollwitzer, & Bargh, 2013). These implicit or *automatic* processes tend to control many everyday behaviors for which elaborate, reasoned decision making is both unnecessary and inefficient, and particularly mundane behaviors with which individuals have copious prior experience (Gardner, Lally, & Wardle, 2012; Wood, Quinn, & Kashy, 2002). According to these approaches, individuals learn over time to associate behavioral responses with concomitantly-experienced information such as cues or initiating events or evaluations in memory in organized knowledge structures or schema. Subsequent presentation of a triggering event or evaluation linked to the behavioral response leads to rapid, efficient activation of the behavior. Accordingly, dual-process theories of social cognition have been proposed aimed at providing more comprehensive explanations of behavior and to evaluate the extent to which target behaviors are determined by reasoned and automatic processes, and the conditions that might determine when each process predominates (Strack & Deutsch, 2004; Wood, Labrecque, Lin, & Rüniger, 2014).

In predictive tests of dual process theories, reasoned processes are represented through the effects of constructs traditionally specified in social cognition theories such as attitudes, norms, risk perceptions, and self-efficacy (e.g., Bandura, 1986; Fishbein & Ajzen, 2010). In contrast, automatic processes tend to be inferred from constructs representing different types of implicit cognition such as implicit attitudes and motives and measures of habit, (e.g., Hagger, Trost, Keech, Chan, & Hamilton, 2017; Hamilton, Gibbs, Keech, & Hagger, 2020), or affective desires or behavioral prepotency that reflect impulse-related tendencies, internal drive states, and cue salience (e.g., Gibbons, Gerrard, Blanton, & Russell, 1998; Hall & Fong, 2007). Incorporating these types of construct in predictive studies of social cognition theories enables researchers to estimate the relative contribution of each to explaining variance in a target behavior. For example, given that implicit cognition is assumed to bypass the reasoned processes that lead to behavior, effects of constructs representing implicit processes are expected to relate to behavior directly, unmediated by intentions. Studies adopting this integrated approach have demonstrated unique effects of implicit attitudes and motives on behavior independent of intentions and other social cognition constructs (e.g., Hamilton, Gibbs, et al., 2020; Keatley, Clarke, & Hagger, 2012). A similar pattern of effects has been found for measures of habit, a specific form of automaticity that is cue- or context-dependent but unrelated to goal pursuit (Brown, Hagger, & Hamilton, 2020; Hamilton, Kirkpatrick, Rebar, & Hagger, 2017; Verplanken & Orbell, 2003). In addition, there is research that has illustrated that certain types of behavior, such as those that are less complex, have high propensity to be formed as habits, or demand less deliberative or reasoned consideration, are more likely to be impacted by implicit cognition and habit (Verplanken, 2006). In addition, effects of traditional social cognition constructs have smaller effects on behavior when individuals report higher levels of implicit attitudes or habit. For example, habits and implicit attitudes have been shown to moderate the intention-behavior relationship (Divine, Berry, Rodgers, & Hall, 2021; Gardner, Lally, & Rebar, 2020). Taken together, predictive studies applying integrated approaches that incorporate constructs that represent automatic processes have provided useful information on the contribution of non-conscious processes that lead to behavior and the moderating conditions.

Predictive studies examining dual process effects are expected to provide important insight into potentially efficacious intervention strategies. In behavioral contexts where implicit cognition or habit account for non-trivial variance in an undesired behavior, interventionists can select strategies that block or counter cues and initiating events, or promote skills that assist in overriding or managing the behavioral response (Duckworth, Gendler, & Gross, 2016; Gardner, Rebar, & Lally, 2020). These include strategies such as environmental or context

restructuring, which aim to limit or dampen the salience of the cues (e.g., altering the layout of a grocery store so as to reduce capacity or density of checkout queues or lines), or cue identification, monitoring, and management that aim to provide individuals with an awareness of the conditions that lead to the unwanted behavior (e.g., signage or notices illustrating how viruses spread when an unmasked individual coughs, floor markers showing recommended social distance, provision of hand sanitizer at points of entry to venues), capacity to identify when the cues occur (e.g., facilitating mental imagery of a typical trip to a grocery store and the frequency of contact with people on the way), and knowledge of an appropriate alternative response (e.g., prompting practice with booking a rapid antigen test in the event of exposure). In contexts where implicit cognition or habit explain substantive variance in a desired behavior, strategies that enhance habits or cue-dependent responding are appropriate. These might include habit-forming strategies such as repetition of the behavior in stable contexts and providing reinforcement for successful behavioral performance.

