Optimizing Primary and Secondary Control in Achievement Settings: An Examination of Rothbaum et al.'s (1982) Congruence Hypothesis

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Abstract

Rothbaum, Weisz, and Snyder's (1982) dual-process model of control proposed that in addition to attempts to change one's environment (primary control, PC) or psychologically adjust to one's circumstances (secondary control, SC), the higher-order capacity to alternate between these processes in congruence with performance (optimization) served to foster development in achievement settings. The present five-phase longitudinal study conducted over an academic year explored how college students (n = 568) shift between PC and SC over time in response to actual performance feedback, as well as the differential effectiveness of congruent emphasis shifts for development based on the perceived ability to shift in a strategic manner. Dependent measures included academic achievement (course test scores), motivation (achievement orientation, perceived success and value, expectations), emotions (enjoyment, anxiety, boredom), health status (global health, illness symptoms), and overall adjustment (perceived stress, self-esteem, depression). Hypotheses were evaluated using phase-specific and cross-lagged structural equation models assessing moderation effects for perceived congruence ability. Results showed that students shift toward PC after success and toward SC following failure, and suggest an elaborated theoretical model of how PC and SC contribute to beliefs and behaviour involving strategic and congruent emphasis shifts. These findings also demonstrate that some individuals better recognize when this behaviour is most effective for their performance and well-being and strategically make congruent emphasis shifts to improve their subsequent development. In sum, this study highlights the benefits of one's ability to make strategic emphasis shifts between PC and

SC in an academic achievement setting, and provides empirical support for this effective yet relatively unexplored facet of Rothbaum et al.'s model.

Optimizing Primary and Secondary Control in Achievement Settings: An Examination of Rothbaum et al.'s (1982) Congruence Hypothesis

Since Rothbaum, Weisz, and Snyder's (1982) initial reformulation of control theory as a dual-process model involving primary and secondary control, this paradigm has guided psychological research in such fields as life-span development, health and well-being, and achievement settings. Theoretical developments in primary/secondary control theory by Heckhausen and Schulz (1995) concerning the use of control strategies have also contributed to the large-scale impact of Rothbaum et al.'s original model. To date, the most extensive application of this theoretical perspective has been in the domains of developmental and health psychology as evidenced by empirical research conducted by Heckhausen (e.g., Wrosch, Heckhausen, & Lachman, 2000), Thompson (e.g., Thompson, Nanni, & Levine, 1994), Chipperfield (e.g., Chipperfield & Perry, in press), Compas (e.g., Wadsworth & Compas, 2002), Weisz (e.g., Weisz, McCabe, & Dennig, 1994), and others (e.g., Petito & Cummins, 2000; Taylor, Helgeson, Reed, & Skokan, 1991). More recently, Rothbaum et al.'s model has also been applied to achievement settings involving the workplace (e.g., Allen & Mellor, 1992) and academic development in college students (e.g., Perry, Hall, & Ruthig, 2005). The present study focused on Rothbaum et al.'s dual-process model of primary and secondary control in an academic achievement setting with specific emphasis on how people shift between them in response to success and failure experiences.

Rothbaum et al. (1982): A Dual-Process Model of Perceived Control

According to Rothbaum et al. (1982), individuals are motivated to sustain their

perceptions of personal control through two forms of control-enhancing behaviors referred to as primary and secondary control. Specifically, primary control is described as attempts to change the world to fit one's needs, whereas secondary control involves efforts to fit in with one's environment. Together, these two approaches comprise a dual-process model whereby individuals sustain their sense of control in adverse or uncontrollable situations. Rothbaum et al. further suggest that people vacillate between these two control processes, and "shift from one method of striving for control to another" (p. 7) in response to environmental contingencies, with optimal adaptation involving the appropriate relative emphasis on primary- vs. secondary-control efforts based on the perceived controllability of a given setting (i.e., "congruence hypothesis").

Taxonomy of control processes. The theoretical model outlined by Rothbaum et al. (1982) proposed that both primary- and secondary-control processes are characterized by four types of control-striving behavior, namely predictive, illusory, vicarious, and interpretive control. *Predictive control* is described as referring to one's ability to predict negative events so as to avoid disappointment, the occurrence of which would indicate that the individual not only failed to control the outcome (primary control) but also was unable to predict its occurrence (secondary control). Thus, although predictive primary-control efforts would involve anticipating an event so as to succeed at it, predictive secondary-control striving would be evidenced in difficult achievement settings by withdrawn behavior and attributions to limited ability to better predict a negative outcome. In contrast, *illusory control* is presented as pertaining to attributions to luck or chance, and entails either active behavior in chance settings (primary control), due to a

misperception of the events as potentially modifiable (i.e., "gambler's fallacy"), or withdrawn behavior in skill-based situations, a result of fatalistic beliefs in which luck is construed as a personal attribute (i.e., associating with chance; secondary control).

Rothbaum et al. (1982) also outline a class of cognitive processes referred to as *vicarious control* which consists of deindividuation and identification with powerful or similar others. Specifically, these behaviors are described as involving attempts to influence or imitate others to achieve one's goals (primary control), or psychologically associate with others to bolster feelings of control (secondary control). Finally, these authors also discuss a fourth type of control behavior called *interpretive control* which entails manipulating one's interpretation of an aversive event in order to maintain perceptions of personal control. Whereas interpretive primary control is presented in terms of attempts to understand negative outcomes in order to actively solve or master them in the future, interpretive secondary-control efforts are described as attempts to reinterpret aversive events in a meaningful or positive manner (e.g., learning personal lessons, "finding the silver lining," etc.; see Thornton, 2002, for an elaborated discussion of this distinction). Thus, Rothbaum et al. (1982) suggest that attempts to change or adjust to one's environment are evidenced in these four types of control behaviors, all of which may be used to foster one's sense of personal control.

Adaptation in failure situations. In their discussion on the impact of environmental conditions on control processes, Rothbaum et al. (1982) suggest that secondary-control striving is particularly important in situations involving "prolonged failure to obtain highly desired and important incentives or cases in which the inability is

perceived as permanent" (p. 29). Further, these authors also stress the importance of empirical research toward developing models of adaptiveness with respect to the optimal emphasis on primary vs. secondary control in various environments. For instance, Rothbaum et al. hypothesized that an overemphasis on primary control may generally be beneficial in achievement settings in terms of actual performance, however they also noted the importance of considering potential long-term performance deficits due to an overemphasis on primary- or secondary-control processes (for a cross-cultural perspective, see Weisz, Rothbaum, & Blackburn, 1984). Specifically, these authors suggest that both primary and secondary control are likely to be optimal in a performance environment due to the potential for failure experiences which may erode one's sense of personal control.

Rothbaum et al. (1982) also suggest, however, that individuals who rely only on primary-control beliefs are "prime candidates for perceived uncontrollability when they are finally tested and fail" (p. 29). These authors propose that unsuccessful individuals who typically emphasize primary at the expense of secondary control are particularly vulnerable to feelings of helplessness due to the intensive and exhaustive nature of their primary-control efforts. Nonetheless, Rothbaum et al. (1982) define "optimal adaptation" as not simply being able to engage in primary- and secondary-control behaviors but being able to alternate between them in order to effectively respond to aversive events, and that this "knowledge of how and when to exert the two processes of control and how to integrate them" (p. 30) is in fact "one of the most significant implications of the two-process model" (p. 29). Although this self-regulatory ability to realize when primary-

control efforts are not effective is considered by these authors to be a critical component of successful adaptation in failure settings, this aspect of Rothbaum et al.'s model has yet to be empirically examined.

Heckhausen and Schulz (1995): A Developmental Model of Control Striving

In their examination of control-related phenomena from a life-span developmental perspective, Heckhausen and Schulz (1995) provide a conceptual framework for understanding how people adapt to developmental changes in opportunities for control. More specifically, these authors propose what can be considered a greatly elaborated version of Rothbaum et al.'s (1982) model of adaptiveness with respect to primary- and secondary-control striving throughout the life course. According to Heckhausen and Schulz, humans are universally motivated to manipulate their environment through direct action (i.e., primary control), and as such, are threatened by events that challenge or decrease existing opportunities for control. Further, this capacity to engage in primary control is described by these authors as an integral component of their model, such that secondary-control striving is beneficial insofar as it fosters the motivational resources required to sustain primary-control efforts (selective secondary control) or buffers the emotional and motivational impact of primary-control deficits (compensatory secondary control).

Heckhausen and Schulz (1995) describe secondary control as providing motivational support for primary-control behaviors through three distinct processes including changes in (1) *expectations* concerning one's goal, (2) the *value* of goal attainment, and (3) *causal attributions* for the outcomes of goal striving. First, these

authors outline various secondary-control strategies which entail either raising one's expectations (e.g., optimistic beliefs) or lowering one's expectations (e.g., defensive pessimism, lowering aspirations, downward social comparisons) so as to bolster or preserve one's physical and psychological resources for future primary-control striving. Second, value-oriented secondary-control strategies are also discussed, particularly those involving a strategic increase in the perceived value of the desired goal (a process referred to as "motivation control"; Kuhl, 1986), downgrading the importance of one's goal, as well as disengaging from a goal once it is no longer considered attainable. The third form of secondary-control behaviors described by these authors pertains to the strategic use of causal attributions to explain failure outcomes, for instance, attributional biases of a self-serving nature (i.e., hedonic bias) or to powerful others. The importance of evaluating these secondary-control strategies with respect their veridicality and functionality in real-world situations is also noted by Heckhausen and Schulz (1995). By this, they mean the degree to which they are based on real-life behavior-outcome contingencies and adaptive in terms of maintaining/enhancing primary-control efforts.

Selectivity and failure compensation. In their model of life-span development, Heckhausen and Schulz (1998) propose that success- and failure-oriented behavior of a selective and compensatory nature, respectively, are required in order for successful adaptation to occur. With respect to primary-control striving, these authors suggest that strategies consisting of both the selective, focused investment of internal resources (e.g., effort, ability, task-specific skills) and compensatory use of external resources (e.g., assistance from others, technical aids, use of indirect means) are enacted in the pursuit of

chosen goals. In contrast, secondary-control striving is described as motivational strategies aimed at protecting a selected intention against competing action tendencies (also referred to as volitional control; Kuhl, 1994), as well as compensatory, cognitive strategies for protecting one's motivational resources in failure situations. Thus, secondary-control strategies involving selectivity concern protecting a chosen goal by enhancing its perceived value and avoiding distractions, whereas compensatory strategies are used to buffer the impact of failed goal striving by disengaging from the goal completely, engaging in downward social comparisons, and through self-serving attributional biases.

In addition to the above distinction between selective and compensatory forms of primary- and secondary-control striving, the model of adaptiveness proposed by Heckhausen and Schulz (1998) also suggests that a higher-order self-regulation process referred to as "optimization" is required for maintaining a balance between these strategies to promote successful development over the long term. Specifically, these authors propose three general principles involved in the optimization of developmental regulation consisting of (a) selecting appropriate goals, (b) managing the advantages and limitations of domain-specific control striving, and (c) maintaining diversity in opportunities for primary control. Whereas the first and second tenets concern the selection of tasks and domains of functioning which minimize age-normative constraints, the third emphasizes the need to maintain some variability in *opportunities* for primary control in order to sustain overall *perceptions* of personal control (see also Schulz, Wrosch, & Heckhausen, 2003). Although this developmental regulation process is

described as particularly applicable to elderly individuals, Heckhausen and Schulz (1998) suggest that adults of all ages strive to optimize their adaptation through the judicious investment of personal resources in accordance with age-specific developmental opportunities.

Adaptation across the life span. Heckhausen and Schulz (1995) argue that the relative effectiveness of primary- and secondary-control strategies is directly related to one's developmental ecology in that "biological and sociostructural constraints over the life course generate a time-ordered structure of opportunities and challenges for extending and maintaining control" (p. 289). Biological constraints primarily concern the well-known inverted U-shaped pattern of physical and cognitive development over the life span. In contrast, societal constraints are described as pertaining to normative, age-related transitions involving social networks, occupations, and financial circumstances (e.g., Wrosch et al., 2000). Thus, realistic assessments of behavior-outcome contingencies may be optimal for developing behavioral competencies during childhood, whereas slightly exaggerated perceptions of primary-control appear most adaptive for young adults to realize potential physical and societal gains (e.g., health, occupational status). In terms of successful adaptation in old age, these authors suggest that increased use of secondary-control strategies of a selective nature (i.e., increasing motivational support, removing distraction) enhance the efficiency of *current* primary-control striving, whereas compensatory strategies (e.g., lowering expectations, downward social comparison, disengagement) serve to bolster motivational declines due to unsuccessful primary-control efforts.

Consistent with their assumption concerning the functional primacy of primary control, Heckhausen and Schulz (1995) suggest that primary-control striving does not diminish with age but remains remarkably consistent across the life span. Thus, although primary-control efforts become more selectively invested in specific domains of functioning with increasing age, due to the use of selective secondary-control strategies (i.e., the enhancing and devaluing of selected and alternative goals, respectively), actual levels of control striving appear to remain unchanged over time. In terms of secondary control, these authors propose that individuals rely to an increasing extent on secondary-control strategies as they age in order to compensate for the increased frequency of failure experiences due to biological and societal constraints. As such, Heckhausen and Schulz (1995) provide a developmental perspective on Rothbaum et al.'s (1982) original model in suggesting that (a) primary-control striving remains stable from childhood to old age, (b) secondary-control strategies become more sophisticated and increasingly beneficial over time, and consequently, that (c) secondary-control strategies may be used to maintain some degree of actual control over selected life domains and buffer the psychological impact of age-related failure experiences.

Review of Empirical Research

Adaptation in Childhood

Based on Rothbaum et al.'s (1982) original dual-process model of control, research conducted by Weisz and associates has focused on how children adapt to physical and psychological difficulties through the use of primary- and secondary-control strategies. In an early study by Band and Weisz (1990), self-reported coping strategies of

children with diabetes were examined with respect to physician and parent ratings of medical and behavioral adjustment, respectively. Results showed that, although secondary-control strategies of an interpretive nature (e.g., "telling myself I can still live a full life"; p. 152, Band & Weisz, 1990) were more highly associated with successful adjustment than primary-control strategies for pre-formal children, primary-control efforts involving self-care (e.g., taking insulin) were more strongly related to optimal development in formal operational children. Secondary-control strategies involving downgrading the perceived importance of one's medical condition appeared to be less adaptive due to the often treatable nature of this illness.

A similar study by Weisz et al. (1994) investigated how children cope with low-controllability stressors related to leukemia and its treatment (e.g., invasive medical procedures). Specifically, this study found that self-reported secondary-control strategies concerning a cognitive reinterpretation of one's condition (e.g., expectations, goals, interpretations, attributions) most highly corresponded with illness-specific adjustment (i.e., self-reported distress, behavioral observations during medical procedures), as well as parent-observed behavioral and emotional adjustment for children suffering from leukemia. Following from the results of these two studies, Weisz, Thurber, Sweeney, Proffitt, and LeGagnoux (1997) outline the development of a Primary and Secondary Control-Enhancing Treatment (PASCET) aimed at teaching children dealing with depression to apply primary- and secondary-control strategies (e.g., finding a "silver lining") to high- and low-control stressors, respectively. The findings of this study are encouraging, showing significant improvements in short-term (18 days) and long-term (9

months) psychological adjustment for children with mild-to-moderate depressive symptoms.

Recent research from a coping perspective conducted by Compas and others has also investigated how children and adolescents deal with aversive circumstances using primary and secondary control. In a study by Langrock, Compas, Keller, Merchant, and Copeland (2002), for example, which examined the manner in which children cope with *parental* depression, self-reported secondary-control strategies (e.g., positive thinking, cognitive restructuring, acceptance, distraction), as opposed to primary-control strategies (e.g., problem solving), were effective in mediating the effects of parental depression on observed levels of anxiety and depression in their children. A related study from Thomsen et al. (2002), utilizing similar measures, assessed how children cope with recurrent abdominal pain, a medical condition characterized by ambiguous causality. The results of this study showed that parent-observed coping strategies involving secondary control, and to a lesser extent, primary control, were associated with lower levels of anxiety/depression, pain, and illness symptoms, with primary control strategies actually relating to *higher* levels of pain for these children.

Adaptation in Adolescence

In exploring how perceptions of control contribute to quality of life in adolescence, Petito and Cummins (2000) assessed primary and secondary control in high-school students concerning various life domains such as health, intimacy, and productivity. This study is unique in that both control processes were measured in terms of *beliefs* as opposed to strategies, that is, the self-reported results of control striving

(e.g., stating one is better off than others with less control) rather than accounts of deliberate control-striving behavior (e.g., conscious attempts to compare oneself with worse off others). Although the findings of this study are consistent with the premise that primary-control beliefs decline from childhood to young adulthood (i.e., a decreased overemphasis on primary control; Heckhausen & Schulz, 1995), they also indicate that these beliefs are positively associated with self-rated quality of life, as are engagement-oriented secondary-control beliefs that facilitate future goal attainment (e.g., interpretive control, optimism, downward comparison). As in Band and Weisz (1990), disengagement-oriented secondary-control beliefs (i.e., predictive control, devaluing, disengagement) were negatively related to quality of life in adolescents.

In a similar study by Wadsworth and Compas (2002), the effectiveness of control strategies as potential mediators of the effects of economic strain and family conflict on high-school students was assessed. Using measures of control strategies and adjustment adapted from Langrock et al. (2002), this study found that both primary- and secondary-control strategies mediated the negative impact of economic (partially) and family stressors (fully), corresponding to lower levels of self-reported negative affect (i.e., anxiety, depression) and aggression. Ironically, these findings also suggest that youth experiencing higher amounts stress are, in fact, less likely to use these potentially beneficial techniques.

