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Development and initial validity of the Exercise-Related Cognitive Errors Questionnaire

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ABSTRACT

Objective: Cognitive errors (CEs) reflect individuals' biased evaluations of context-relevant information. In the exercise domain, a valid form of exercise CE assessment is needed. The Exercise-related Cognitive Errors Questionnaire (E-CEQ) was developed to determine to what extent adults make cognitive errors regarding exercise decisions. The purpose of this study was to develop and provide initial validity evidence for the E-CEQ.

Design: The current study used an online self-report survey.

Method: First, 24 initial vignettes representing 6 CEs were created and content validated. Second, data from 364 adults (M_{age} = 29.1, SD_{age} = 11.6; 81.3% female) was gathered to examine the E-CEQ's factor structure. Finally, data from the 364 participants was used to examine aspects of criterion-related validity.

Results: A 16-item, three-factor model was retained as the final E-CEQ factor structure and had good psychometric properties (χ^2 = 164.35, df = 75, p < .001; RMSEA = .057; CFI = .947; TLI = .915). Evidence of the questionnaire's predictive utility is provided. For example, exercise CEs were negatively related to exercise and accounted for 4.9% of additional variance beyond the contribution of past exercise in predicting exercise intention.

Conclusions: The steps taken to examine different forms of validity helped provide a platform from which to continue (a) to study biases linked to cognitive errors and (b) the E-CEQ validation process through ongoing investigation.

Despite the well-known benefits of regular physical activity engagement, only 15% of Canadians (Statistics Canada, 2013) and 31% of Europeans (World Health Organization, 2015) are sufficiently active to meet physical activity guidelines to accrue health benefits. Failing to meet guidelines may in part be the result of failing to effectively self-regulate personal health-related thoughts and behaviours (e.g., failure to quit smoking, poor diet, being physically inactive; Bandura, 2005; Vohs & Baumeister, 2011). While social cognitive models are useful in understanding health behaviours (cf. Artinian et al., 2010; Conner & Norman, 2005), Janis (1984) has argued that they do not capture all factors that further the understanding of health behaviour. They assume that health information is rationally processed and acted upon.

However, people do not always make rational decisions; biased information processing can influence how individuals perceive the situations they experience. Cognitive errors is one such factor reflecting individuals' biased thinking (Milman & Drapeau, 2012). Taking cognitive errors into account may broaden our understanding of why some individuals fail to regularly exercise. Exercise-related cognitive errors (ECEs) should influence individuals' exercise self-regulation by affecting the information that individuals process in making decisions to engage in planned exercise.

1. Biased thinking and health behaviour

Evidence within the study of health behaviour has demonstrated that biased or irrational beliefs might exacerbate the failure to follow good health practices. They have been related to behavioural failures such as: poor adherence to treatment regimens (Anderson & Emery, 2014; Meichenbaum & Turk, 1987), poor

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health practices (Christensen, Moran, & Wiebe, 1999), disability status (Smith, Follick, Ahern, & Adams, 1986), and excessive or inadequate rest leading to extreme cycles of activity (Moss-Morris & Petrie, 1997; Petrie, Moss-Morris, & Weinman, 1995; Spence, Moss-Morris, & Chalder, 2005). Psychologically, they have been related to lower confidence to self-manage one's chronic disease symptoms (Shnek et al., 1997), body dissatisfaction and weight preoccupation (Jakatdar, Cash, & Engle, 2006), This evidence illustrates that biased or irrational beliefs may distort the processing and interpretation of health-relevant information and be related to subsequent poor health behaviours.

Research regarding negative exercise cognitions might provide another indication that individuals' thinking may be affected by ECEs. Gyurcsik and Brawley (2000) found that negative thinkers had lower self-efficacy, lower exercise intentions, and lower exercise class attendance than did positive thinkers. Subsequent research by Glazebrook and Brawley (2011) indicated a similar pattern among maintenance cardiac rehabilitation participants. Their findings demonstrate the potential presence of negative thoughts, which could be the result of ECEs.

1.1. Cognitive errors

Irrational thinking has long been studied within the area of depression, conceptualized as biased information processing and thus labelled cognitive errors (Beck, 1976; Beck, Rush, Shaw, & Emery, 1979). These errors cause depressed individuals to systematically misinterpret the meaning of events (Lefebvre, 1981) and often result in dysphoric emotions and maladaptive behaviours (Beck, 1976). Milman and Drapeau (2012) define *cognitive errors* as "distorted information processes [that] do not consist of thought content … *A cognitive error* refers to a verbal statement that suggests ways of evaluating information that reflect errors or biases away from the average or normative evaluation of the same material" (p.129). This definition is broadly operationalized such that cognitive errors are not found exclusively among depressive or anxious individuals.