In the context of COVID-19 preventive behaviors, studies integrating constructs from dual-process models have provided preliminary evidence to indicate the relevance of automatic processes in predicting behavior and elucidating the mechanisms involved. For example, research adopting prospective and longitudinal designs has indicated that habits account for unique variance in physical distancing behavior in two national samples, effects which hold when accounting for past behavior (Hagger, Smith, et al., 2020; Hagger et al., 2021). Importantly, these results also indicate, unsurprisingly, that there is substantive stability in habits across three time points, and consistency in their effects on behavior unmediated by intentions, congruent with proposals of dual-process theories. However, it must be stressed that effect sizes for the habit effects in these samples and for this behavior were relatively modest, particularly relative to effects of intentions and the other social cognition constructs. To speculate, it may be that physical distancing requirements vary from context to context, which means the cues to this behavior may not be sufficiently consistent, necessitating reasoned consideration on the part of the actor when making decisions to act in future. It is also a relatively 'new' behavior for many, so there may have been less opportunity for many to form habits, especially given time to form a habit varies considerably across individuals (Lally, van Jaarsveld, Potts, & Wardle, 2010). Research is needed to explore potential moderators of habit effects in research on physical distancing in the context of COVID-19, such as the extent to which individuals have had the opportunity to practice physical distancing in the same context. More broadly, research is needed to corroborate habit effects for other COVID-19 preventive behaviors.

4. Mechanisms of action

While researchers have long recognized the value of theory in informing behavior change interventions, many interventions do not have a clear basis in theory despite claims to the contrary by intervention developers (e.g., Michie et al., 2018). A major issue for these interventions is the lack of systematic mapping of theoretical principles on to the content and components of the intervention resulting in 'theory inspired' rather than 'theory based' interventions (Michie et al., 2018). Advances in the scientific study of behavior change has sought to formalize the processes of development and subsequent description of the theoretical constructs targeted in behavioral interventions, the strategies or *techniques* that form the content of the intervention and how it is delivered (Kok et al., 2016; Michie et al., 2013), and the links between them that specify how the intervention 'works', that is, the process or *mechanism* by which the intervention acts to change behavior (Rothman et al., 2020; Sheeran et al., 2017). To this end, researchers have used expert consensus and reviews of the extant literature on behavioral interventions to develop organized characterizations or *taxonomies* of behavior change techniques, and specified links between techniques from taxonomies and the psychological constructs, many

originating from social cognition theories, they are purported to change or activate in order to change behavior, known as *mechanisms of action* (Avishai et al., 2021; Hagger, Moyers, et al., 2020; Rothman et al., 2020; Sheeran et al., 2017). Research is beginning to provide indication of associations between the identified behavior change techniques and theory-based constructs implicated in their mechanisms of action through expert consensus and reviews of stated associations in the extant literature (Carey et al., 2019; Connell et al., 2019). There is also research that has identified how theory-based techniques targeting change in social cognition constructs change intention and behavior (Knittle et al., 2018; Sheeran et al., 2016). Together this work has advanced knowledge by providing a common, formal nomenclature to describe the techniques that form the content of behavioral interventions, and enabled researchers to better specify how interventions work in changing behavior through change or activation of the theory-based constructs involved. Importantly, it has highlighted the value of developing interventions based on theory, the importance of formal specification of the mechanism of action involved, and facilitated greater clarity and precision in intervention description that enables more effective research syntheses and conceptual replications of interventions.