The manner in which adolescents deal with the stress of selecting a future career was also assessed in a recent study conducted by Heckhausen and Tomasik (2002). In this longitudinal study, German high-school students with overly optimistic vocational

preferences were found to downgrade their occupational aspirations as the deadline to apply for an apprenticeship program approached, highlighting the role of compensatory secondary-control strategies in adjusting to developmental challenges in adolescence. Finally, a study by Connor-Smith and Compas (2002) examined how adolescents cope with the stress of developing and sustaining peer relationships in the absence of family support, particularly those with a dispositional, heightened sensitivity to social disapproval (i.e., sociotropy). In a sample of first-year university students reporting stressful interpersonal events, self-reported primary- and secondary-control strategies (see Langrock et al., 2002) were found to buffer the impact of sociotropy on symptoms of anxiety and depression. These results suggest that the ability to generate social support (primary control) can help overcome social difficulties, and further, that one's capability to reinterpret or accept interpersonal difficulties (secondary control) can help adolescents gain perspective on the social challenges they experience.

Adaptation in Adulthood

Developmental regulation across adulthood. Research by Heckhausen and associates on the role of primary- and secondary-control striving from young adulthood to old age has served to provide valuable empirical support for the model of life-span development proposed by Heckhausen and Schulz (1995). In Heckhausen (1997), developmental goals reported by young (20-35), middle aged (40-55), and older adults (60+) were assessed with respect to their self-reported probability of attainment, controllability, and age normality, as well as self-report measures of beliefs concerning goal tenacity (selective primary control) and flexibility (compensatory secondary

control). This study found that, compared to their younger counterparts, older adults were cognizant of decreased opportunities for control and goal attainment, yet continued to report high levels of tenacious goal pursuit (primary control). This study further suggests that sustained control beliefs in older adults result primarily from a focus on age-normative tasks and secondary-control striving, as evidenced by enhanced goal flexibility (e.g., finding benefit in aversive circumstances, lowering aspirations), positively biased subjective age identification, and disengagement from unattainable goals.

A related study by Wrosch et al. (2000) also examined developmental differences between these three age groups with respect to the control strategies used in dealing with financial and health-related difficulties. First, this study showed that, relative to younger adults, older adults reported *greater* use of primary-control strategies (i.e., persistent goal pursuit), and secondary-control strategies involving lowering aspirations and positive reappraisal (i.e., "seeing the positive side of a bad situation"; p. 388, Wrosch et al., 2000; this process is referred to by Rothbaum as interpretive secondary control). However, it was also found that for middle-aged and older adults reporting financial- or health-related difficulties, only positive reappraisal, and to a lesser extent, persistence were positively associated with self-reported well-being (e.g., life satisfaction, worry, etc.). Although persistence and positive reappraisal were equally beneficial for well-being in young adults regardless of financial or health-related stress, these two strategies were found to explain almost twice the variance in well-being among young adults with health problems than their healthier counterparts. Consistent with research on children (Band & Weisz, 1990) and adolescents (Petito & Cummins, 2000), decreased aspirations were

negatively related to subjective well-being in all age groups and financial/health conditions assessed in this study.

A series of studies conducted by Lang and Heckhausen (2001) also examined the influence of primary control in young, middle-aged, and older adults, albeit with respect to primary-control *beliefs*. In Study 1, primary-control beliefs were found to correspond with higher levels of *positive* affect and life satisfaction across adulthood, and were related to lower *negative* affect only in young and middle-aged adults. In a 6-month follow-up of older adults in Study 1, Study 2 demonstrated that although older individuals with high primary-control beliefs showed increased positive affect following positive life events, these high-control individuals also showed significant *declines* in positive affect when few positive events were experienced. Finally, whereas Study 2 highlighted the potentially detrimental nature of high primary-control beliefs in aversive situations, Study 3 paralleled Heckhausen's (1997) study in examining the perceptions of probability, controllability, and potential causes (i.e., attributions; Weiner, 1985) of goal attainment from young adulthood to old age. Specifically, this study found that although perceived control over developmental goals was positively related to life satisfaction at all ages, younger and older adults showed optimal levels of subjective well-being when attributing their development to effort and ability, respectively, suggesting that older adults are most satisfied "when they control their developmental goals in congruence with their abilities" (p. 521; Lang & Heckhausen, 2001).

In a similar vein, a study conducted by Thompson et al. (1998) explored how young (30-35), early-middle-age (45-54), and late-middle-age adults (55-64) adjust to

age-related changes in physical appearance through self-reported *beliefs* involving primary control (e.g., effort, persistence) and secondary control, the latter in terms of passive acceptance and all four processes described in Rothbaum et al. (1982). The findings of this study suggest that, consistent with the developmental model of Heckhausen and Schulz (1995), secondary-control beliefs were more strongly endorsed in later adulthood, whereas primary-control beliefs declined with age. Nonetheless, primary-control beliefs were found to correspond with lower emotional distress, and secondary-control beliefs appeared to be beneficial only for individuals with low primary-control beliefs. These results are consistent Rothbaum et al.'s (1982) model outlining the potential benefits of predictive, illusory, vicarious, and interpretive secondary control, the developmental model of Heckhausen and Schulz (1995) concerning passive acceptance, as well as the description of secondary control as a back-up to failed primary-control attempts originally provided in Rothbaum et al. (1982).

Developmental deadlines. Based on the Rubicon model of action phases, empirical research on adult development by Heckhausen and colleagues has also examined how individuals adjust to age-graded "developmental deadlines," namely, the point at which opportunities for primary control over a given developmental goal become increasingly limited. For instance, in Wrosch and Heckhausen's (1999) study, the manner in which people adapt to decreased opportunities for romantic partnerships later in life was assessed with respect to both selective and compensatory primary- and secondary-control striving in young adults (21-35) and adults in late midlife (49-59). The findings of this study suggest that, whereas younger separated adults endorse more gain-oriented

partnership goals, strategies involving selectivity, and positive aspects of long-term romantic relationships, older separated adults rely more on compensatory secondary-control strategies, and redirect their efforts to more favorable social domains. Further, whereas downward social comparisons were related to increased positive affect in older separated individuals at a 15-month follow-up, goal disengagement strategies negatively predicted improvements in positive affect for younger separated adults. Nonetheless, selective primary-control strategies (i.e., efforts toward obtaining a partnership) and compensatory secondary-control striving (i.e., refocusing on non-partnership-related goals) were positively related to enhanced positive affect and decreased negative affect over time, respectively, for both younger and older separated adults.

In a similar study investigating how women adjust to rapid declines in childbearing potential (i.e., one's "biological clock"), Heckhausen et al. (2001) once again employed an action-phase model to examine how control strategies are used in response to this developmental deadline. In Study 1, women who were approaching the deadline (27 to 33 and childless) were found to report more goals related to child-bearing and recalled more baby-relevant sentences than women who had missed the deadline (40 to 46 and childless) or were new mothers (19 to 44 and < 1 year-old child). Further, among women who had failed to meet this deadline, positive affect was associated with recall of non-baby related sentences, whereas superior recall of baby-related phrases corresponded with greater negative affect. The use of specific childbearing control strategies was more explicitly examined in Study 2, which showed that primary- and selective secondary-control strategies were rated more highly by pre-deadline women and

those with children, whereas compensatory secondary-control strategies (e.g., goal disengagement, self-protection) were most strongly endorsed by women who had passed this deadline either recently or long ago. Consistent with Study 1, selective primary-control strategies were related to lower depressive symptomology in pre-deadline women and greater depression in post-deadline females, again highlighting the aversive nature of primary-control striving in low-controllability circumstances related to childbearing.

Low-control health problems. Research on primary and secondary control has examined not only how individuals adapt to developmental challenges from young adulthood to old age, but also the effectiveness of control strategies used by adults faced with low-control health problems. Following from Rothbaum et al.'s (1982) original model, a study by Affleck, Tennen, Pfeiffer, and Fifield (1987) examined the benefits of general perceptions of primary control (i.e., personal control) and vicarious secondary control (i.e., by health care providers) for adults with rheumatoid arthritis. Whereas perceived primary control over symptoms and vicarious control over the course of the disease were most prevalent, perceptions of primary control over one's treatment and vicarious control over symptoms were related to positive and negative affect, respectively. Further, although symptom-related primary control corresponded with positive affect and observed psychosocial adjustment in individuals with moderate or severe arthritis, perceived primary control over the disease course was associated with greater negative affect and poorer adjustment in those with more severe symptoms. These findings highlight the adaptive nature of perceptions of control which correspond to the objective controllability of health-related goals (i.e., symptoms vs. underlying disease)

and opportunities for control afforded by one's medical condition (i.e., mild vs. severe diagnosis).

A related study by Affleck, Tennen, Croog, and Levine (1987) based on Rothbaum et al.'s (1982) model explored how interpretive secondary-control *beliefs* (i.e., finding benefit in adversity) contributed to morbidity and recurrence over an 8-year period in male heart attack victims. This study found that failure to perceive benefits in one's condition was directly related to a higher likelihood of reinfarction at 7 weeks, and higher ratings of self-rated morbidity 8 years later. Furthermore, survivors of a second heart attack were found to engage in greater causal search (i.e., generating attributions) and reported more benefits at the 8-year follow-up, suggesting that positive reappraisal of one's condition was effective in not only preventing the recurrence of heart attacks but also fostering adjustment in those suffering multiple infarctions.

In a series of studies conducted by Taylor et al. (1991) based on Rothbaum et al.'s (1982) model, adults faced with serious illnesses including cardiac disease, cancer, and AIDS were assessed with respect to their perceptions of primary and secondary control. First, their findings showed that self-generated, high general perceptions of primary control (i.e., "in control" vs. helpless) corresponded with reduced anxiety and depression in individuals with coronary heart disease. Second, in a study of homosexual males diagnosed with AIDS, it was found that perceived personal (primary) control over one's symptoms or treatment were most strongly endorsed, and, particularly for males in poorer health, were also more beneficial for psychological adjustment than perceived vicarious control (i.e., perceived control by "others"), which were negatively associated with

subjective well-being. Finally, a third study on cancer patients demonstrated the adaptive nature of perceptions of primary control for self-rated and observed psychosocial adjustment in *males*, and also showed a strong positive relation between perceived vicarious control and adjustment for *female* patients with good prognoses (the opposite was observed for males and females with poor prognoses). In sum, these studies illustrated the overall significance of general perceptions of control in low-control health circumstances, and particularly the advantages of perceived primary control (for males) and the drawbacks of perceived vicarious control in adjusting to low-control health conditions.

Research by Thompson and colleagues has also investigated perceptions of primary and secondary control in individuals adapting to low-control medical conditions such as cancer and HIV. In Thompson, Sobolew-Shubin, Galbraith, Schwankovsky, and Cruzen's (1993) study, cancer patients' sense of control with respect to consequence-related aspects of their condition (i.e., emotions, physical symptoms) was a stronger predictor of lower anxiety and depression than perceptions of control related to the disease itself (i.e., treatment, disease course). Further, these results also showed that perceived primary control over emotions and symptoms was most highly related to successful adjustment in those experiencing more serious cancer-related physical limitations. This study provides further empirical support for the findings of Affleck, Tennen, Pfeiffer, and Fifield (1987) showing that perceptions of primary control are most adaptive when they concern the controllable aspects of particularly low-control medical conditions.

In contrast to Rothbaum et al.'s (1982) original formulation, Thompson et al. (1994) proposed an alternative approach to the study of secondary control, in which *acceptance* of aversive circumstances is proposed as the key component underlying secondary-control attempts. Specifically, in their examination of males diagnosed with HIV, these authors assessed their perceptions of primary control (i.e., perceived direct influence over the course *and* consequences of HIV), self-reported benefits of secondary control (i.e., sense of control derived from accepting one's illness), as well as central vs. consequence-related control concerning this disease (i.e., disease course vs. daily life events). The results of this study showed that consequence-related control, and to a considerably lesser extent, perceptions of central control, and primary and secondary control (which collapsed the central/consequence distinction) corresponded to lower levels of depression, with the former also relating to fewer illness symptoms and perceived stress. Moreover, perceived secondary control was found to be associated with better adjustment only when beliefs in primary control were low. These findings are consistent with the aforementioned research on consequence-related control, as well as the benefits of passive acceptance later outlined by Heckhausen and Schulz (1995) and the back-up role of secondary control described in Rothbaum et al. (1982).

A similar study on HIV-positive male prison inmates was also conducted by Thompson, Collins, Newcomb, and Hunt (1996), using measures of control adapted from Thompson et al. (1994; again collapsing central and consequence-related factors). Although perceptions of primary control were again associated with lower psychological distress, albeit only for Caucasian as opposed to African American participants,

perceived secondary control (acceptance) was, in fact, *positively* associated with anxiety for males with a low sense of primary control. These authors argued that due to the extremely limited opportunities for control afforded to these individuals as a result of their medical condition and incarceration, acceptance may be viewed not as a choice but an inevitability, and thus, be more closely aligned to feelings of helplessness. Further, consistent with earlier work by Rothbaum, Weisz, and others (e.g., Weisz et al., 1984; Gould, 1999), these authors highlight the importance of examining cultural differences in the manner in which primary and secondary control are endorsed.

Adaptation in Older Adults

Following from the above research on how individuals adjust to low-control health problems such as rheumatoid arthritis (Affleck, Tennen, Pfeiffer, & Fifield, 1987), cancer (Thompson et al., 1993), and AIDS (Taylor et al., 1991), research by Chipperfield has focused specifically on how older adults adjust to age-related restrictions through perceptions and strategies involving primary and secondary control. For instance, a study conducted by Menec and Chipperfield (1997) examined perceptions of consequence-related primary control over the *difficulties* presented by serious self-reported health problems reported by young-old (65-79) and old-old adults (80+). Results showed that perceived primary control was related to lower hospitalization and lower mortality rates for old-old individuals with low as opposed to high levels of functional impairment, providing empirical support for the health benefits of perceptions of primary control in elderly individuals with a greater capability for goal attainment. Consistent with these findings, a follow-up study by Chipperfield and Greenslade (1999) also found low

perceptions of consequence-related primary control to correspond with lower rates of physician visits, medical tests, and hospitalization in older adults (66-98) with greater self-reported restrictions from arthritis.

Based on the theoretical perspectives of both Rothbaum et al. (1982) and Heckhausen and Schulz (1995), further research by Chipperfield, Perry, and Menec (1999) assessed the specific types of control-enhancing strategies used by older adults on a daily basis in dealing with the difficulties of completing everyday tasks. These results indicated that whereas primary-control strategies (e.g., active persistence, effort exertion) were most strongly related to higher self-reported health (i.e., morbidity, perceived health) in young-old adults (< 80), secondary-control strategies (i.e., lowering expectations, accepting limitations) corresponded to optimal perceived health in old-old adults (80+). The importance of assessing gender differences in control-striving behavior is highlighted by the finding that males relied more on primary- than secondary-control strategies, whereas females were more likely to emphasize both control processes. A subsequent study conducted by Wrosch, Schulz, and Heckhausen (2002) also examined specific control strategies used by older adults in responding to health difficulties. Consistent with the developmental model of Heckhausen and Schulz (1995), this study found that an overall control orientation consisting of both selective and compensatory primary control as well as selective secondary-control strategies was associated with reduced depressive symptomology in older adults, and particularly those faced with acute (vs. chronic) physical symptoms which imply a greater potential for future remediation.

Comparing Theoretical Models

Existing Theoretical Comparisons

Despite the continued research based on both models of primary and secondary control outlined by Rothbaum et al. (1982) and Heckhausen and Schulz (1995), there exists to date only a single published article by Thompson et al. (1998) outlining the relative strengths and weaknesses of these two paradigms. In this article, Rothbaum et al.'s model of adaptiveness is presented as a "Discrimination Model" in which perceived control is "adaptive only when it is realistic" (p. 599). This model is further described by Thompson as suggesting that primary control is of benefit only in high-control settings, and secondary control only in low-control settings. Rothbaum et al.'s model is then contrasted with a "Primacy/Back-Up Model" based on the developmental paradigm of Heckhausen and Schulz which presents primary control as adaptive, regardless of situational constraints, and secondary control as beneficial only when opportunities for primary control are compromised.

As described above, however, Rothbaum et al.'s (1982) model of adaptiveness clearly states that successful adaptation entails differences in *emphasis* between primary and secondary control, suggesting that, although both processes are involved to some degree in any given situation, the manner in which one is emphasized over the other in response to environmental constraints is a critical component of goal attainment and psychological adjustment. In fact, Rothbaum et al. (1982) consistently distinguish between one's use or knowledge of primary- and secondary-control behaviors and the relative *emphasis* placed on these approaches in a given setting (see Band & Weisz,

1990, and Halliday & Graham, 2000, for a consideration of ratio measures based on this approach). Rothbaum et al. further suggest that although individuals may perceive only extremes of primary or secondary control as adaptive in extreme circumstances (i.e., HIV; Thompson et al., 1994; functional impairment in old age; Chipperfield et al., 1999), this polarization is less evident among individuals faced with everyday tasks of varying controllability.

That is, for individuals responding to more normative control-threatening situations, such as missing an appointment or misplacing an important document, both primary and secondary control are likely to play a role because of the greater degree of controllability afforded by the situation relative to more low-control, life-threatening circumstances. In fact, research by Heckhausen and associates on life-span development also highlights the importance of both primary- *and* secondary-control strategies in adapting to challenging life experiences (Schulz & Heckhausen, 1999), as shown in recent research suggesting that reality-based expectations for goal attainment during these times are "most effective in maximizing longer term resource investment payoffs" (p. 215, Heckhausen & Tomasik, 2002; see also Lang & Heckhausen, 2001; Heckhausen, 1997; Heckhausen, Wrosch, & Fleeson, 2001; and Wrosch & Heckhausen, 1999, for empirical evidence in support of Rothbaum et al.'s congruence hypothesis).