Milman and Drapeau's definition allows the notion of cognitive errors to be extended to a non-clinical population. It also highlights that cognitive errors are thought processes. When cognitive errors occur among individuals, there are two components: the error in processing and the resultant thoughts. Inasmuch as these information processes are not directly observable, they are identified by the thoughts that they produce. These resultant thoughts are examined to elucidate the specific cognitive error being manifested. The definition also suggests that cognitive errors reflect information processing that differs from the normal or average evaluation. A person with erroneous thinking will interpret certain information in a way that is markedly different from the normal, adaptive processing of the same information. Consider the following example to illustrate how a cognitive error might manifest within an exercise context. The "all-or-nothing" ECE might influence individuals to interpret their pre-exercise energy as low and that they can only exert 75% effort. In turn, these individuals may feel that suboptimal effort is not sufficient and thus not make the effort to exercise at all.

2. Study purposes and hypotheses

This investigation has two broad purposes. The first purpose concerns measure development and the second concerns the relationship of cognitive errors relevant to exercise adherence (i.e., criterion-related validity). Background for each follows.

2.1. Purpose 1: measure development

A valid, non-clinical measure is needed if we are to examine whether or not asymptomatic adults process exercise-relevant information in a biased fashion characteristic of the influence of cognitive errors. Existing measures in psychology and health are developed for other purposes and lack exercise-specificity. For example, the irrational health beliefs scale (Christensen et al., 1999) measures a broad array of biased beliefs, but only one item specific to exercise. Likewise, the behavioural responses to illness questionnaire (Spence et al., 2005) contains only one general exercise item ("I have avoided physical exercise") that represents maladaptive behavioural responses to illness. Current measures are not applicable to the context of exercise for non-clinical individuals.

The first purpose of this study was to create the Exercise-related Cognitive Errors Questionnaire (E-CEQ) as a non-clinical measure of ECEs for adults. We used Lefebvre's (1981) original Cognitive Errors Questionnaire (CEQ) as a model for measure development because it offers a broad perspective on the concept of cognitive errors, has a substantive evidence base, and has a way of presenting items that has demonstrated that cognitive errors can be successfully identified. After item development and refinement, the data were factor analysed to examine the E-CEQ's factor structure.

2.2. Purpose 2: evidence of criterion-related validity

Biased information processing as reflected by cognitive errors has the potential to influence how individuals perceive the situations they experience. Sources of criterion validity were sought as the second study purpose to provide evidence that the E-CEQ is related to exercise. Four hypotheses (Hyp.) were advanced. First, evidence of convergent validity was examined using Lefebvre's (1981) CEQ and the E-CEQ. A moderate relationship (Hyp. 1) was expected between both measures because both assess conceptually similar, yet distinct, constructs.

Second, the associations between ECEs and planned exercise and exercise intention were examined. Establishing that ECEs can be assessed through a face valid measure represents an initial first step in demonstrating predictive utility in the psychometric process. Based upon previous exercise research with related concepts (e.g., positive and negative thinkers; Gyurcsik & Brawley, 2000), and the general cognitive errors literature (e.g., Anderson & Emery, 2014), it was hypothesized that (Hyp. 2) ECEs would be negatively associated with planned exercise and exercise intention.

Third, with respect to predictive validity, the E-CEQ's utility in predicting number of planned exercise bouts beyond the contribution of the original CEQ was examined to demonstrate the measure's specificity and utility to the exercise context. It was hypothesized that (Hyp. 3) the E-CEQ would account for a significant amount of variance in planned exercise after controlling for the CEQ. Finally, the ECE-Q's utility in predicting exercise intention while controlling for past exercise was examined. Intentions represent proximal goals which motivate and facilitate goal-directed behaviour (cf. Bandura, 1986). ECEs may bias the information that is processed when forming and carrying out these goals. In using ECEs to predict exercise intention, Bandura (1986) reminds us of the dynamic reciprocal nature of behaviour and cognition: past behaviour is a determinant of future beliefs (i.e., proximal goals), which in turn, influence future behaviour. Accordingly, past exercise was controlled as the strongest determinant of exercise intention and future exercise (Sutton, 2004). It was hypothesized that (Hyp. 4) ECEs would account for a significant proportion of variance in exercise intention after controlling for past exercise behaviour.