Providing strong evidence to support the mechanisms of action of behavioral interventions necessitates randomized controlled trials or experimental research designs that demonstrate the effect of behavior change techniques that form the content of the interventions on change in the target theoretical constructs and concomitant change in behavior (Hagger, Moyers, et al., 2020; Rothman et al., 2020; Sheeran et al., 2017). Verification is derived from testing the mediation of the effect of the intervention on behavior change by change in the theoretical construct. This test of a mechanism of action is illustrated in Fig. 1 (Hagger, 2019). The effect of the intervention on change in the theoretical construct (path *a*, Fig. 1) and the effect of change in the construct on behavior change (path *b*, Fig. 1) constitutes the indirect or *mediated* effect of the intervention on behavior that should fully or, at least, partially account for the direct effect (path *c*, Fig. 1) on behavior. From an analytic perspective, the mediated effect is tested, the residual effect of the intervention on behavior (path *c'*, Fig. 1) should be attenuated to

zero for full or complete mediation, or to a significantly smaller value for partial mediation. Such tests provide clear evidence in support of the proposed mechanism of action of a behavior change intervention. It is important to note that the change in the mediator should occur in advance of the changes in the behavior, otherwise the mediator may just signal or be broadly indicative of the mechanism (Kazdin, 2007). Testing for the effects of extraneous moderators, such as interpersonal or intrapersonal characteristics, or contextual or environmental variables, of the mediated effect is also indicated by these tests, and would elucidate the extent to which the mechanism accounts for behavior change across such contexts. It is also important that such tests utilize factorial designs that enable isolation of the effects of specific techniques and their mechanisms, which would resolve a perennial problem in cases where interventions use multiple techniques in a single intervention.

A proliferating body of research has conducted formal tests of the mechanism of action of behavioral interventions adopting theory-based behavior change techniques to change behavior. For example, studies have demonstrated that interventions adopting randomized controlled designs and applying techniques targeting change in attitudes (Chatzisarantis & Hagger, 2005), social support (Quaresma, Palmeira, Martins, Minderico, & Sardinha, 2014), and self-efficacy (Larsen et al., 2021) changed physical activity behavior in the target populations through the mediation of change in the measures of the targeted constructs. However, such tests are not routinely conducted – a recent set of meta-reviews indicated that evidence supporting mechanisms of action using mediation tests is sparse and has not advanced significantly over the years (Suls et al., 2020). Meta-analytic research syntheses of behavioral intervention studies have offered some insight demonstrating that interventions that change constructs from social cognition theories, such as attitudes, subjective norms, and self-efficacy, also result in concomitant change in behavior (Sheeran et al., 2021; Webb & Sheeran, 2006). However, the change observed using these meta-analytic designs still do not provide definitive evidence for mediation. Alternative approaches to research synthesis have formally tested mediation demonstrating indirect intervention effects on behavior through theory-based constructs across studies (Rhodes, Boudreau, Weman Josefsson, & Ivarsson, 2020; Sheeran et al., 2020). However,