Present Theoretical Comparison

Theoretical differences. Although both the Rothbaum et al. (1982) and Heckhausen and Schulz (1995) paradigms acknowledge that primary and secondary control play a simultaneous role in how people adapt to control-threatening situations,

these models differ in the manner in which their arguments are presented and their relative emphasis on specific control techniques. *First*, whereas Rothbaum et al. outline primary- and secondary-control processes from a social-psychological perspective and refer mainly to *perceptions* of control, Heckhausen and Schulz describe these processes from a life-span, developmental point of view and focus their discussion primarily on specific control-enhancing *strategies*. Nonetheless, Rothbaum et al. also allude to general classes of control-striving behavior and Heckhausen and Schulz to the importance of overall perceptions of control (see Heckhausen & Schulz, 1998; Schulz et al., 2003). *Second*, although Rothbaum et al. proposed that interpretive control underlies the various forms of secondary control including the acceptance of aversive circumstances, Heckhausen and Schulz (1995) did not explicitly discuss this interpretive secondary-control process despite their focus on acceptance as an effective control strategy. Nonetheless, this interpretive secondary-control process has been addressed in more recent research by Heckhausen and colleagues (i.e., "positive reappraisal"; Wrosch et al., 2000; see also Heckhausen, 1997, in which positive reinterpretation of the aging process was assessed using a measure of goal flexibility).

In addition, a *third* difference between these theoretical approaches involves the discussion of distraction techniques as secondary-control strategies in Heckhausen and Schulz (1995). According to Rothbaum et al. (1982), people's attempts to maintain self-esteem through strategies such as denial and forgetfulness does not involve secondary control because they imply an underlying belief in the eventual effectiveness of their primary-control efforts. That is, distraction techniques are presented as similar to other

behaviors aimed at simply suspending primary-control efforts for a limited time rather than actual secondary-control behaviors which are used to adjust to unsuccessful control attempts. In contrast, Heckhausen and Schulz (1995) clearly state that "behavioral and cognitive distractions ... represent secondary control strategies" (p. 293) due to their inward nature and the manner in which they foster long-term primary-control striving. Regardless, these dissimilarities should not be considered contradictions, but rather differences in emphasis between these two models which are characterized far more by similar as opposed to contrary theoretical positions.

Theoretical similarities. Although Heckhausen and Schulz (1995) discuss specific strategies which loosely parallel the types of control striving described by Rothbaum et al. (1982), such as lowering expectations (predictive control), egotistic attributional biases (interpretive control), and attributions to powerful others (vicarious control), these two perspectives also share important theoretical tenets on which each models is based. Specifically, both theoretical models acknowledge (a) the functional primacy of primary control, (b) the advantageous nature of secondary control when the limitations of primary control are evident (i.e., low-control situations), (c) the potentially deleterious effects of unmitigated primary-control beliefs, and (d) the importance of a higher-order, self-regulatory capacity to differentially emphasize primary or secondary control in accordance with situational constraints.

With respect to the *first* point, both paradigms are based on the premise that people are motivated to perceive themselves as efficacious, whether described in terms of *perceptions* of control (Rothbaum et al., 1982) or control-striving *behaviors* (Heckhausen

& Schulz, 1995). For instance, although Rothbaum et al. suggest that individuals are motivated to maintain their beliefs in personal control, Heckhausen and Schulz typically phrase this motive in actional terms, such as, a "desire to produce behavior-event contingencies" (p. 285). Thus, although the Rothbaum and Heckhausen paradigms are primarily concerned with perceptions of control and the actual enactment of control strategies, respectively, these two models do share an underlying assumption that people are motivated to exert primary control over their social and physical environment.

The *second* point of similarity is that both models acknowledge that secondary-control efforts are most likely to be observed following failed primary-control attempts. As such, secondary control is particularly beneficial in situations affording limited opportunities to engage in primary-control behaviors (i.e., low-control settings). Thus, both Rothbaum et al. (1982) and Heckhausen and Schulz (1995) present secondary control as a back-up to failed primary-control efforts, with Rothbaum et al. actually coining the term "secondary control" due to its later occurrence in the temporal sequence of control-striving behaviors. A *third* commonality between Rothbaum et al. and Heckhausen and Schulz is that, although an overestimation of personal control is indicative of mental health in young adulthood, such exaggerated perceptions of control "may be very dysfunctional if it undermines direct action, which has the potential of being effective" (p. 287; Heckhausen & Schulz, 1995). Moreover, this point is reiterated by Heckhausen and Schulz (1998) who state that primary-control beliefs can actually result in *decreased* persistence when directed toward a goal which is considered unattainable, or when excessive costs are incurred (e.g., to one's emotional well-being in

the absence of secondary control).

Finally, a *fourth* similarity between these two perspectives is that both stress the importance of a higher-order, self-regulatory capacity to shift between primary and secondary control in response to important life events (Rothbaum et al., 1982) and over the life course (Heckhausen & Schulz, 1995), so as to foster long-term emotional, motivational, and performance outcomes. Heckhausen and Schulz refer to this process as involving the "optimization" of selective and compensatory control-striving in accordance with age-graded environmental contingencies, whereas Rothbaum et al. describe it in terms of a difference in emphasis between primary- and secondary-control processes in congruence with the objective controllability of a given setting. Previous research has provided much empirical evidence in support of the primacy of primary control (Affleck, Tennen, Pfeiffer, & Fifield, 1987; Lang & Heckhausen, 2001; Heckhausen, 1997; Taylor et al., 1991; Thompson, Sobolew-Shubin, Galbraith, Schwankovsky, & Cruzen, 1993; Thompson et al., 1998), secondary control as a back-up process (Thompson et al., 1994; Thompson et al., 1998), and the possible disadvantages of relying mainly on primary control in low-control or aversive situations (Affleck, Tennen, Pfeiffer, and Fifield, 1987; Lang & Heckhausen, 2001, Study 2; Hall, Perry, Ruthig, Hladkyj, & Chipperfield, in press; Heckhausen et al., 2001, Study 2). In contrast, the capacity to switch between primary and secondary control in response to both success and failure situations has yet to be examined in existing research on these constructs, and as such, is the focus of this study.

Optimizing Primary and Secondary Control in an Academic Achievement Setting

In Rothbaum et al.'s (1982) model of primary and secondary control, the "knowledge of how and when to exert the two processes of control and how to integrate them" (p. 30) is presented as an integral component of this dual-process model. Moreover, Heckhausen and Schulz (1995) refer to this "optimization" of primary- and secondary-control striving as the central process underlying successful adjustment to developmental challenges across the life span. Despite the apparent significance of one's capacity to shift between primary and secondary control in response to varying opportunities for situational control, this process has yet to be fully examined in this literature and represents a potentially fruitful area of investigation in research on adaptation in achievement settings.

The present longitudinal study explored how individuals switch between primary and secondary control in an academic achievement context. Further, this study also examined the higher-order capacity to switch one's emphasis between these control processes. In so doing, this research explores the tenets of optimization as proposed in Rothbaum et al.'s original dual-process model and also draws on Heckhausen and Schulz's developmental model in focussing on how students engage in primary- and secondary-control processes during this critical academic transition period.

Adaptation in Achievement Settings: Balancing Primary and Secondary Control

Rothbaum et al. (1982) define "optimal adaptation" as not simply being able to use primary- and secondary-control techniques, but also to shift one's emphasis between them so as to effectively respond to both low- and high-control circumstances. They

further describe this capability as "one of the most significant implications of the two-process model" (p. 29). Heckhausen and Schulz (1995) also highlight the importance of a higher-order, self-regulatory process involving the optimal utilization of selective and compensatory primary- and secondary-control strategies, albeit in the developmental context of successfully adapting to increasing physical and social limitations associated with the aging process. Thus, whereas Heckhausen and Schulz focus on long-term shifts in relative emphasis from primary- to secondary-control striving with increasing age, Rothbaum et al.'s model of adaptiveness can be seen as more applicable to the study of how individuals adjust to on-going situational demands in their daily lives. Therefore, Heckhausen's developmental model provides a valuable theoretical framework for examining longitudinal changes in control-striving behavior across the life span, whereas Rothbaum et al.'s original model addresses one's capacity to switch between primary and secondary control in response to both positive and negative everyday events. As both success and failure outcomes occur with particular frequency and intensity in achievement settings, the present research examined how individuals adjust to actual performance outcomes in a challenging academic environment.

As persistence and effort are necessary prerequisites of successful development in high-control achievement settings, one is more likely to rely on goal-directed, primary-control striving, and as a result, experience a greater likelihood of both success *and* failure outcomes than in non-achievement settings (e.g., leisure activities, daily routines). From a developmental perspective, Heckhausen and Schulz (1995) suggest that primary-control striving is of considerable importance particularly in adolescence and young

adulthood, a period in which developmental goals are to be pursued to their fullest extent so as to provide opportunities for successful goal attainment in a subset of these domains in later life. Recent research also suggests that examining how young adults adjust to a demanding university setting may improve our understanding of primary and secondary control as they relate to optimal adjustment during this critical developmental phase (Connor-Smith & Compas, 2002; Hall, Perry, Ruthig, et al., in press; see also Heckhausen & Tomasik, 2002). As such, it appears that the higher-order implications of Rothbaum et al.'s (1982) model, that is, how individuals switch between primary and secondary control in response to high- and low-control outcomes, can be effectively explored by examining how young adults adjust to academic challenges in a university setting.

Preliminary research. With respect to performance and motivation in achievement settings, Kuhl's theory of self-regulation suggests that one's ability to recognize when one's (primary control) efforts are no longer effective may buffer the negative motivational and affective impact of failure experiences. In Kuhl's research, the capability to recognize situational limitations and pursue action alternatives in an efficient manner is referred to as action control and is proposed as the underlying process responsible for the successful enactment of intentions (Kuhl, 1986, 1994). High levels of action control are referred to as an *action orientation*, whereas lower levels of action control, indicating a tendency to become preoccupied with failure, is referred to as a *state orientation*. More specifically, action control is described by Kuhl (1994) as a higher-order, cognitive process involving the coordination of volitional activities related to (a)

the maintenance and strengthening of goal-directed intentions ("goal maintenance"), and (b) the modification or dissolution of these intentions in order to preserve one's overall motivation and emotional well-being ("self-maintenance"). Because these two volitional components described by Kuhl seem to parallel the primary/secondary control distinction found in Rothbaum et al. (1982), preliminary research on students' "switching capacity" was based on the premise that one's capacity for action control may capture the essence of optimization as described in Rothbaum's model.

For example, a recent study on how action control relates to primary control in first-year university students by Perry, Hladkyj, Pekrun, and Pelletier (2001) found that action-oriented students reported higher primary-control beliefs. However, this study also showed that action-oriented students performed more poorly than state-oriented students who were more preoccupied with academic failure experiences. Preliminary research on action control as a measure of students' "switching capacity" has also provided intriguing results, particularly for unsuccessful students who are most likely to benefit from an ability to switch to more adaptive secondary-control strategies (Hall, Hladkyj, Chipperfield, & Perry, 2002; Hall, Hladkyj, Chipperfield, & Stupnisky, 2003; Hall, Hladkyj, Ruthig, Pekrun, & Perry, 2002). Specifically, these studies suggest that for students experiencing academic failure, the highest levels of action control are among students high in both primary *and* secondary control, with an action orientation corresponding to greater optimism, emotional well-being, and perceived health, as well as slightly *poorer* levels of academic performance (due to the increased focus on secondary relative to primary control) among unsuccessful students with the ability to

switch.

Taken together, the findings of recent research on action control in an academic achievement context provided some preliminary empirical support for the construct of action control as a proxy for one's capability to shift one's emphasis between primary and secondary control as outlined in Rothbaum et al. (1982). First, these results are consistent with an important theoretical assumption proposed by Rothbaum et al., namely that one's ability to switch is based on an existing proficiency with both primary *and* secondary control. Second, these findings also suggest that this capacity to switch is most beneficial for unsuccessful students for whom a switch from primary to secondary control could serve to preserve their sense of control. Finally, these preliminary results also indicate that, although an action orientation (vs. state orientation) may be effective in improving outcomes typically associated with secondary control (e.g., positive affect, health), this approach may be detrimental to actual performance outcomes, which according to Rothbaum et al. (1982) are "most fostered by primary control and most jeopardized by secondary control" (p. 29). That is, although a switch from primary to secondary control may have a positive impact on students' health status, this benefit may come at the expense of achievement-striving behaviour and performance which typically result from primary-control efforts (Perry et al., 2005).

Diary Methods: Assessing Adaptation in Everyday Life

In the study of optimal adaptation in achievement settings, diary-based research methods represent a valuable tool for examining how individuals adjust to success and failure experiences in everyday situations. Specifically, diary methods involve the

relatively unobtrusive assessment of self-reported experiences and internal states at multiple points over a specific period of time. This technique has also been found to significantly reduce recall biases commonly observed using retrospective self-report measures administered in laboratory settings (e.g., Coxon, 1999; see Nisbett & Wilson, 1977). Diary techniques have often been employed in social science research (see Verbrugge, 1980) involving such topics as sexual behavior (Minnis & Padian, 2001; Coxon, 1999), drug abuse (Carney, Armeli, Tennen, Affleck, & O'Neil, 2000), physical illness (Gijsbers van Wijk, Huisman, & Kolk, 1999), work-related stress (Grandey, Tam, & Brauburger, 2002; Hahn, 2000), and interpersonal relationships (Bradford, Feeney, & Campbell, 2002; Vittengl & Holt, 1998).

According to Bolger, Davis, and Rafaeli (2003), diary-based research methods are particularly well-suited for exploring individual differences in within-person variability, that is, changes in the same individual over time (see also Breakwell & Wood, 2000). These authors further suggest that diary methods are especially useful in research on how psychological processes change during academic or health-related transition phases. Concerning the latter, diary techniques have been used by researchers employing a dual-process model of coping based on Rothbaum et al. (1982) to examine how people cope with physical and psychological health problems such as arthritis (Affleck & Tennen, 1994), fatigue (Affleck et al., 2001), and depression (Tennen & Affleck, 2000). Thus, based on the apparent applicability of longitudinal diary methods for studying the role of primary/secondary control during academic transition phases (i.e., first-year university students), this technique was employed in the presents study.

Research on the use of diary techniques highlights important aspects of the diary completion process that were incorporated into the present research design. Diary research suggests that a sufficiently large number of participants be initially recruited and minimal effort be required on the part of the participant in order to prevent the increased participant drop-out and missing data typically found in diary studies (Breakwell & Wood, 2000). In an ongoing effort to ease the burden of participant involvement in diary research, recent studies have opted for structured scales (e.g., Likert) as opposed to open-ended measures, shorter versus more exhaustive diary entries, as well as the implementation of computer-based rather than traditional pencil-and-paper diary formats (Bolger et al., 2003; Breakwell & Wood, 2000). With respect to the effectiveness of these techniques for diary research on younger samples, Minnis and Padian (2001) showed that these modifications to traditional diary designs can be particularly beneficial for younger individuals in terms of improving sample maintenance and reducing missing data. The results of this study also suggest that computer-based diary methods can result in more candid (accurate) responding, as well as a more enjoyable experience for the participant.

Web-based diary methods. With respect to computer-based diary techniques, Bolger et al. (2003) suggest that the use of web-based diaries has several advantages over traditional pencil-and-paper formats and is becoming an increasingly popular form of diary research. Aside from the obvious benefits involving ease of completion for participants (e.g., no paperwork, record-keeping, or mailing in of surveys), there are numerous advantages of on-line diary techniques for researchers involving efficiency and accuracy. As web-based diary techniques allow for responses to be immediately saved to

a data file, the process of data collection is made considerably shorter and more accurate due to minimizing the time and human error involved in the transcription, concatenation, and double-checking of participants' responses. The quality of the data collected is also improved through the prevention of out-of-range, duplicate, and ambiguous responses, as well as the use of reminder messages for omitted questions that decrease the occurrence of missing data.

Additional advantages of web-based diaries concern increased experimenter control over how items are presented. For instance, on-line surveys allow for various response formats (i.e., Likert, check box, drop-down menu, open-ended), item randomization, dynamic item sequences, as well as time restrictions with respect to specific items as well as times at which the survey may be completed. The proper use of web-based diary formats also prevent participants' access to collected data that could be used, intentionally or otherwise, to regulate the very behavior or cognitions being assessed (Breakwell & Wood, 2000). Web-based diary methods also allow for large numbers of participants to be assessed with minimal direct experimenter supervision of the participant, and may hold participants' interest to a greater extent due to the novel manner in which the survey is completed (see Minnis & Padian, 2001, for positive participant feedback concerning computer-assisted diary methods).

Bolger et al. (2003) also highlight some of the limitations associated with web-based diary techniques. These disadvantages include the financial costs involved in the development of survey programs, the difficulty in incorporating longer open-ended responses, as well as the risk of perpetuating the "digital divide" between participants

with access to computer technology and those without (see also Sax, Gilmartin, & Bryant, 2003). This point is also made by Breakwell and Wood (2000) who stress the importance of using a diary medium that is most appropriate for the respondents under investigation. Furthermore, as suggested by Coxon (1999), one's findings may be also be confounded by a selection bias that can result in one's sample consisting primarily of those who are more comfortable completing a regular diary, or in this case, more proficient in using computers or web-based applications. A third limitation of all take-home diary methods concerns the environment in which responding occurs in that, whereas typical pencil-and-paper questionnaires are completed by students in classroom settings under experimenter supervision, take-home diary questionnaires, particularly those administered over the web, can be completed by students at any hour, from any location, and in any state of mind (e.g., tired, distracted, inebriated, etc.).