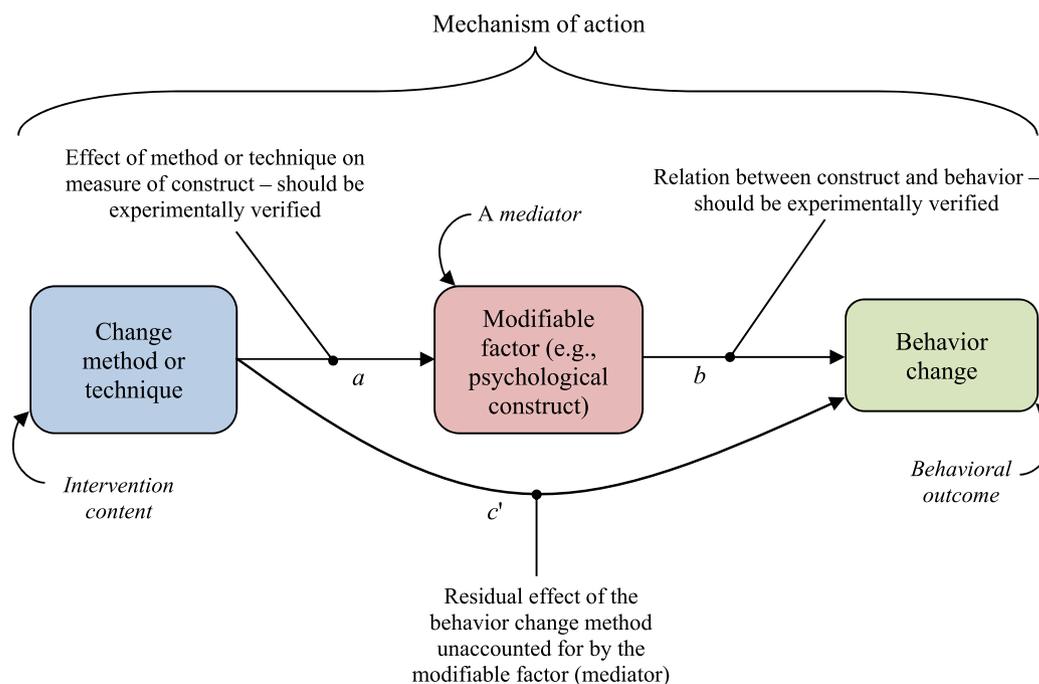


Fig. 1. Diagram of a behavior change mechanism of action (Hagger, M. S. (2019). Basic model of a behavior change mechanism of action. *PsyArXiv*. <https://doi.org/10.31234/osf.io/9a5k6>).

these syntheses are still sub-optimal means to test the mechanisms as the synthesized data did not provide evidence for the effect of *change* in the theoretical constructs on change in behavior, both as a result of the intervention, so that association may still be affected by extraneous variables.

Specifying the theoretical basis for behavioral interventions and testing their mechanisms of action in the context of COVID-19 preventive behaviors holds considerable promise in advancing knowledge on how interventions work and their breadth of application. Such an approach together with judicious testing of contextual attributes such as location and target population may provide important evidence of the contexts in which interventions targeting social cognition constructs, such as attitudes and risk perceptions, are likely to have optimal efficacy. However, although a small number of randomized controlled designed interventions adopting techniques aimed at changing behavior through changes in social cognition theory constructs have been reported (e.g., Ahn et al., 2021; Keller et al., 2021; Okuhara et al., 2020; Smith et al., 2021), none have tested mechanisms of action using the proposed mediated effects. Given the paucity of this research we recommend the need for interventions based on social cognition theories that test mechanisms of action. Such interventions should use optimal methods including randomized controlled designs and sufficient measures to model behavior change through putative mediators of intervention techniques. These interventions should also be pre-registered consistent with open science guidelines (Hagger, 2022).

5. Future directions

In previous sections we outlined the value of application of social cognition theories in the prediction of COVID-19 preventive behaviors, and their utility in informing behavioral interventions that are optimally efficacious in changing these behaviors. We provided an overview of the current state of the research literature applying these theories in these contexts, and, along the way, highlighted some important avenues for future research, including the need for predictive studies adopting cross-lagged panel and experimental designs to better infer directionality and causality in theory effects; the need for more research testing the prediction of social cognition theories that integrate additional salient processes from other theories to provide comprehensive, optimally parsimonious predictions of these behaviors; and the need for more theory-based interventions testing effects of specific behavior change techniques with formal mediation analyses to test their mechanisms of action. Next, we outline additional research directions that will make important contributions to knowledge on the determinants of preventive behaviors as the global COVID-19 pandemic evolves, and will provide important formative knowledge to inform ongoing intervention and messaging efforts toward the pandemic 'endgame' and a shift toward COVID-19 as an endemic illness with threat levels commensurate with other endemic viruses like influenza and the common cold.

5.1. Moving from pandemic to endemic management of COVID-19

There is a need for data on application of social cognition theories to predict preventive behaviors under conditions of endemic management of COVID-19. The theories may provide insight into the determinants of preventive behaviors in isolated outbreaks, short-term 'circuit breaker' lockdown measures, and ongoing 'booster' vaccination, measures that are likely needed in the foreseeable future to manage the infections. Unsurprisingly, research to date has focused exclusively on preventive behaviors under global pandemic conditions, and ongoing waves of infection including breakthrough infections among the vaccinated population suggest that the pandemic is currently far from over. Continuing research focusing on social cognition determinants of preventive behaviors under current conditions, therefore, has immediate value and is essential to ongoing management. However, preparation for long-term management of COVID-19 infections in the transition from

pandemic to endemic conditions needs an evidence base. This can be provided through studies in which hypothetical future COVID-19 conditions are proposed (e.g., the advent of a localized outbreak) followed by measures of social cognition beliefs and intentions to engage in preventive behaviors as a response. Such research may inform messaging interventions relevant to ongoing infection management as pandemic-level infection rates subside and are replaced by isolated outbreaks and seasonal waves.

With the recognition that the immunity afforded by COVID-19 vaccines wanes over time (Naaber et al., 2021), governmental health agencies have approved and recommended the administration of an additional vaccine dose to boost immunity (CDC, 2021a; Jvci, 2021). These 'booster' vaccines are likely to become an ongoing requirement to maintain immunity and minimize infection transmission, particularly to those who are most vulnerable to serious bouts of the illness (Krause et al., 2021). Social cognition theories may offer insight into the determinants likely associated with the uptake of these 'booster' vaccine doses, with a view to informing public health messages aimed at promoting adherence to booster vaccine recommendations. The theories may contribute to identification of the beliefs salient to booster vaccine intentions and behavior, such as apathy, fatigue, and decreased perceptions of vulnerability and severity, which may lead the previously vaccinated to fail to get a booster vaccine (Hagger & Hamilton, 2022). Identification of these beliefs may signal potential strategies to counter such perceptions.

5.2. Social cognition, health disparities, and COVID-19

From the onset of the pandemic, studies have demonstrated considerable disparities in COVID-19 infection rates and outcomes related to the illness including serious cases, 'long COVID', and mortality rates in minority groups, particularly racial and ethnic groups that have historically been underserved and those from low incomes and educational backgrounds (CDC, 2020). There is also evidence to suggest disparities in COVID-19 preventive behaviors in these groups, particularly for vaccination (Ndugga, Hill, Artiga, & Haldar, 2021). Recent research has suggested that such behavioral disparities in health contexts may be manifested in the social cognition constructs that line up these behaviors. For example, studies have indicated that constructs from social cognition theories mediate the associations between socio-structural variables that indicate health disparities (e.g., race and ethnicity, income, education) on health behavior participation (Hagger & Hamilton, 2021; Orbell, Szczepura, Weller, Gumber, & Hagger, 2017). These data suggest that individuals from underserved minority groups, on low incomes, or with lower levels of education may be less likely to view illnesses and other risky conditions as threatening, and report lower self-efficacy with respect to health behaviors, which manifests in lower participation in health behaviors. Furthermore, these socio-structural variables also moderate relations among constructs and behavior in social cognition theories (Schüz, Brick, Wilding, & Conner, 2020). For example, individuals from low income and education backgrounds are less likely to act on their intentions, which may be the result of lower expectation of control over their behavior due to experiences of healthcare inaccessibility or disenfranchisement from healthcare services. Recent research has corroborated these moderating effects in eight COVID-19 preventive behaviors including physical distancing, restricting time outside the home, and wearing facemasks (Schüz et al., 2021). Larger intention-COVID-19 preventive behavior relations were observed in less socio-economically deprived groups. The research provides preliminary information on the mechanisms to which observed disparities in preventive behaviors could be attributed. It may also signal potential targets for interventions that may be effective in promoting behavior change in these groups when the source of disparities are difficult to modify or change in the short term.

5.3. Traits in social cognition theories

While there is emerging research examining effects of traits or trait-like constructs such as personality and other intrapersonal individual difference constructs on COVID-19 preventive behaviors (e.g., Nofal, Cacciotti, & Lee, 2020), there is little research that has explored the effects of these dispositional constructs in the context of social cognition theories. Incorporating trait-like constructs into social cognition theories may indicate mechanistic explanations for how these dispositions relate to behavior. A central premise of many social cognition theories is that trait-like constructs serve as sources of information in the decision-making process and inform individuals' beliefs with respect to performing a target behavior in future (Ajzen, 1991; Bandura, 1986). Empirically, therefore, social cognition constructs should act as mediators of effects of dispositions on behavior. Accordingly, verifying that such constructs serve as distal correlates of behavior, will provide potential information on the constructs that should be targeted to change behavior, particularly among groups with specific traits. Tests of these proposed mediation effects in health contexts abound. For example, researchers have demonstrated that dispositional constructs that reflect better capacity to pursue goal-directed behaviors, such as the conscientiousness personality trait and trait self-control, are associated with greater participation in health behavior mediated by social cognition constructs such as attitudes and self-efficacy (e.g., Bogg, 2008; Conner & Abraham, 2001; Hagger et al., 2019).