When considering a web-based diary study on achievement-striving conducted in an academic setting with university students as participants, many of these limitations described above are no longer applicable. First, as student samples are typically comprised of individuals enrolled in introductory psychology and required to participate in research for course credit, problems associated with selection bias and drop-out become less important than ensuring that experimental activities are sufficiently engaging. Second, development costs may be minimized or eliminated completely through collaboration with technology-related cooperative work programs in which students complete such projects for course credit (e.g., TECHNET Program, University of Manitoba; Cooperative Education Program, University of Waterloo). Third, as most

universities require course assignments to be completed using computers, encourage web-based course registration, provide online library services, and maintain open-area computer facilities, the majority of students should have not only access to computers, but also the basic computer skills required to complete an online diary questionnaire.

Finally, although pencil-and-paper diary questionnaires may be completed at any location or any time of day, web-based surveys, as in the case of the present study, can restrict student access to the online survey to campus computing facilities that have limited hours of operation and rules of conduct concerning appropriate computer use and behavior. Moreover, most larger campus computing facilities employ laboratory personnel who not only monitor students' computing activities, but ensure proper decorum and assist students with computing problems (e.g., login difficulties, Internet access, etc.). As such, web-based survey methods appear to be the most efficient and user-friendly means of conducting a diary study in highly computer-literate populations, and may in fact be the most appropriate diary method for use with university students considering the computing resources and skills available to them.

Research Study Overview

Based on the above reviews outlining the theory and empirical research on switching one's emphasis between primary and secondary control, and the potential benefits of diary methods, the current study examined how university students, primarily freshman students, shift their emphasis between primary and secondary control in response to actual achievement outcomes through the use of web-based diary techniques. More specifically, the present research consisted of a sample of introductory psychology

students at the University of Manitoba who completed multiple web-based questionnaires from October through March of the 2004/2005 academic year - once before their first course exam and four additional times each within 10 days following the posting of their first four introductory psychology test results. The questionnaire included self-report measures of primary control, secondary control, perceived ability to switch between primary/secondary control, as well as self-report dependent measures assessing students' motivational orientation, expectations, values, perceived success, emotions, health, and overall adjustment. Actual test scores were obtained from course professors throughout the year. Structural equation modelling techniques were used to assess the proposed hypotheses based on Rothbaum et al.'s (1982) original model of primary/secondary control.

Although the inclusion of only students enrolled in introductory psychology may represent a biased sample to the extent that more senior students and students enrolled in other courses are not assessed, the present sample was ideal for assessing the present study hypotheses. In the context of control-threatening experiences, the freshman year of university can be considered a prototypical transition period during which perceptions of control are in flux due to environmental intrusions (Perry, 2003) and developmental shifts in control beliefs and strategies are likely to occur (Schulz & Heckhausen, 1999). According to Heckhausen et al. (2001), enhanced cognitive receptiveness in the beginning of such critical life phases is typical, making feedback early in the first year of university particularly influential in terms of students' long-term academic development (Perry, Hechter, Menec, & Weinberg, 1993). Thus, first-year university students

represent an ideal sample in which to examine how individuals adapt to performance outcomes in normative achievement situations.

With respect to recruiting students from only a single course, namely introductory psychology, this focus represents one of the primary strengths of the present experimental design. First, introductory psychology is a subject area that attracts students from a variety of academic disciplines, many of whom take the course to fulfill an ancillary course requirement. In a recent study by Ruthig, Perry, Hall, & Hladkyj (2005), although the majority of introductory psychology students recruited were from the Faculty of Arts (50%), many were from the Faculty of Science (31%) and various other faculties such as management, engineering, human ecology, nursing, and physical education. Second, by recruiting participants from multiple sections of a course consisting of over 3000 students taught by different instructors and varying in classroom size, the study hypotheses are tested in a real-life academic context that takes into account differences in classroom teaching and learning dynamics not found in more specific courses (e.g., biochemistry). It should be noted, however, that the inclusion of students from various course sections also serves to prevent the atypical testing and grading practices of a few professors from biassing the overall study findings involving performance outcomes. Finally, by recruiting only students enrolled in a single course, the course curriculum as well as the number, format, and timing of course exams remained relatively consistent across participants from different course sections. As such, the influence of these and other potentially confounding factors including test importance and preparation time (both are higher when fewer tests are administered), as well as

familiarity with course content (introductory level courses consist of novice students) were minimized.

Consistent with Rothbaum et al.'s (1982) congruence hypothesis, *successful course performance* was expected to correspond with an observed shift in emphasis from secondary to primary control, whereas *poor course performance* was hypothesized to relate to actual switching from primary to secondary control. In accordance with Rothbaum et al. (1982) and preliminary research (Hall et al., 2003), both high primary control (PC) and high secondary control (SC) were also expected to positively relate to higher levels of self-reported switching based on the assumption that one must possess both types of control in order to switch between them. In turn, students' self-reported ability to switch between primary and secondary control was expected to relate to actual shifts in emphasis between these processes over time. That is, students perceived ability to switch from primary to secondary control after performing poorly should relate to actual shifts from primary to secondary control following low grades, whereas the perceived ability to shift from secondary to primary control when success is possible should correspond with actual shifts in emphasis from secondary to primary control following a success experience. Moreover, each *congruent* shift (i.e., SC to PC in success situations, PC to SC in failure situations) was expected to positively relate to academic and psychosocial development (i.e., performance, motivation, emotions, health, stress, depression, and self-esteem). These three hypothesized congruence effects were also expected to be most significant for students reporting a high ability to adaptively switch between primary and secondary control. Finally, it was anticipated that congruent shifts

to primary control would positively associate with subsequent performance and that congruent shifts to secondary control will be detrimental to future performance, as achievement outcomes are "most fostered by primary control and most jeopardized by secondary control" (p. 29; Rothbaum et al., 1982).

In examining the adaptiveness of students' overall levels of academic control, as well as the degree to which these levels change over time, the present study follows from previous research by this laboratory that over the past 20 years has empirically addressed the dispositional as well as situational components of students' self-reports of academic control. As described in Perry et al. (2005), students' scores on typical measures of perceived academic control primarily reflect their level of *stable academic control*, a dispositional trait that students bring into the classroom situation. Nonetheless, these measures are referred to as "trait-like" due to the influence of environmental intrusions that may temporarily increase or decrease one's immediate state of perceived personal control, or *transient academic control* (Perry et al., 2005; see also Rotter, 1975; Skinner, Zimmer-Gembeck, & Connell, 1998). According to Perry et al., students' perceptions of control are "deemed to be 'relatively' stable because assessments of trait perceived control may include the effects of transient elements as well" (p. 370).

Early research by this laboratory repeatedly demonstrated the importance of transient academic control for student motivation and performance in showing how temporary losses in perceived control, induced through manipulated failure experiences, result in observable deficits on subsequent measures of motivation and academic performance (e.g., Magnusson & Perry, 1989; Perry & Dickens, 1984, 1987; Perry,

Magnusson, Parsonson, & Dickens, 1986). Similarly, considerable research since by Perry and colleagues has convincingly illustrated the critical role played by stable perceptions of control in students' academic development (e.g., Perry et al., 2001; see Perry, 1991, and Perry et al., 2005 for reviews). Consistent with this research, the present study examined both the stable and transient components of academic control in the context of Rothbaum et al.'s (1982) dual-process model. More specifically, the present study explored the academic implications of both primary *and* secondary control, and further, examined the degree to which positive and negative performance feedback predicted changes in relative emphasis between these processes over time, which in turn, should contribute to academic development and performance in an actual classroom setting.

Method

Participant Demographics

Three weeks into the academic year, 424 students were recruited from six sections of a two-semester introductory psychology course at the University of Manitoba for a five-phase study in exchange for experimental credit. The initial sample consisted of 143 males (34%) and 279 female students (2 students did not report their gender), with 80% of students reporting English as their first language, and 90% being under 25 years of age (M = 20.46 years). With respect to self-report academic characteristics, 90% of the initial sample were enrolled in the equivalent of at least 3 full-year courses (43% were enrolled in 5 or more full-year courses), and 89% were first- or second-year students. The average high school grade for the initial sample was 81%. These demographic characteristics are

comparable to those found in a similar, large-scale pencil-and-paper survey study administered in 2001 by this laboratory (Hall, Perry, Chipperfield, Clifton, & Haynes, in press) which consisted of 31% males, 93% under 25 years of age, 88% reporting English as their first language, 92% with at least at 3 full-year course equivalent enrollment, and an average high school grade between 81-85% (Likert scale).

Although students at this institution are not registered in a specific faculty until their second year, the most common faculty affiliations reported by the remaining 31% of the initial sample included the faculties of Science (40%), Arts (23%), Management (10%), Nursing (5%), and Human Ecology (5%). Because program year was not assessed in the 2001 data collection, it was not possible to compare the faculty designations of more senior students to those of participants in previous pencil-and-paper studies. Due to the lower than anticipated initial sample size (< 500 students) and high level of participant attrition expected (as is common in diary studies), 144 students were recruited (85 from two additional introductory psychology course sections) to complete the final four parts of the study in exchange for experimental credit.

Participant Engagement

Attrition rates. For the present study, participant engagement in the study procedures was assessed based on the examination of four variables: attrition rates, missing item responses, actual student comments, and number of students providing contact information. Concerning study attrition rates, the total sample sizes for each phase of the study are as follows: Time 1 $n = 424$; Time 2 $n = 544$; Time 3 $n = 517$; Time 4 $n = 487$; Time 5 $n = 477$ (higher sample size in Time 2 is due to additional recruitment

described above). As expected, participant attrition did occur from one phase to the next, the reasons for which include students having already completed their experimental credit requirements, having withdrawn from the course, illness, etc. However, participant attrition in the present study was minimal: 6% from Time 1 to 2, 5% from Time 2 to 3, 6% from Time 3 to 4, and 2% from Time 4 to 5. Total attrition rates for the entire study was 16% for 5-part participants, and 17% for 4-part participants - attrition rates not only show considerable student engagement in the experimental protocol, but that are also well below those in observed in recent studies from this laboratory (e.g., 21%, Hall, Perry, Chipperfield, et al., in press; 55%, Perry et al., 2001).

These attrition rates are particularly impressive considering that the present study consisted of 4 to 5 parts as opposed to the traditional 2-part design. Regression analyses on the number of phases completed indicated that of the various demographic variables assessed (i.e., age, gender, faculty, course load, year in program, high school grade, English as first language), only having withdrawn from the introductory psychology course (inferred from having no scores for 2 or more tests in a row) negatively predicted staying in the study (5-part participants: $\beta = -.47$, $p < .001$; 4-part participants: $\beta = -.56$, $p < .001$). Students in the 5-part study with higher high school grades were more likely to complete more phases of the study ($\beta = .16$, $p < .001$).

Missing item responses. Analyses of missing item responses also demonstrated student engagement, with item-specific analyses showing that 85% of all 641 questions in this study had none or only one missing response and 98% of all study questions having 5 or fewer missing responses. More specifically, the maximum number of

students who missed responses for a question was 10 in Time 1, 4 in Time 3, and 3 in Times 2, 4, and 5. In other words, although some people chose to not answer certain questions, these people constituted a maximum of 2.4% of the sample for any specific question, and in all parts of the study except the first, the proportion of people who skipped a given question was less than 1% of the entire sample.

These findings show that despite completing the survey up to 5 times and having no experimenter supervision, nearly all students in this study completed every survey item - a finding likely because of having incorporated a reminder message for unanswered questions into the web survey. Moreover, these findings are similar to those of previous pencil-and-paper questionnaires of the same length administered twice per year by this laboratory in 1998 (Hall, Perry, Ruthig, et al., in press) and 2001 (Hall, Perry, Chipperfield, et al., in press) which showed maximum item nonresponse rates of 2.24% and 1.90% respectively, and average item nonresponse rates of .41% and .59% respectively (.32% average item nonresponding was found in this study).

Student comments. Immediately following the last page of survey items, students were provided an opportunity in each phase to provide a brief written comment to the experimenter concerning the study. As found in the Minnis and Padian (2001) study with young adults, the computer-based diary method in the present study was expected to generate positive comments from students concerning ease of use and the novel nature of the experience. Following a visual inspection of all comments provided, students' comments were classified as (1) no comment (and phrases indicating such), (2) question or request, (3) suggestion, (4) clarification of responses or further reflection (e.g., about

their thought processes, studies, class, professor, etc.), (5) positive comment concerning the survey (e.g., enjoying the experience), (6) negative comment concerning the survey (e.g., too long, repetitive, boring, complicated, important questions and response options being inadequate or absent, etc.), and (7) neutral comment involving greetings, well-wishing, ambiguous phrases (e.g., "thanks"), and logistical issues (e.g., providing an email address, identifying minor computer problems, etc.).

First, it should be noted that most students did not provide written comments to the experimenter and that this proportion of students increased with each phase (Times 1-5: 68%, 77%, 82%, 86%, 83%). With respect to the comments that were provided, the greatest proportion in each phase were positive in nature, particularly in the first and last parts of the study (Times 1-5: 49%, 46%, 39%, 31%, 41%). Although negative comments were also provided, they were much less common and generally declined over time (Times 1-5: 16%, 11%, 15%, 11%, 3%). Comments concerning clarification of responses or indicating further reflection on the issues raised in the questionnaire (e.g., ways of thinking about one's studies) showed a steady increase during the middle of the study (Times 1-5: 14%, 15%, 21%, 31%, 16%). Thus, considering that between 70 and 134 participants in this study took the time to provide a written comment, and that approximately 60% of comments in each phase were either positive or demonstrated further reflection on the study materials, it can be inferred that the computer-based web survey employed in this study was a considerably more positive than negative experience for participants and did not compromise student engagement in the experimental protocol.

Contact information. Finally, student engagement in the study procedures was assessed by tabulating how many students provided email contact information to the experimenter. At the start of the first and second administrations of the web survey, students were encouraged to provide their email address in order to receive study updates and reminders via email. Because all student participants have access to campus computer facilities and email services, it was expected that many students would provide an email address. In fact, email contact information was provided by 98% of participants, with 31 students providing two addresses. Although many of the addresses provided were hosted by the university system, these constituted only 183 of the 584 addresses, indicating that over two-thirds of the present sample had email-related computer experience in addition to that afforded by the university.

Although this finding may be interpreted as sample bias in favour of participants with more computer experience (Bolger et al., 2003; Sax et al., 2003), it is important to note that the demographic characteristics of the present sample were consistent with those of a similar pencil-and-paper study (see Participants), and actually showed a slightly *greater* proportion of nontraditional students over the age of 30 (5% vs. 3% in 2001) - individuals often identified has having lower computer literacy (e.g., Sax et al., 2003). As such, preliminary analyses demonstrated low rates of attrition and omitted responses, the majority of student comments being positive or reflective in nature, and that nearly all students wished to receive ongoing information about the study via email - all of which demonstrate that most students maintained a sufficient level of engagement while completing the multiple web survey questionnaires administered in this study.

Participant Exclusions

Despite preliminary evidence in support of the representative demographic composition and sufficient engagement level of the present study sample, ongoing monitoring of students' elapsed times for completing the survey (time elapsed from the first to last question) and the nature of students' responses revealed that a small proportion in each phase completed the survey very quickly and provided responses inconsistent with item valences. Although experimental controls were in place to prevent students from accessing the survey outside of campus computer facilities, it was observed that in each part of the study, some students had very low elapsed times which suggest that all survey items were not read or responded to with due consideration. Based on the visual inspection of item responses, approximately 5% of participants in each phase were found to have noticeably lower elapsed times than other students as well as responses that were not consistent across both positively and negatively worded items in the same scale (e.g., primary control).

A five-part rationale presented in Appendix A outlines additional empirical support for the exclusion of these participants from subsequent descriptive and inferential analyses based on (1) estimated rates of responding, (2) item-specific descriptives, (3) inter-item correlations, (4) composite variable analyses, and (5) demographic characteristics. In sum, these analyses provide clear empirical support for excluding the top 5% of the elapsed time distribution in each phase in showing that these students spent little or no time reading the survey items, had greater within-group heterogeneity on specific items and inter-item correlations, based their responses largely on previous

responses, did not attend to item valence, and were representative of the larger sample with respect to most demographic characteristics. Based on these analyses, this group of students was not included in all subsequent descriptive and inferential analyses concerning the study variables and hypotheses.

Overview of Study Measures

The independent measures in the present study included students' actual test performance in introductory psychology as well as students' beliefs and strategies involving primary control, secondary control, their perceived ability to shift between these two processes, and actual observed changes in the relative emphasis on these two processes over time. Self-report dependent variables included scales assessing students' academic motivation, emotions, as well as their health and overall psychosocial adjustment. Specific items for all self-report scales assessed are presented in the Appendix B, and an overview of study measures is provided in Appendix C. Scale reliability levels, means, and standard deviations for each phase are described in Appendix D.

Independent Measures

Primary academic control (PC). A 10-item measure assessing primary academic control based on Perry et al.'s (2001) Primary Academic Control (PAC) scale was administered in all phases of the study and required students to indicate on a 7-point Likert scale the extent to which they agreed with statements such as "I have a great deal of control over my academic performance in my psychology course," and "The more effort I put into my courses, the better I do in them" (1 = strongly disagree, 7 = strongly

agree). The 7-point response format was selected for this study in order to allow for greater variability in students' responses concerning their perceptions of control. For the purpose of the present study, both the primary and secondary control scales were prefaced by instructions informing students to respond to the survey items based on how they feel about their university experience and course performance *at that moment*. It was anticipated that by encouraging students to respond in a temporally-specific manner, these scales that are typically used to assess stable academic control (Perry et al., 2001) may become more sensitive to slight changes in control from one phase of the study to the next (i.e., transient academic control).

The primary academic control (PC) scale showed high internal reliability in each phase (α Times 1-5: .80, .83, .84, .84, .87), consistent with the degree of internal consistency found for the 5-point version of scale in previous studies employing a pencil-and-paper version of the scale (e.g., Perry et al., 2001: α = .80; Hall, Perry, Ruthig, et al., in press: α = .78) and in a pilot study (October 2003) utilizing the same web-based, 7-point version of this measure (α = .80). As expected based on previous research utilizing the 5-point PC measure (e.g., Hall, Perry, Ruthig, et al., in press; Perry et al., 2001), the present Time 1 measure was also found to be negatively skewed (Skewness = -1.13), with the majority of students scoring above the midpoint. This finding may be explained, in part, by truly low-control individuals being less likely to enter university (Perry, 1991; Rotter, 1975; Stipek & Weisz, 1981). However, the degree of skewness decreased consistently with each phase (Skewness Time 2-5: -.82, -.72, -.56, -.54) as the distribution for the PC measure increasingly resembled a normal curve likely due to

decreased mean levels of PC over time (see Means Analyses section below).

Secondary academic control (SC). Interpretive secondary academic control was assessed in all phases of the study using a 4-item, 7-point Likert-style measure derived from the 5-point Secondary Academic Control (SAC) Scale (Hladkyj, Pelletier, Drewniak, & Perry, 1998). The four items assessed consisted of statements such as "No matter how well I do on a test or in a course, I try to 'see beyond' my grades to how my experience at university helps me to learn about myself," and "Whenever I have a bad experience at university, I try to see how I can 'turn it around' and benefit from it" (1 = strongly disagree, 7 = strongly agree). This scale showed a respectable degree of internal consistency which improved over time (α Times 1-5: .77, .77, .80, .83, .85) and was considerably higher than that found for the 5-point pencil-and-paper format (Hall, Perry, Ruthig, et al., in press; α = .62) and 7-point web format (October 2003; α = .65). It should be noted that in these previous assessments, these items were interspersed with various other items from less reliable SC subscales, whereas in the present study they were assessed together on a single web page - a factor which may have reduced distraction and improved the reliability of item responses.

The interpretive form of secondary control was selected based on Rothbaum's original formulation in which interpretive control is presented as the critical psychological process underlying the effectiveness of all forms of secondary control, and on research showing this type of secondary control to be associated with positive psychological adjustment (Affleck, Tennen, Croog, & Levine, 1987; Croog & Levine, 1982; Hall, Perry, Ruthig, et al., in press; Wrosch et al., 2000). Recent research suggests

that interpretive secondary-control strategies, rather than more passive secondary-control beliefs and strategies (e.g., acceptance, disengagement) are of greater benefit to adolescents and university students (Halliday & Graham, 2000; Petito & Cummins, 2000; Wadsworth & Compas, 2002). From a developmental perspective, Heckhausen and Schultz (1998) also suggest that compensatory secondary-control strategies, such as positive reappraisal (i.e., reinterpreting negative events in a positive manner), allow for sustained motivation and future primary-control striving in situations affording opportunities for future success (e.g., achievement settings), and represent an effective form of secondary control following an unexpected failure of primary control efforts (e.g., poor academic performance).

With respect to the theoretical perspectives on secondary-control efforts of an interpretive nature, Rothbaum et al. (1982) describe these as reframing an aversive outcome so it is perceived as a beneficial experience, and refer to this type of cognitive construals as "interpretive control." Empirical research on interpretive control based on Rothbaum et al. has repeatedly explored the psychological benefits of reinterpreting negative events in a positive manner (e.g., Affleck, Tennen, Croog, & Levine, 1987; Band & Weisz, 1990; Thompson et al., 1998; Wadsworth & Compas, 2002; Weisz et al., 1994; Weisz, Thurber, Sweeney, Proffitt, & LeGagnoux, 1997). In a similar vein, research by Heckhausen and associates has also recently examined the developmental implications of secondary-control strategies concerning the positive reconstrual of negative events, a process referred to by these authors using the term "positive reappraisal" (Wrosch et al., 2000; see also Heckhausen, 1997). Thus, because the

secondary-control strategy referred to as "positive reappraisal" assessed by Heckhausen is consistent with the construct of "interpretive control" measured in previous research based on Rothbaum et al., only the latter term will be used throughout the remainder of the present paper to describe the secondary-control process of finding benefit in failure.

Observed emphasis change (OEC). Measures of emphasis change from primary to secondary control or secondary to primary control from one phase to the next were also constructed. As outlined in Table 1, actual shifts in emphasis between primary and secondary control over time were examined by first creating a difference score between primary and secondary control for each phase of assessment. The emphasis change scores were then created by subtracting the difference score at one phase (Time X) from that of the subsequent phase (Time X + 1), or, $(PC - SC)_{X+1}$ minus $(PC - SC)_{X}$. As such, positive values on this measure indicate that the increase in primary control was greater than the increase in secondary control between Time X and Time X + 1. Negative values indicate that the increase in secondary control was greater than the increase in primary control from one phase to the next (see Means Analyses section below for OEC means and standard deviations).

It is important to note that *the OEC scores reflect a change in relative emphasis between primary and secondary control over time, not necessarily an overemphasis on one process relative to the other over time.* This distinction is important because students begin the academic year with trait-like levels of primary vs. secondary control, and as such, a large shift in emphasis where the endorsement of one type of control subsequently *exceeds* that of the other (e.g., PC > SC to PC < SC) is less likely to occur than a more

Table 1

Construction of observed emphasis change (OEC) scores.

1.	Change scores for both PC and SC ([Time X + 1] minus Time X) were obtained.
2.	The metric for the scales were made equal by multiplying the SC change scores by 2.5 (to equate this 4-item with the larger 10-item PC measure).
3.	The change scores for SC were subtracted from the PC change scores.
	Positive scores: PC increased more than SC (or did not decrease as much as SC); greater increase in primary relative to secondary control.
	Negative scores: SC increased more than PC (or did not decrease as much as PC); greater increase in secondary relative to primary control.
4.	A variable assessing SC-to-PC shifts alone was created by recoding all negatives as zero.
5.	A variable assessing PC-to-SC shifts alone was created by recoding all positives as zero, and multiplying the remaining values by -1 (to create a positively-valenced score similar to that in Step 4).

subtle shift *towards* one form of control (e.g., PC > SC to PC = SC). For instance, a high-PC/moderate-SC student may show a greater increase in SC than PC from Time 1 to Time 2, but may still have higher levels of PC than SC at Time 2 due to the trait-like nature of the control measures. As such, the present measure assesses the full range of *relative* changes in emphasis over time rather than a more dramatic, and unlikely *overemphasis* of one process over the other over time.

Further to the above point, it is also important to note that the *OEC scores are not a zero-sum calculation* where an increase in one form of control entails a decrease in the

other. Although this may, in fact, be the case for some students, scores on this measure only indicate that one control process increased in emphasis *relative* to the other and not necessarily *at the expense* of the other. For example, consider Student A having no change in PC and a 1 point decrease in SC, Student B with a .5 increase in PC and a .5 decrease in SC, Student C having a 1 point increase in PC and no change in SC, and Student D with a 2 point increase in PC as well as a 1 point increase in SC. In each case presented, the student would have a score of +1 indicating that some change in the levels of PC and SC occurred such that PC is now receiving greater emphasis *relative to SC* than it did before (i.e., an increased PC/SC ratio). Conversely, negative scores would indicate that the levels of control have shifted in the other direction resulting in SC being evaluated more favourably *relative to PC* than it was in the previous phase (i.e., a decreased PC/SC ratio). As such, OEC scores reflect any change in the levels of primary and secondary control that result in one control process having an increased level of endorsement relative to other, whether due to an increase or decrease in one or both types of control over time.

Reported congruence ability (RCA). Although the measure of action control developed by Kuhl (1994) was used to approximate students' "switching capacity" in preliminary research, this scale concerns the pursuit of alternative actions in response to only *negative* academic outcomes, and as such, entail a shift in emphasis mainly from primary to secondary control following failure or low-control events. Rothbaum et al.'s (1982) original model describes optimal adaptation as the ability to shift one's control emphasis between primary and secondary control in response to both high- *and* low-

control experiences, respectively (i.e., the "congruence hypothesis"). Moreover, although the action control measure examined students' ability to *disengage* from unsuccessful primary control attempts, it did not specifically address students' capacity to switch between primary control (e.g., persistence) and secondary control (e.g., interpretive control) in response to classroom experiences. Thus, the present study employed a *control-specific*, self-report measure assessing students' ability to make congruent shifts in emphasis between primary and secondary control following failure *and* success.

A 7-point, 14-item measure assessing students' self-reported ability to switch between primary and secondary control following both positive and negative performance outcomes was constructed for this study and administered in all study phases (see Appendix B). The RCA scale showed acceptable reliability levels that improved over time (α Times 1-5: .81, .85, .88, .90, .89) and exceeded those of a preliminary 10-item version of this measure assessed in the October 2003 web-based pilot study (α = .79). Because factor analyses of the preliminary data revealed one factor pertaining to the perceived ability to shift from primary to secondary control and a second involving the perceived ability to shift from secondary to primary control as well as back and forth between the two processes, factor analyses were also conducted on the present RCA measure. It was anticipated that by including more items concerning a shift from secondary to primary control and students' overall switching ability, a three-factor structure would emerge for the RCA scale involving the perceived ability to shift from (1) PC to SC, (2) SC to PC, and (3) back and forth ("Both") in congruence with perceived success vs. failure experiences.

Factor analyses conducted on RCA items in each phase of the study (Varimax rotation) revealed the expected 3-factor structure, and moreover, found this factor structure to become more apparent over time. The Varimax rotation was selected because although there is some conceptual overlap between the three subscales, the items were tailored based on pilot testing to fall into three mutually exclusive factors, the first two concerning opposite emphasis shifts and the third reflecting an independent metacognitive ability to know when these shifts are appropriate. For Time 1 RCA, although an unrestricted factor analyses showed four factors with eigenvalues greater than 1 (Factors 1-4: 4.28, 1.73, 1.18, 1.10), visual inspection of the scree plot suggested a three-factor structure due to the virtually identical eigenvalues found for the third and fourth factors. As such, the solution was subsequently restricted to three factors and resulted in the anticipated item loadings. That is, three factors emerged corresponding to PC-to-SC (Factor 1), SC-to-PC (Factor 2), and "Both" (Factor 3) directions of switching, and the items expected to load on Factor 1 (items 2-4, 7, 9, and 10), Factor 2 (items 6, 11-13), and Factor 3 (items 1, 5, 8, and 14) loaded on the appropriate factor either over .30 or most highly (e.g., item 1 loading = .28). It should be noted, however, that 7 of 14 items double-loaded on at least one other factor at Time 1, with items 6, 7, and 14 loading notably higher on another factor (i.e., Factors 3, 3, and 1 respectively).

Analyses of the RCA factor structure for the remaining phases, however, showed only four items double loading in each phase, with all items except one (item 14) consistently loading most highly on the expected factor. The single item that did not load on the intended Factor 3 ("Both") but Factor 1 (PC to SC) was the last item on the RCA

scale: “I can switch back and forth between trying to succeed and adjusting to disappointment depending on how well I do in my studies.” Although this item is face valid for Factor 3 because of the phrase “back and forth,” students may have overlooked these words (due to an increased pace of reading and responding over time), and understood the item as simply suggesting a shift from trying to succeed (PC) to adjusting to disappointment (SC). Thus, as this item is not face valid for Factor 1 and did not load over .30 or more highly on Factor in Parts 3 through 5 of the present study, it was removed from all subsequent analyses involving the RCA measure. It should be also noted that all double-loadings, with the exception of one (item 10, Time 1), involved the “Both” subscale as would be expected considering the overarching nature of these RCA items.

Internal reliability analyses for the three RCA subscales found the PC-to-SC measure to be most reliable (α Times 1-5: .75, .84, .87, .88, .89), the SC-to-PC measure to have slightly lower reliability (α Times 1-5: .73, .79, .78, .79, .83), and the Both measure to have the poorest, albeit most improved, reliability levels over time (α Times 1-5: .41, .51, .62, .65, .68). In fact, a one-way ANOVA on changes in reliability from the start to end of the study (i.e., 5-part participants: Time 5 minus Time 1; 4-part participants: Time 5 minus Time 2) including measures assessed in all five phases and consisting of three or more items was significant, $F(11) = 5.00$, $p < .01$, and found this change in reliability to be not only the most dramatic, but also the *only* significant improvement in reliability (relative to zero improvement; Bonferroni post-hoc comparisons: $p < .01$). Thus, although the directional RCA subscales had acceptable

reliability at the outset of the study, the bidirectional RCA subscale had low initial reliability but improved considerably over time.

Finally, following from the above factor analyses, confirmatory factor analyses were also conducted using the AMOS program (Arbuckle, 2003) to competitively evaluate the relative fit of the proposed 3-factor model vs. a more general single-factor model based on three fit indices including Bentler's comparative fit index (CFI; Bentler, 1990), the Tucker-Lewis Index (TLI; Tucker & Lewis, 1973), and Steiger and Lind's (1980) root mean square error of approximation (RMSEA). CFI and TLI values greater than .90 (Bentler, 1992) and close to .95 for larger samples (Hu & Bentler, 1999) indicate an acceptable level of model fit, whereas RMSEA values over .10 indicate poor fit, between .08 and .10 indicate mediocre fit, and around or below .06 indicate a good fit to the data (Hu & Bentler, 1999; MacCallum, Browne, & Sugawara, 1996). Results showed the single-factor model (one latent factor predicting all RCA items except item 14) to provide a poor fit to the data (CFI Times 1-5: .68, .70, .76, .76, .71; TLI Times 1-5: .55, .58, .66, .66, .59; RMSEA Times 1-5: .10, .13, .12, .13, .15). In contrast, the three-factor RCA model consistent with that assessed above (including correlations between the three latent factor residuals) fit the data significantly better (CFI Times 1-5: .82, .94, .94, .92, .93; TLI Times 1-5: .74, .91, .92, .88, .90; RMSEA Times 1-5: .08, .06, .06, .08, .07). Thus, based on the above factor analyses, differential reliability levels, and subsequent confirmatory factor analyses, the three RCA subscales were assessed separately in all correlational and SEM analyses.

Academic performance. Students' grades on their first five tests in introductory psychology were obtained from instructors throughout the academic year. Actual course performance represents an objective academic achievement outcome following which shifts in primary and secondary academic control should be observed. Actual course performance in introductory psychology has been found to parallel students' subjective perceptions of academic success in the course, as evidenced by a significant positive relationship between Test 1 and a single-item measure of perceived success in introductory psychology (1 = very unsuccessful, 10 = very successful) administered in a web-based pilot study conducted in October 2003, $r(732) = .67$, $p < .001$. Test means and standard deviations for each phase are presented in Appendix D.

Dependent Measures

The self-report dependent measures in the present study assessed students' motivation with respect to mastery and performance orientation, expectations, values, and perceived success in each phase of the study. Students' learning-related emotions of enjoyment, anxiety, and boredom, as well as perceived global health status and illness symptoms were also examined in each phase. Finally, overall psychosocial adjustment was measured in the first and final phases of the study with respect to students' self-esteem, perceived stress, and depressive symptomology. Specific item wordings are outlined in Appendix B, and scale reliability levels, means, and standard deviations for each phase are presented in Appendix D.

Academic motivation. Two 4-item, 7-point scales adapted from Pintrich, Smith, and McKeachie (1989) were used in all phases of the study to measure students'

achievement motivation with respect to *mastery orientation* (α Times 1-5: .70, .73, .79, .80, .81) and *performance orientation* (α Times 1-5: .72, .73, .79, .79, .83). Both scales showed equivalent and acceptable reliability levels over time that exceeded those observed for these measures in the web-based pilot study (α = .65 and .70, respectively). The mastery orientation scale included items such as "I prefer course material that really challenges me so I can learn new things," whereas the performance orientation scale consisted of items such as "The most important thing for me right now is getting good grades so that I have a high grade point average" (1 = not at all true of me, 7 = very true of me).

Motivation to succeed was also assessed in all phases of the study using a 5-item, 10-point scale as well as two single-item measures asking students about their current *perceived academic success* based on that employed in Hall, Perry, Ruthig, et al. (in press). This 5-item scale asked students to report how successful they felt with respect to their grades, learning goals, course requirements, effort invested, and knowledge gained (1 = not at all successful, 10 = totally successful). The grades item was omitted from the Time 1 questionnaire because students had not yet completed a course exam. The two additional single-item success measures asked students to rate their global perceptions of academic success with respect to their introductory psychology course to date and also in comparison to other university students (1 = not at all, 10 = very much so). The 5-item success measure showed a high degree of internal reliability that remained relatively stable over time (α Times 1-5: .89, .91, .91, .92, .91). The two global perceived success items were significantly and strongly correlated in each phase (*r* Times 1-5: .71, .65, .71,

.68, .71). Although all 7 items can be combined (Hall, Perry, Ruthig, et al., in press; combined α = .88), the two sets of items were assessed separately in the Time Analyses of Descriptive Data section (Appendix D) due to the additional two items having different anchor labels and assessing more global perceptions of academic success.