The mediation of traits on behavior in social cognition theories has been tested in the context of COVID-19 preventive behaviors. As an illustrative example, personality traits openness to experience and agreeableness personality traits on adherence to COVID-19 prevention guidelines were mediated by attitudes, and both attitudes and perceived norms, respectively (Bogg & Milad, 2020). A finding that suggests that individuals with tendencies to be more socially agreeable and open-minded are more likely to hold beliefs in the utility of COVID-19 preventive behaviors, and view their social environments as supportive, which may be implicated in their decisions to engage in those behaviors. Analogously, highly politicized context of COVID-19 prevention, political orientation, a summary of individuals' political beliefs as liberal or conservative, is a trait-like construct that would be expected to affect individuals' decision making with respect to COVID-19 preventive behaviors. For example, studies have indicated that political orientation has been shown to be associated with COVID-19 vaccine intentions, with conservatives less likely to intend to perform behaviors such as mask wearing and getting vaccinated (e.g., Hamilton & Hagger, 2022; Huynh, Zsila, & Martinez-Berman, 2022). Further, effects of political orientation on booster vaccine intentions has been shown to be fully mediated by social cognition constructs (attitudes, subjective norms, perceived behavioral control, risk perceptions), with more conservative beliefs related to lower intentions (Hagger & Hamilton, 2022). These findings highlight the importance of considering political beliefs as a trait that informs individuals' estimates of their intentions in this context. Incorporating measures of political orientation in social cognition theories may, therefore, assist in explaining the mechanisms underpinning these effects.

A further, seldom-investigated role for traits or trait-like constructs in social cognition theories is their role in moderating the effects of social cognition constructs on intention and behaviors. Traits may magnify or diminish effects of key social cognition constructs on intention and behavior, and may, therefore, be directly implicated in the decision-making process. For example, research indicates that conscientiousness and extraversion personality traits moderate the intention-behavior relationship in the domain of physical activity, with larger intention-behavior relations observed at higher levels of these traits (Rhodes, Courneya, & Hayduk, 2002). This finding indicates that individuals with greater work ethic and those who have greater tendency to explore new opportunities tend to be more effective in acting on their exercise intentions. Similarly, research demonstrates that

conscientiousness moderates the effect of affective attitudes on intention, such that the affective attitude-intention relationship was smaller among those reporting high conscientiousness (Rhodes et al., 2002). This suggests that individuals scoring higher on conscientiousness are less likely to base their intentions on a consideration of affective, impulse-related outcomes (e.g., "exercise makes me feel good) and more likely to base them on cognitive, utility-based outcomes (e.g., "exercise will make me fitter").

Numerous traits have been explored as determinants of COVID-19 preventive behaviors, including personality constructs (Zettler et al., 2022) and need for cognition (Xu & Cheng, 2021), but relatively few as moderators of intention-behavior relations or effects of social cognition constructs on intentions. As in the mediation analyses reported previously, political orientation would be expected to impact individuals' decision making in the context of COVID-19 preventive behaviors. As an illustration, political orientation has been shown to moderate effects of perceived determining factors like catastrophic potential, dread, and moral nature on risk perceptions, a social cognition construct (Ju & You, 2022). However, there has been few investigations examining political orientation as a moderator within social cognition models, particularly its role as a moderator of the intention-behavior relationship. To speculate, individuals with more conservative political beliefs may not only be less likely to form intentions to perform behaviors viewed as overly-restrictive, or associated with government overreach, such as face mask wearing, but may also be less likely to act on their intentions because their beliefs may place limits on their desire to act non-normatively. As such, political orientation would be expected to moderate the intention-behavior relationship. We look to future research to explore such effects.

Taken together, knowledge that traits and enduring beliefs such as personality and political orientation are both associated with individuals' specific beliefs regarding performing COVID-19 preventive behaviors, and may moderate their effects on behavior, highlights the need for tailored interventions, or dedicated messages, aimed at countering or challenging those behavioral beliefs. Future research should seek to verify these predictions and test the efficacy of messaging aimed at promoting COVID-19 preventive behaviors in groups defined by specific dispositional characteristics.

5.4. Affective processes

Incorporation of constructs that represent affective processes in social cognition theories has made an important contribution to explaining variance in health behavior. For example, numerous studies have incorporated constructs representing anticipated affect, including the affective component of attitude and constructs such as anticipated regret and negative emotion, into predictive tests of these theories in health behavior contexts (e.g., Ravis, Sheeran, & Armitage, 2009). Generally, anticipated affective responses have been shown to predict behavior via the mediation of intentions, but also directly, suggesting that affective considerations not only inform decision making, but may also lead to impulsive or automatic behavioral engagement (e.g., Conner, McEachan, Taylor, O'Hara, & Lawton, 2015). Exploring effects of these constructs may also provide salient information on the determinants of COVID-19 preventive behaviors. For example, anticipated affect constructs such as regret have been shown to be related to physical distancing behavior, but effects are small and tend to be usurped by other constructs that have greater salience, such as moral norms (Hagger, Smith, et al., 2020). Similarly, fear and worry of COVID-19 infection has also been shown to predict intentions to perform COVID-19 preventive behaviors (Coifman et al., 2021), and have been shown to be mediated by constructs from the theory of planned behavior (Yahaghi et al., 2021). In such cases, fear perceptions serve as an information source in decision making toward these preventive behaviors, a process consistent with the premise from social cognition theories that threat perceptions are likely to compel individuals to select a course of

behavior to manage the threat.

These findings notwithstanding, there is a relative dearth of research examining affective processes in the context of social cognition theories in COVID-19. Such approaches have much potential to inform knowledge given that affective beliefs are likely to be highly salient to making decisions for some COVID-19 preventive behaviors, such as vaccination (Chou & Budenz, 2020). Similarly, researchers should also consider examining the moderating conditions that determine whether affective beliefs, such as affective attitudes, are likely to be most salient when predicting intentions to perform these behaviors alongside utilitarian beliefs, such as cognitive attitudes. Such research may provide further insight into the relative contribution of affective processes in decision making, and a basis for the development of targeted messages in behavior change interventions that promote engagement in preventive COVID-19 behaviors.

6. Conclusion

Minimizing the transmission of COVID-19 infections requires widespread adherence to COVID-19 preventive behaviors that include mitigation measures (e.g., physical distancing, wearing face coverings, avoiding gathering in large groups, engaging in sanitization behaviors, participating in rapid testing) and immunization through vaccination. Adherence, however, is sub-optimal for many of these behaviors, necessitating health authorities to intervene to promote uptake and maintenance of these behaviors going forward. Such behavior change interventions should be informed by theory and evidence derived from behavioral science. Social cognition theories have made substantive contributions to the identification of the belief-based determinants of health behavior (e.g., attitudes, norms, self-efficacy, risk perceptions). In addition, research based on these theories has led to the specification of links between theoretical constructs and behavior change techniques purported to change them, known as mechanisms of action. Application of social cognition theories in the context of COVID-19 has identified the salient predictors of multiple preventive behaviors. Furthermore, integrated approaches have also demonstrated the salience of additional constructs, like moral norms and anticipated affect, and processes, such as planning and habits, in accounting for unique variance in these behaviors. Importantly, these data have begun to inform behavior change interventions adopting techniques targeting the social cognition constructs shown to be related to COVID-19 preventive behaviors. However, few interventions in this context have a strong basis in theory, and none have tested theory-based mechanisms of action.

Considering these evidence gaps in research on COVID-19 preventive behaviors, future studies should test social cognition theory predictions using cross-lagged panel, randomized controlled, and experimental designs that better enable inference of directionality and causality. There is also the need to apply these theories to predict emergent preventive behaviors such as booster vaccination, and to the management of COVID-19 as an endemic illness. We also call for research that incorporates socio-structural variables, individual difference constructs, and constructs representing affective processes into existing theories to address key questions on the determinants of COVID-19 preventive behaviors. These recommendations will broaden the contribution that applying social cognition theories makes to an evidence base to inform efficacious and efficient behavior change interventions in the context of COVID-19 prevention.

CRedit authorship contribution statement

Martin S. Hagger: Conceptualization, Writing – original draft, Writing – review & editing. **Kyra Hamilton:** Conceptualization, Writing – original draft, Writing – review & editing.

Declarations of competing interest

The authors declare no conflicts of interest with the work conducted in this study. All views expressed are solely those of the authors. The other authors have no financial disclosures.

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