According to the expectancy-value approach to achievement motivation (Weiner, 1985; Wigfield & Eccles, 2000), both the perceived likelihood of success and the inherent importance of one's studies or course material are critical components of student motivation. As such, this study examined both academic expectations and perceived value of success and learning as representative of students' academic motivation levels. *Expectations* for academic success was assessed in all phases of the study using a 2-item, 7-point Likert measure (1 = not at all true of me, 7 = very true of me) assessing global expectations for future success in introductory psychology and university in general. These items were significantly and consistently correlated in each phase (*r* Times 1-5: .75, .71, .71, .71, .71).

Expectations were also assessed in each phase using two open-ended items asking students to estimate the actual percentage they expected to obtain on their next test and for their final grade in introductory psychology. These items were also significantly correlated in each study phase (*r* Times 1-5: .75, .82, .84, .86, .80). Three of these four expectation items were assessed separately in previous studies, namely global expectations for success in introductory psychology (Hall, Perry, Chipperfield, in press; *M* = 6.20, *SD* = 2.01) and in university (Hall, Perry, Ruthig, et al., in press; *M* = 6.60, *SD* = 2.11), and actual expected percentages in introductory psychology (1 = 50% or less, 10

= 91-100%; *M* = 6.50, *SD* = 1.95; Hall, Perry, Chipperfield et al., in press). However, the present study assessed both global and specific expectations and improved on these measures by allowing open-ended responses to the more specific expectation items.

Perceived value of academic activities and course material was assessed in all phases of the study using four 10-point Likert items (1 = strongly disagree, 10 = strongly agree), with two items assessing the perceived importance of performing well in introductory psychology and university in general (e.g., "It is important for me to do well overall at university this year"), and two items adapted from a 5-item scale by Pintrich et al. (1989) concerning intrinsic motivation for learning and performing well in introductory psychology (e.g., "I think that what we learn in my Introductory Psychology course is interesting"). Significant inter-item correlations were found within both sets of items, with correlations for the importance items (*r* Times 1-5: .72, .79, .80, .77, .80) being higher than those for the intrinsic motivation items (*r* Times 1-5: .59, .66, .70, .73, .71). In sum, academic motivation was assessed using multiple measures including motivational orientation, perceptions of success, and expectancy-value items, thus providing a comprehensive account of students' motivation level throughout the academic year.

Academic emotions. Three academic emotion scales based on the Academic Emotions Questionnaire (AEQ) developed by Pekrun, Titz, Perry, and Spangler (2000) were also examined. These 6-item, 5-point scales addressed students' emotions of enjoyment, anxiety, and boredom concerning their learning experiences in their introductory psychology course (1 = not at all true, 5 = completely true), and were

administered in all phases of the study. Learning-related *enjoyment* was assessed by asking students to indicate the extent to which statements such as "Some topics are so fascinating that I am very motivated to continue studying them" were true of themselves. The enjoyment measure showed acceptable reliability levels (α Times 1-5: .75, .74, .75, .78, .80) similar to those found using a pencil-and-paper format (α = .75; Hall, Perry, Chipperfield, et al., in press) or web-based presentation (α = .73 in 2003 pilot study).

Learning-related *anxiety* was measured using items such as "When I have problems learning the material in this course, I get anxious," and was found to be consistently reliable over time (α Times 1-5: .84, .86, .86, .87, .87) and more reliable than in previous pencil-and-paper studies (α = .81; Perry et al., 2001) or web-based assessments (α = .80 in 2003 pilot study). Learning-related *boredom* was assessed with items such as "The things I have to do for this course are often boring," and showed the highest reliability levels of the three emotions assessed (α Times 1-5: .88, .90, .90, .91, .92) - levels similar to those found for previous pencil-and-paper and web versions of the scale (α = .90, Perry et al., 2001; α = .89 in web-based pilot study). These specific negative and positive academic emotions were selected from the AEQ based on recent research showing these emotions to be more highly correlated with academic performance outcomes than other emotions such as hope, pride, relief, anger, shame, and hopelessness (Pekrun, Goetz, Titz, & Perry, 2002).

Perceived health. Students' overall self-reported health status was assessed in all study phases using a 5-point, Likert-style measure (1 = very poor, 5 = very good) summing two items asking students to rate their physical and psychological health at that

moment. The global health status items were significantly correlated in each study phase (*r* Times 1-5: .49, .51, .55, .59, .56) and were more highly correlated than in a previous pencil-and-paper assessment (*r* = .43; Hall, Chipperfield, Perry, Ruthig, & Goetz, in press). An 8-item symptom checklist adapted from the Cohen-Hoberman Inventory of Physical Symptoms (CHIPS; Cohen & Hoberman, 1983) was also administered in all phases of the study and asked students to indicate how often they were bothered by headaches, sleep problems, low energy, fatigue, muscle tension, stomach pain, heart pounding, and poor appetite over the past week (1 = not at all, 2 = about once, 3 = about twice, 4 = about 4 times, 5 = 5 or more times). The symptom measure showed acceptable reliability levels (α Times 1-5: .82, .83, .84, .86, .87) similar to those observed for a similar pencil-and-paper measure asking students to rate their frequency of these same symptoms over the past month (α = .80; Hall, Chipperfield, et al., in press).

Overall psychosocial adjustment. Measures assessing students' level of psychosocial adjustment with respect to perceptions of stress, self-esteem, and symptoms of depression were also assessed in first and final phases of the study. A 6-item measure of general perceived stress (Cohen, Kamarck, & Mermelstein, 1983) asked students to respond to questions such as how often they had "felt nervous and 'stressed'" or were unable to cope with events in their daily lives, and was found to have acceptable reliability levels (α Times 1 and 5: .89) that in both phases exceeded that observed for recent pencil-and-paper assessment of this scale (α = .85; Hall, Chipperfield, et al., in press). The Goldberg Depression Scale (GDS; Goldberg, 1993) was used to assess depressive symptomology in the present sample, a 17-item, 6-point Likert scale including

items such as “My future seems hopeless,” and “I feel depressed even when good things happen to me” (1 = not at all, 6 = very much). It should be noted that although the present version of this measure did not include one item from the original scale (“I spend time thinking about HOW I might kill myself”), similar yet more subtle items such as “I feel lifeless - more dead than alive” were retained. The internal consistency of the present GDS showed the highest reliability of all scales in the present study (α Times 1 and 5: .93, .94) and significantly exceeded that found in recent large-scale, computer-based survey of Australian young adults (α = .74, *N* = 2404; Caldwell et al., 2002). Finally, a 10-item, 5-point measure of self-esteem (Rosenberg, 1965) included items such as “I take a positive attitude toward myself” (1 = strongly disagree, 5 = strongly agree) and was found to also have reliability levels (α Times 1 and 5: .90, .91) similar to those of a recent pencil-and-paper version of this scale (α = .88; Stupnisky, Perry, Clifton, & Hall, 2003).

Procedure

In September of 2004, students were recruited from multiple introductory psychology course sections for a multi-phase diary study involving the completion of a web-based questionnaire at five points throughout the first and second academic semesters. During the recruitment process, students were informed of three study requirements: (1) consent to participate also constituted consent to release grades information to the experimenter due to the achievement-oriented nature of the study, (2) students must participate in the first phase of the study to be eligible to complete the remaining phases, and (3) students who miss a phase cannot complete or receive credit for any subsequent phases. Although the latter was intended as a disincentive to prevent

premature study attrition, students were also informed of an additional monetary incentive for full study completion during the recruitment phase. Specifically, in an additional attempt to reduce expected student attrition, 40 vouchers for the campus bookstore totalling $500 were awarded to randomly selected participants who had completed all five phases of the study. Reminders concerning the study requirements, prize draw, survey completion times, and logistical issues were regularly provided to participants through in class announcements, email updates, and printed notices displayed beside the posted course grades.

An overview of the study procedures as well as average test result posting and survey completion dates per phase is provided in Table 2. The initial questionnaire was completed during the third and fourth week of classes (Time 1) to ensure that students had *not* yet completed a course exam, and consisted of the self-report demographic as well as all independent and dependent measures described above. Students then completed a reduced version of the questionnaire, excluding the overall adjustment measures (perceived stress, depression, and self-esteem) within 10 days after each of next two test results were posted (Time 2 and Time 3). Because Test 3 was typically administered one week prior to the end of the first semester (e.g., first week in December), many professors posted their test results during the holiday break and many students did not check their grades until they returned to classes in January. As such, although the Times 2, 3, and 5 of the study were each held within 10 days of course test results being posted, Time 4 of the study was conducted during the first 10 days of the following semester. The final phase of the study (Time 5) was conducted within 10 days

Table 2

Overview of study phases and measures.

Phase	Time	Procedure	Measures obtained
Time 1:	Before Test 1 Time 1 completed: 25/09/04	Full survey	PC, SC, & RCA Demographics Motivation, affect, health Overall adjustment
Time 2:	After Test 1 Test 1 posted: 10/10/04 Time 2 completed: 16/10/04	Short survey	PC, SC, & RCA Demographics (4-pt study) OEC (from Time 1) Motivation, affect, health
Time 3:	After Test 2 Test 2 posted: 12/11/04 Time 3 completed: 18/11/04	Short survey	PC, SC, & RCA OEC (from Time 2) Motivation, affect, health
Time 4:	After Test 3 Test 3 posted: N/A Time 4 completed: 13/01/05	Short survey	PC, SC, & RCA OEC (from Time 3) Motivation, affect, health
Time 5:	After Test 4 Test 4 posted: 15/02/05 Time 5 completed: 24/02/05	Full survey	PC, SC, & RCA OEC (from Time 4) Motivation, affect, health Overall adjustment

Note. PC = primary control, SC = secondary control, RCA = reported congruence ability. Test X posted = average test result posting date. Time X completed: average survey completion date.

of students' fourth course exam, during which the full Time 1 questionnaire (excluding demographic variables) was again administered.

The web-based questionnaire employed (developed in cooperation with the TECHNET program in the Faculty of Computer Science at the University of Manitoba from January to April, 2003) was restricted to open-area campus computing facilities to prevent distraction during survey completion, and was available only during the five time periods specified. Students were automatically notified through the web system of omitted responses before proceeding to the following questionnaire page, and were allowed to continue if the omission was intentional. Participants' responses were electronically transmitted immediately in a secure manner to a password-protected data file located on a University of Manitoba web server accessible only by the experimenter and Department of Psychology LAN administrator. Extra encryption was applied to students' identifying information to ensure confidentiality of responses. Finally, students' questions and concerns were responded to immediately by the experimenter via email and telephone, with debriefing information provided to all participants via an email link to online information outlining the research program of this laboratory (see Appendix E).

Results

Preliminary Analyses

Reliability analyses. Although reliability analyses involving item removal were conducted on all self-report measures below, none of the scale items were omitted based on these analyses for two main reasons. First, because many of the measures included in this study already consist of only the most reliable items based on previous assessments by this laboratory (e.g., primary control, secondary control, perceived stress, etc.), none of the observed improvements in fit, if one or multiple items were removed, was dramatic

enough to warrant removing one or multiple items (maximum improvement in Cronbach's alpha was .04). Second, if one item was omitted from analyses in one phase of the study, it should also be removed from analyses on that variable in all other phases to maintain scale consistency. Because no item consistently reduced scale reliability and because all fit improvements decreased over time and were not evident by the final phase of the study, no items were removed based on reliability analyses.

Time analyses of descriptive data. Descriptive information concerning scale reliabilities, means, and standard deviations for each study phase as well as time analyses of this descriptive data are presented in Appendix D. To summarize these findings, repeated-measures analyses of descriptive data for the present study measures set the stage for the inferential analyses to follow in demonstrating (a) no practically significant differences based on time of participant recruitment, (b) increased scale reliability over time, (c) poorer mean levels of primary control, motivation-related constructs, health, and overall adjustment over time, (d) initial declines followed by equivalent improvements for secondary control mean levels, and (e) theoretically consistent shifts in relative emphasis between PC and SC over time in congruence with actual performance outcomes.

Correlational analyses. To determine which background variables should be included as covariates in the main SEM analyses, correlations between the demographic and academic background measures (i.e., age, gender, course load, year in university, high school grades, and English as first language) and critical study measures from Times 1 through 5 were examined (PC, SC, OEC, RCA - PC-to-SC, RCA - SC-to-PC, RCA -

Both, Tests 1-5). Most correlations were either not significant ($p < .05$) or relatively weak ($r \# .3$) and thus of little practical importance. One exception showed that students with English as their second language had significantly lower levels of primary control at Time 1 than other students, $r(400) = -.44$, $p < .001$, but because this relationship was observed in only one phase and also decreased considerably in each subsequent phase (Time 5: $r(454) = -.21$, $p < .001$), it was not included as a covariate in the subsequent analyses.

Correlations between study variables within each study phase are presented in Appendix F, with the general pattern of change in correlations over time indicated by a different background pattern in the table cell (see table notes). Considering the academic nature of most study measures, that most variables were significantly intercorrelated is not surprising. However, these correlational analyses are particularly intriguing with respect to the patterns of observed changes in the valence and magnitude over time. Most correlations showed an increase in magnitude as the academic year progressed, with positive values becoming increasingly positive (e.g., test performance and motivation measures) and negative values increasingly negative (e.g., primary control and anxiety/boredom). Other correlation values remained consistent over time (e.g., overall psychosocial adjustment scales), tended to fluctuate (e.g., enjoyment and the directional RCA scales), showed a curvilinear trend (e.g., mastery motivation and value; illness symptoms and boredom; global health and enjoyment), or were consistently nonsignificant (e.g., anxiety did not correlate with either enjoyment or performance motivation in any study phase).

Although an exhaustive explication of correlations presented in Appendix F is beyond the scope of the present study, two specific sets correlations warrant further consideration. First, it is notable that no significant correlation was found between primary and secondary control in Time 1, yet this relationship became increasingly positive and significant over time. Second, the negative relationship between secondary control and performance in Time 1 was not found subsequent phases, with correlations actually becoming positive in valence by Time 4. Taken together, these results show that as primary and secondary control became more interdependent as the academic year progressed, secondary control was no longer negatively related to performing well and was increasingly related to primary control. This finding in combination with observed changes in mean levels showing that secondary control levels increased as primary control levels decreased suggests that over time, secondary control may come to serve as a back-up to unsuccessful primary control efforts in sustaining motivation levels and possibly future primary-control striving when faced with consistent declines in test performance.

Test-retest reliability estimates based on correlations within each self-report measure between adjacent assessment periods (e.g., Time 1 to 2, Time 2 to 3, etc.) are presented in the final column of Appendix F. Also presented in this column are the correlations between adjacent test scores and between OEC scores, the latter conducted to see if the direction of observed emphasis change following one test predicted the direction of switching following the next test. Results showed acceptable stability in the self-report measures from one phase to the next, with 10 of 18 applicable measures

showing increased correlations over time, and the remaining measures demonstrating stable between-phase correlation levels. Results also revealed that all tests scores except the last were highly correlated with previous test results, reflecting the significant increase in performance observed on Test 5 following a steady decline from Tests 1 through 4.

Finally, correlations between OEC scores were negative and became more negative over time, indicating that shifting toward a specific control process (e.g., SC to PC, positive scores) after one test was typically associated with less of a shift toward that process (e.g., scores becoming less positive, closer to zero) and/or a shift toward the other process (e.g., PC to SC - negative scores) following the next test. *Because it is not possible to determine which of the two interpretations is most accurate due to the total OEC measure including both positive (PC to SC) and negative values (SC to PC),* a factor which may also have influenced the general lack of significant correlations involving the total OEC measure, *the direction-specific variants of this scale were employed in all subsequent analyses*. That is, instead of using the total OEC score (Table 1, Step 3), scores representing either increased emphasis specifically on primary control (vs. SC; Table 1, Step 4), or secondary control (vs. PC; Table 1, Step 5) were used in all analyses described below.

Hypotheses for SEM Analyses

Before outlining the findings from the main structural equation modelling (SEM) analyses of the relationships between the PC, SC, RCA, OEC, and outcome measures, it is important to first reiterate the specific research hypotheses under investigation.

Hypothesis 1. Consistent with Rothbaum et al.'s (1982) "congruence" hypothesis, Hypothesis 1a notes that good course performance should contribute to an observed shift in emphasis from secondary to primary control, or in other words, to higher SC-to-PC OEC scores. Also following from this congruence hypothesis, Hypothesis 1b states that poor course performance should relate to an increased emphasis on secondary relative to primary control, or higher PC-to-SC OEC scores. Put simply, doing well should encourage subsequent shifts towards primary as opposed to secondary control whereas doing poorly should prompt shifts towards secondary rather than primary control.

Hypothesis 2. Primary control (PC) and secondary control (SC) are expected to both relate to higher levels of reported congruence ability (RCA) to switch between these control processes (i.e., the "Both" RCA subscale). This hypothesis is based on the assumption that one must possess both types of control in order to shift between them, as well as recent research showing that a combination of high primary and secondary control fosters an ability to shift between them in congruence with performance outcomes (Hall, Perry, Stupnisky, Haynes, & Bailis, 2005), and in turn, better academic development (Hall, Perry, Ruthig, et al., in press). Although this assumption is most comprehensively assessed as an interaction between these control constructs, only the independent effects of primary and secondary control on the perceived switching ability were examined. Analyses were conducted as such because (a) in-depth analyses of additive and multiplicative interaction terms can be found in the two studies cited above, (b) interaction effects are not readily assessed in structural equation models, and (c) the focus of this study was more on the processes and consequences, and less on the

antecedents, of perceived and observed emphasis shifts in primary and secondary control.

Hypothesis 3. RCA scores should correspond to observed emphasis changes (OEC) between primary and secondary control. With respect to the relationship between perceived and observed shifts in emphasis from *primary to secondary control*, Hypothesis 3a states that PC-to-SC RCA (items 2-4, 7, 9, and 10) should positively relate to PC-to-SC OEC (Table 1, Step 4). Conversely, in terms of students' perceived vs. observed ability to switch from *secondary to primary control*, Hypothesis 3b states that SC-to-PC RCA (items 6, 11-13) should positively relate to SC-to-PC OEC (Table 1, Step 5). Finally, Hypothesis 3c proposes that the "Both" RCA subscale should positively relate to both PC-to-SC OEC as well as SC-to-PC OEC due to the bidirectional nature of this self-report measure. It is important to note that although significant relations are expected between the RCA and OEC measures, the magnitude of these relations is not anticipated to be large enough to suggest that these measures are redundant. Students are not expected to be making emphasis shifts often simply because they know how to do so, but they should be more likely than other students to act on this ability at some point during the academic year. To sum up, if students believe they can shift toward primary control with success, secondary control with failure, or back and forth depending on their grades, these perceptions should be demonstrated by a greater likelihood of actual, observed emphasis shifts over time in congruence with real performance outcomes.

Hypothesis 4. Concerning the consequences of these predicted observed changes in emphasis for *psychological adjustment*, it is also proposed that each *congruent* observed shift in emphasis (i.e., SC to PC after success, PC to SC after failure) should

positively relate to adjustment. Furthermore, shifts from primary to secondary control after failure were expected to best predict subsequent adjustment outcomes due to the performance- and adjustment-focussed nature of primary- and secondary-control strategies, respectively. In other words, although emphasis shifts toward either primary or secondary control in congruence with performance should be adaptive for psychological well-being, shifts to secondary control after poor performance should be most beneficial because these strategies are specifically aimed at changing one's cognitions to improve adjustment rather than changing one's behavior to improve performance (primary control).

Hypothesis 5. With respect to the consequences of congruent shifts in emphasis for *academic achievement*, Hypothesis 5a states that SC-to-PC OEC following success should be positively associated with performance. Conversely, Hypothesis 5b suggests that PC-to-SC OEC following poor performance should be *negatively* related to subsequent performance based on Rothbaum et al.'s assertion that achievement outcomes are "most fostered by primary control and most jeopardized by secondary control" (p. 29; Rothbaum et al., 1982). That is, this hypothesis suggests that shifts toward primary control should help students' grades whereas shifts toward secondary control should hurt their performance as a result of the achievement- as opposed to self-oriented focus of primary- vs. secondary-control strategies.

Hypothesis 6. Finally, it was also hypothesized that the patterns predicted in Hypotheses 4 and 5 should be more significant for students with a higher self-reported ability to adaptively switch between primary and secondary control. That is, Hypothesis 6

proposes that stronger expected relationships from PC-to-SC and SC-to-PC OEC scores to academic adjustment (positive and less positive, respectively) and performance (negative and positive, respectively) should be observed for students with higher levels on the "Both" RCA subscale. It should be noted, however, that Hypotheses 3 and 6 could be contradictory to the extent that the reported and observed congruence measures are redundant. More specifically, the greater the relationships are between the RCA and OEC measures in Hypothesis 3, the less tenable it is to pursue Hypothesis 6 in which the effects of the OEC measures are assessed for different RCA levels because the two variables would not be sufficiently independent. Therefore, Hypothesis 6 will not be examined if the relations found in Hypothesis 3 indicate redundancy but will be explored if, as hypothesized, they demonstrate that the RCA and OEC measures are significantly and positively related.

Rationale for SEM Analyses

Structural equation models were assessed using the AMOS program (version 5.0; Arbuckle, 2003). Fit indices included the comparative fit index (CFI), the Tucker-Lewis Index (TLI), and the root mean square error of approximation (RMSEA). CFI and TLI values exceeding .90 represent well-fitting models, whereas RMSEA values over .10 indicate a poor fit, between .08 and .10 a mediocre fit, and around or lower than .06 a good fit to the data. Three fit indices were assessed in order to examine indices that compare the proposed model both to a null model which assumes the variables are uncorrelated (i.e., CFI, TLI) and to a predicted population covariance matrix to provide an estimated error of approximation (RMSEA). In the present study, the RMSEA fit

index is considered most informative as it is one of the least affected by sample size, it accounts for model complexity, and is sensitive to model misspecification. Further, RMSEA was also preferred due to it being better suited to the confirmatory hypothesis testing conducted in this study than incremental fit indices which function best in exploratory research with smaller sample sizes (e.g., CFI, TLI; see Rigdon, 1996). Fit indices for all SEM models presented in figure form are outlined in Appendix G. *First*, cross-lagged panel SEM models were used to assess the causal relationships between test performance and the directional OEC scores (PC to SC, SC to PC), as well as the three RCA subscales and two directional OEC variables (multiplied by test performance; see below).

Second, phase-specific SEM analyses examining the proposed interrelationships between PC, SC, RCA, and the directional, multiplicative OEC scores in a comprehensive analytical model were conducted. The *third* set of analyses examined the effects of the PC, SC, RCA, and OEC (multiplicative) variables on the dependent measures using phase-specific as well as cross-lagged panel models. Various *supplemental* SEM analyses presented in appendixes were also conducted examining (a) moderation effects based on the "Both" RCA subscale for models involving the RCA and OEC measures, (b) the hierarchical structure of PC and SC as well as the RCA subscales, and (c) non-hierarchical and subscale-specific variants of the comprehensive phase-specific model involving PC, SC, RCA, and OEC measures described above.

Rationale for multiplicative OEC scores. The original, directional OEC scores (PC to SC, SC to PC) assessed in SEM analyses on Hypothesis 1 were not included in

subsequent hypotheses. Although these scores capture the extent to which individuals shifted their relative emphasis on PC vs. SC from one phase to the next, these values do not specify whether these observed emphasis shifts occurred in response to better or poorer performance. Thus, because the RCA subscales specified emphasis shifts *in congruence with specific performance outcomes*, the original OEC scores were multiplied by the appropriate test performance measure to create a multiplicative OEC score reflecting the extent to which a shift in emphasis occurred in combination with a performance outcome.

First, an OEC - SC to PC x Success term was created by multiplying the directional SC to PC OEC score by performance on the test that occurred between the two phases comprising the OEC score (e.g., OEC - SC to PC (Time 1 to 2) x Test 1). Second, an OEC - PC to SC x Failure term was created by multiplying the directional PC to SC OEC score by the *inverse* of the same test performance measure (e.g., OEC - PC to SC (Time 1 to 2) x Test 1 inverted), with the test inverse calculated by subtracting the test score from 100 (e.g., a score of 90 would be converted to 10, a low test *failure* score). By multiplying both directional OEC scores by test performance, the resulting two measures represent objective measures of *congruence* that can be used to more accurately evaluate the validity of the self-report RCA scales than the directional, nonmultiplicative OEC scores.

Supplemental rationale for SEM analyses. Additional information concerning the analytical rationale and procedures underlying the SEM analyses below involving correlated error terms, the inclusion of covariates, parcelling of scale items, the use of

regression analyses for manifest variables, as well as information on interpreting the figures below is provided in Appendix H.

Hypotheses 1 and 3: Performance, OEC, and RCA

Test performance and OEC. To examine the first hypothesis that individuals shift from secondary to primary control following success experiences (1a) and from primary to secondary control after poor performance (1b), a cross-lagged panel SEM model was assessed controlling for PC and SC with test performance predicting the original, directional OEC scores (SC to PC, PC to SC). Although fit indices were not obtained for this model due to all the main variables being manifest in nature (i.e., test performance and OEC difference scores), parallel regression analyses were not conducted because the significant Beta weights were within normal range (e.g., βs = -.13, -.20, $p < .05$). SEM results for these analyses are presented in Figure 1.

Consistent with Hypothesis 1, students showed significant shifts in emphasis from PC to SC following *poorer* performance on Test 1 and on Test 4, with a near significant

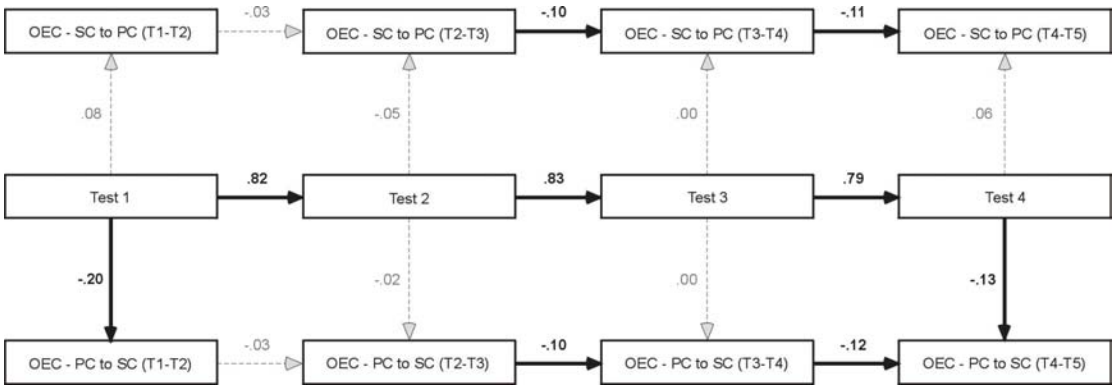

Figure 1. Causal Analysis of Test Performance and OEC measures.

positive path observed from Test 1 to observed shifts in emphasis from SC to PC (p = .13). The strongest paths from test performance to SC-to-PC OEC were positive and all paths from performance to PC-to-SC OEC were zero or negative. Taken together, these results suggest that although actual shifts in emphasis were not significant following each test, the direction of switching following both better and poorer academic performance was consistent with that proposed in Hypothesis 1 and supports the use of multiplicative, directional OEC scores in subsequent analyses (SC to PC with success, PC to SC with failure). Findings also showed that students were significantly less likely to continue switching in the same direction after the second phase of the study, suggesting that individuals likely prefer to switch back and forth between these control processes (see supplementary RCA moderation analyses below). An interpretation of this finding as due to ceiling effects is less plausible because of having included both primary and secondary control as covariates in each phase.

RCA and OEC measures. Hypothesis 3 proposed that the RCA subscales should positively relate to the respective multiplicative OEC scores, but did not specify a directional relationship between these self-report and objective indicators of students' switching capabilities. As such, three cross-lagged panel models was assessed in order to establish the direction of causality, if any, between these key study measures. First, a model examining the directional relationships between the perceived and observed ability to *shift from PC to SC* was assessed (see Figure 2). Covariates included SC but did not include PC or test performance because the PC was not significantly correlated with either the objective or self-report PC-to-SC measures in most phases (except in Time 2

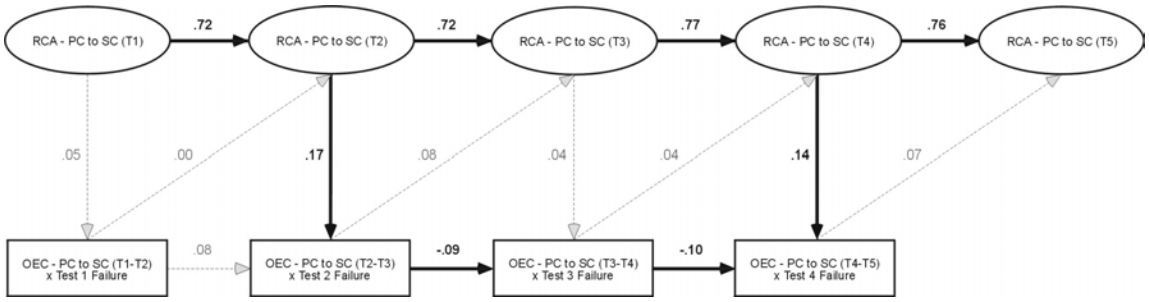

Figure 2. Causal Analysis of PC-to-SC RCA and OEC.

with RCA: $r = .08$, $p = .05$; and in Time 4 with Time 4-5 multiplicative OEC: $r = -.11$, $p < .05$) and because including test performance did not affect model significance nor path coefficients. In addition to these correlations between the covariates and main variables, the OEC scores were also correlated within each phase as individuals with overall OEC scores of zero would have had the same zero score on both the directional OEC measures.

This analysis showed significant, strong, and positive autoregressive paths for the PC-to-SC RCA measure (e.g., from the Time 1 to Time 2 assessment, Time 2 to Time 3 assessment, etc.), as well as weaker yet significant *negative* autoregressive paths between the multiplicative PC-to-SC OEC scores after Test 2. This suggests that perceptions of one's ability to shift from PC to SC with poorer performance were relatively constant, whereas individuals were less likely to actually keep shifting their emphasis to secondary control in response to failure. More importantly, however, these results also revealed significant, positive paths from PC-to-SC RCA to the same OEC at both Times 2 and 4, showing that individuals were more likely to perceive an ability to switch to SC and then

act on it rather than derive a sense of being able to switch to SC from already having done so. Thus, a directional relationship from PC-to-SC RCA and to PC-to-SC OEC was included in subsequent models.

Second, a cross-lagged panel model examining the direction of causality between participants' perceived and demonstrated ability to *shift from SC to PC* was assessed (see Figure 3). Covariates included PC and SC, but did not include test performance because it did not affect the significance of the model nor path coefficients. This analysis revealed significant and strong autoregressive paths between the SC-to-PC RCA measures, as well as negative autoregressive paths between the SC-to-PC OEC scores following Test 2 indicating once again that although participants' perceived ability to shift from SC to PC with success was consistent, actual repeated shifts from SC to PC following success were significantly less likely after Test 2. Concerning the main cross-paths, although results showed significant yet weak and oppositely valenced paths from OEC to RCA at Time 3 ($\beta = -.07$) and Time 4 ($\beta = .08$), a significant and noticeably stronger positive relationship was observed from RCA to OEC at Time 1. This finding demonstrates that although

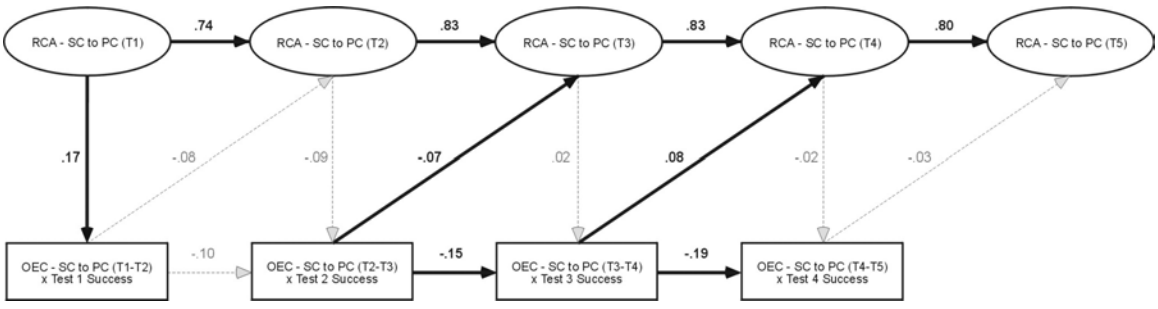

Figure 3. Causal Analysis of SC-to-PC RCA and OEC.

perceptions of one's ability to shift from SC to PC with success can be both positively and negatively predicted by actual shifts in emphasis, the strongest predictive path was from RCA to OEC. Therefore, although the results concerning these measures were mixed, they do show that RCA predicted OEC over twice as strongly than vice versa, and as such, directional paths from SC-to-PC RCA to SC-to-PC OEC were modelled in subsequent analyses.

Finally, a cross-lagged panel model exploring the causal relationships between the perceived and demonstrated ability to switch between *both PC-to-SC and SC-to-PC emphasis shifts* was examined controlling for PC, SC, and test performance (see Figure 4). This model provided an adequate fit to the data, however, the fit values were lower than those observed for the previous two RCA/OEC cross-lagged panel analyses likely due to increased model complexity. Nevertheless, results once again showed consistently

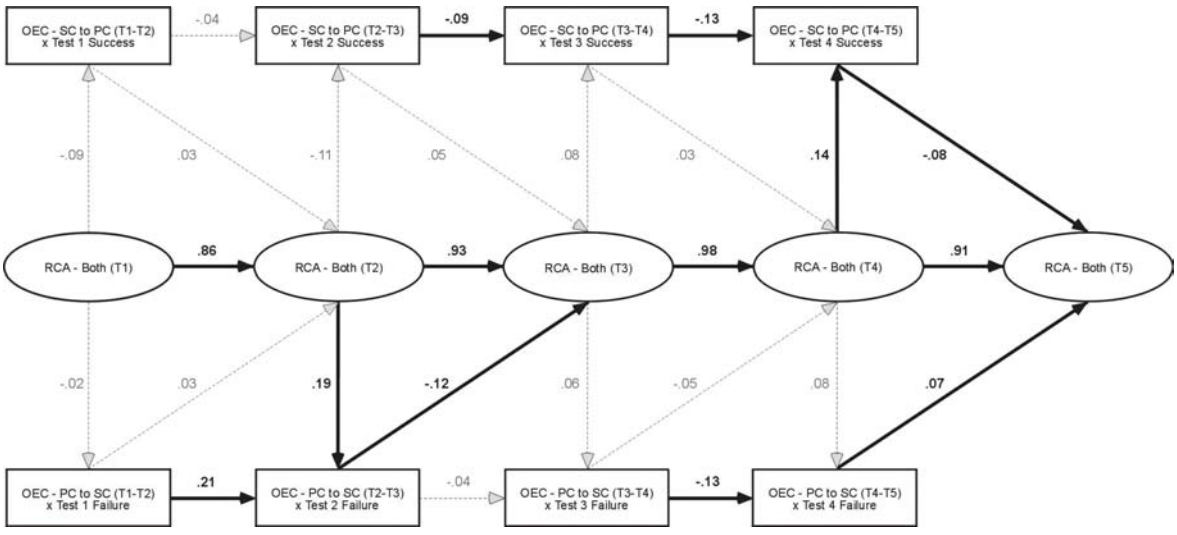

Figure 4. Causal Analysis of "Both" RCA Subscale and Both OEC Measures.

strong positive paths between the RCA measures, indicating that perceptions of one's ability to switch back and forth between PC and SC based on performance outcomes was relatively stable over time. Although autoregressive paths for the SC-to-PC OEC measures were also similar to those shown in Figure 3 (e.g., SC-to-PC OEC after Test 1 to after Test 2, after Test 2 to after Test 3, etc.), the paths from one PC-to-SC OEC score to the next in Figure 4 differed from those in Figure 2 in that individuals were significantly *more* likely to keep switching from PC to SC following repeated poor performance in the first semester (Tests 1 and 2; i.e., a positive autoregressive path was found), but were significantly *less* likely to shift from PC to SC if they had repeatedly performed poorly in the second semester (Tests 3 and 4; i.e., a negative autoregressive path was found).

With respect to the main cross-paths in the model, the Both RCA measure was significantly predicted by shifts from PC to SC after Test 2 (negatively) and after Test 4 (positively), and also by SC to PC shifts in emphasis after Test 4 (negatively). Nevertheless, notably stronger and positive directional path coefficients were found from the Both RCA subscale to both PC to SC emphasis shifts after Test 2 and to SC to PC emphasis shifts after Test 4. In other words, *the perceived ability to switch between PC to SC and SC to PC shifts in emphasis significantly predicted actual emphasis shifts in both directions at different times*, providing empirical support for the utility of this RCA subscale despite its initially lower reliability levels. Supplemental cross-lagged panel SEM analyses outlined in Appendix I provide additional support for the higher-order nature of this RCA subscale in examining Both RCA moderation effects on (a) test

performance and the original OEC scores (see Figure 1), (b) multiplicative OEC scores, and (c) the directional RCA measures.

Hypotheses 2 and 3: PC, SC, RCA, and OEC

Based on the analyses discussed in the previous section, in addition to supplemental cross-lagged panel analyses discussed in Appendix J involving (a) primary and secondary control and (b) the hierarchical structure of RCA subscales, Hypotheses 2 and 3 were examined in a more comprehensive, phase-specific model including PC, SC, the three RCA subscales, and the two multiplicative OEC scores. In this model, PC and SC predicted all three RCA subscales, and each subscale in turn predicted the two multiplicative OEC measures (see Figure 5). The model was assessed using PC, SC, and RCA from Times 1 through 4, with these variables predicting the OEC scores that

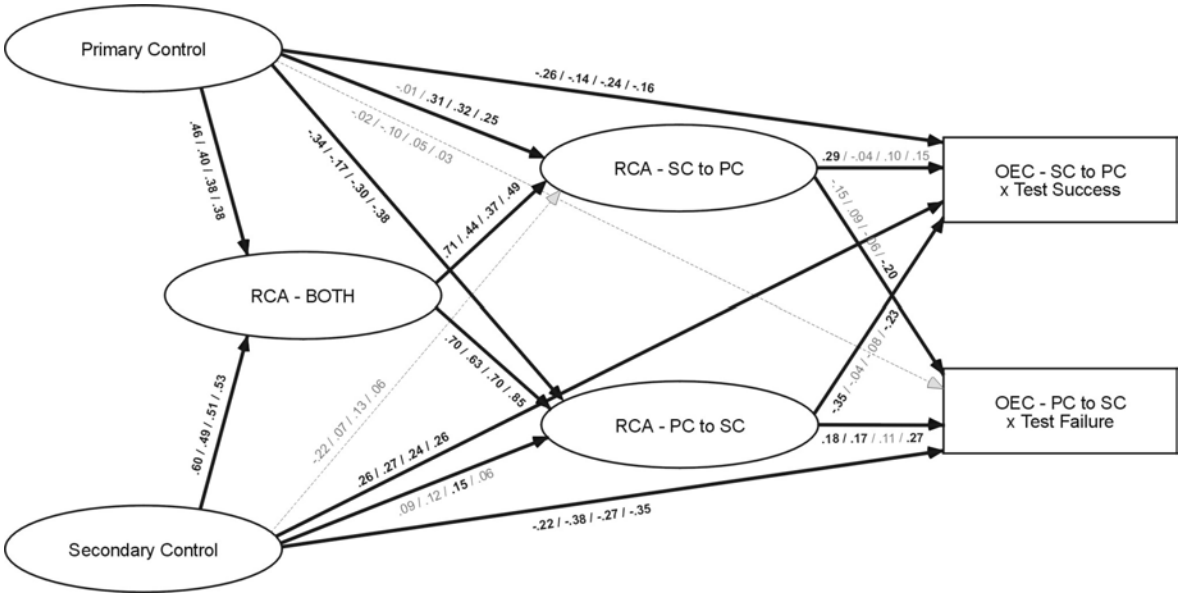

Figure 5. Phase-specific Analyses of PC, SC, RCA (Hierarchical), and OEC Measures.

followed (e.g., Time 4 PC/SC/RCA predicted Time 4-5 OEC). In each analysis, test performance was controlled for, and correlations were included between PC and SC, between the three RCA measures, and between the two multiplicative OEC measures. Findings from supplemental SEM analyses on non-hierarchical and RCA subscale-specific variants of this analytical model as well as analyses supporting the exclusion of alternate, noncongruent OEC scores (e.g., PC-to-SC OEC x Success) are provided in Appendix K.

Consistent with Hypothesis 2, both PC and SC corresponded to greater perceptions of being able to switch between these control processes, with significant and positive paths found from PC (βs = .38 - .46) and SC (βs = .49 - .60) to the Both RCA subscale in each model. Although PC was also found to positively predict SC-to-PC RCA (Times 2-4), and SC was shown to positively, albeit weakly, predict PC-to-SC RCA in Time 3, noticeably stronger paths were observed from PC and SC to the Both RCA subscale. Although the path from SC to SC-to-PC RCA was not significant in any model, PC was found to negatively predict PC-to-SC RCA levels in each study phase. Thus, PC *positively* predicted Both RCA which in turn predicted greater PC-to-SC RCA, whereas PC also *negatively* predicted PC-to-SC RCA controlling for its mediated relationship through Both RCA (these effects cancel each other out in the supplementary non-hierarchical analysis shown in Figure K1 in Appendix K). That is, although PC most strongly contributed to a higher-order perception of switching ability which led to a greater perceived ability to specifically switch from PC to SC, there is another aspect of PC that had a direct negative impact on perceptions of being able to shift toward SC. It is

also notable that PC was positively related to the perceived ability to shift from SC to PC over and above its positive effect on this perception through the Both RCA subscale. Taken together, these results suggest that controlling for the positive relationship between primary control and the perceived switching ability, higher primary-control levels somehow lead people to feel better able to shift to primary control after success, yet less able to shift to secondary control following poor performance.

These results also revealed significant ceiling effects for both PC and SC with respect to the shifts in emphasis toward PC and SC, respectively, with those higher in PC being significantly less likely to keep switching to PC, and those higher in SC being less inclined or able to continue shifting to SC. Although PC did not significantly predict actual shifts in emphasis from PC to SC from one phase to the next, SC was found to consistently and *positively* predict emphasis shifts from SC to PC over time. These results suggest that secondary control is particularly adaptive in terms of not only contributing more strongly than PC to overall perceptions of switching ability, but also affording students the capability to actually increase their emphasis on PC following a success experience. Nonetheless, these observed ceiling effects provide empirical support for including both PC and SC as covariates in the preliminary and subsequent cross-lagged panel analyses involving the OEC measures.

These findings also provide empirical support for Hypothesis 3. More specifically, these analyses showed that not only were the directional RCA subscales predicted by the higher-order Both RCA measure, the PC-to-SC RCA subscale positively predicted the multiplicative PC-to-SC OEC scores in Times 1, 2, and 4 (Time 3

positively predicted the same OEC at $p = .10$), and the SC-to-PC RCA measure positively predicted the same OEC at Time 1 (Time 4 to same OEC was significant at $p < .10$). Moreover, *negative* paths were observed from each directional RCA measure to the opposite OEC score, with PC-to-SC RCA negatively predicting SC-to-PC OEC in Times 1 and 4, and the SC-to-PC RCA subscale negatively predicting PC-to-SC OEC scores at Time 1 (Time 4 significant at $p < .10$). As such, not only did the directional self-report RCA measures in the present study positively predict actual corresponding shifts in emphasis in congruence with performance outcomes, they also negatively predicted the opposing OEC scores - results that, in combination with the preliminary cross-lagged panel analyses, clearly illustrate the convergent as well as discriminant validity of these self-report measures with respect to observed changes in PC vs. SC levels over time.

Hypotheses 4 and 5: RCA, OEC, and Academic Outcomes

To examine Hypotheses 4 and 5 concerning the benefits of congruent emphasis shifts on academic outcomes, multiple phase-specific models were initially assessed in which the hierarchical model presented in Figure 5 was further expanded to assess how the PC, SC, RCA, and multiplicative OEC measures predicted both subsequent performance outcomes and self-report measures involving motivation, emotions, health, and overall adjustment. The results of these analyses are presented in Appendix L. To summarize the findings concerning the implications of congruent emphasis shifts, Hypotheses 4 and 5a were largely supported in that actual emphasis shifts from SC to PC with success were found to predict significantly higher levels of performance, performance orientation, and perceived value, as well as lower anxiety, boredom, and

perceived stress. These emphasis shifts were unrelated to perceived success, academic expectations, enjoyment, global health status, illness symptoms, depression, and self-esteem. However, an unexpected negative effect of SC-to-PC shifts on mastery orientation was also observed.

Hypothesis 5b was also supported in that shifts from PC to SC following poor performance did not contribute to higher but lower grades as predicted by Rothbaum et al. (1982). However, all other significant effects of emphasis shifts from PC to SC were *contrary* to Hypothesis 4, with these shifts corresponding to *lower* motivation in terms of perceived success, performance orientation, expectations, and value, as well as *greater* anxiety, boredom, and reported illness symptoms. These emphasis shifts were unrelated to mastery, enjoyment, global health status, and all three overall adjustment measures.

Limitations of phase-specific models. The main strengths of the phase-specific analyses presented are that they (1) examined a theoretically comprehensive model including all key mediational paths from PC and SC to academic outcomes, (2) were based on earlier analyses showing a hierarchical RCA structure, (3) controlled for test performance, (4) analysed conceptually similar sets of dependent measures, and (5) allowed for comparisons between the perceived and demonstrated ability to switch between control strategies. However, it is also important to note two key limitations of the above phase-specific models that highlight the importance of subsequent cross-lagged panel analyses for examining Hypothesis 6 in which Hypotheses 4 and 5 are assessed with respect to “Both” RCA moderation effects.

First, these analyses did not control for previous levels of the dependent measures

or changes over time in the earlier assessments of the dependent measures. Thus, because preceding outcome levels were not included as covariates, the assumed direction of causality from the PC, SC, RCA, and OEC measures may be inaccurate despite dependent measures from the subsequent phase being included. These potentially opposite directions of causality may provide an explanation for the unexpected relationships observed. For example, with respect to findings involving secondary control, anxious individuals may have used more SC, and students with lower motivation, more negative affect, and poorer health may have been more inclined to switch from PC to SC if they performed poorly.

Second, the above analyses also included the RCA subscales, which although allowed for an examination of a causally accurate and comprehensive analytical model, was not essential for examining Hypotheses 4 and 5 concerning the academic implications of the OEC measures. Although the above analyses also indicated that the implications of switching-related perceptions and actions for subsequent academic outcomes can differ, a detailed explication of this intriguing set of findings is beyond the scope of the present study hypotheses. Moreover, since the directional RCA measures represent proxies for the corresponding OEC variables, including both in the same model can be considered redundant and may have contributed to the contradictory findings observed between the RCA and OEC measures on some outcome variables. Nevertheless, because earlier analyses showed that people do not always act on their perceived ability to switch, the observed redundancy between these two measures was not sufficient to preclude examining the phase-specific models presented in Appendix L. Therefore, in

light of the unexpected results and limitations of the phase-specific analyses, the results of the phase-specific analyses of Hypotheses 4 and 5 should be interpreted with caution.

Hypothesis 6: OEC and Academic Outcomes with RCA Moderation

The final set of analyses utilized cross-lagged panel models to address the limitations noted in the previous section and provide a more specific and conservative test of how OEC relates to subsequent adjustment and performance for individuals who perceive themselves as able or unable to optimize their use of control strategies. These SEM analyses controlled for PC, SC, and test performance and examined each dependent measure in a separate analytical model. For these analyses, the specific and global scale items were predicted by the more general construct they assessed (i.e., perceived success, expectations, or value) and the illness items (parcelled; see Appendix H) were included alongside the two global health items as predictors of a more general latent health variable.

As done in the previous supplemental analyses on RCA moderation effects (see Appendix I), each model was assessed separately for students reporting low vs. high levels on the "Both" RCA subscale, with this low/high classification based on a median split of the Time 5 Both RCA measure (Low RCA: $M = 13.22$, $SD = 1.97$, Range = 4-15; High RCA: $M = 17.71$, $SD = 1.59$, Range = 16-21; $t(452) = 26.74$, $p < .001$). Modified two-phase cross-panel models were evaluated for the overall adjustment measures that controlled for Tests 1 and 4, PC and SC at Time 1, Time 4 (as covariates for the Time 4-5 OEC scores), and at Time 5 (as covariates for the Time 5 dependent measure). Chi-squared difference tests were performed for each dependent measure examined using

cross-lagged SEM analyses to test whether the RCA groups model was significantly different from a group invariant model with respect to the main paths between the latent constructs (structural model). Results of these tests revealed that the parameter estimates for these paths did significantly differ according to RCA levels for all dependent measures assessed in both the five-phase models, $\chi^2(139\text{-}168) = 334.26\text{-}411.35$, $p < .000$, and the modified two-phase models, $\chi^2(73\text{-}91) = 119.91\text{-}243.73$, $p < .000$. As such, the results of the chi-squared difference tests provide empirical support for the subsequent analyses assessing the low and high RCA groups separately. Results of these analyses are summarized in Table 3 in terms of what type of paths were significant, the valence of these paths, and in what phases the paths were significant. Actual path values for the cross-lagged panel SEM analyses referred to in Table 3 and described below are presented in figure form in Appendix M. More detailed information concerning correlated errors, covariates, item parcelling, and regression analyses (for performance) is provided in Appendix H, with fit indices outlined in Appendix G.

Academic motivation. The results for the academic motivation measures are presented in Figures M1 to M5 (Appendix M). Concerning SC to PC emphasis shifts, these OEC scores corresponded with greater mastery orientation (after Tests 2 and 3), perceived success (after Tests 3 and 4), and expectations (after Test 3) for low-RCA individuals. For the high-RCA group, SC-to-PC OEC scores also predicted greater perceived success (after Test 4) yet at the same time resulted in *lower* levels of subsequent mastery and performance orientation (after Test 2) and academic expectations (after Test 1). The findings for perceived value were also more complex for the high-

Table 3

Overview of RCA moderation results on dependent variables.

	SC-to-PC OEC to DV		PC-to-SC OEC to DV		DV to SC-to-PC OEC		DV to PC-to-SC OEC	
DVs	Low RCA	High RCA	Low RCA	High RCA	Low RCA	High RCA	Low RCA	High RCA
Orientation - mastery	+ (2,3)	– (2)	– (2,4)	– (2,4)	– (4)	– (1,3)	– (3)	+ (2,4)
Orientation - performance	x	– (2)	– (4)	– (4)	x	+ (1,2,4)	x	– (2)
Perceived success	+ (3,4)	+ (4)	– (1-4)	– (1-4)	x	+ (3)	– (3)	– (2-4)
Expectations	+ (3)	– (1)	– (1-4)	– (1-4)	x	x	– (3,4)	– (3,4)
Value	x	– (1), + (4)	x	– (1,4)	x	+ (2-4)	– (3,4)	– (1), + (4)
Enjoyment	x	x	– (1,4)	– (2,3)	x	x	x	+ (1)
Anxiety	x	x	x	– (2), + (4)	x	– (3)	+ (2,4)	+ (1)
Boredom	x	+ (2), – (4)	+ (4)	+ (4)	– (3)	– (2,3)	– (2)	+ (2)
Health	– (4)	x	x	+ (4)	x	x	x	– (4)
Stress	x	+ (4)	x	x	x	x	+ (1)	x
Depression	+ (4)	x	x	x	x	x	x	+ (1)
Self-esteem	x	x	x	x	x	x	x	+ (1)
Test performance	x	+ (1)	– (4)	x	N/A	N/A	N/A	N/A

Note. PC = primary control, SC = secondary control, OEC = observed emphasis change, DV = dependent variable, RCA = reported congruence ability, + = positive effect, – = negative effect, x = no significant effect, N/A = not applicable. Brackets in first four columns indicate after which test the effect of OEC on the DV was significant. Brackets in last four columns indicate the phase in which the DV effect on OEC was significant.

RCA group, with SC to PC shifts resulting in *lower* value levels in the first semester (after Test 1) yet *higher* value levels in the second semester (after Test 4). To summarize, shifts from SC to PC after success improved motivation for the low-RCA group midway through the academic year (e.g., after Test 3). In contrast, for the high-RCA group, these same emphasis shifts corresponded to poorer motivation earlier in the first semester (e.g., after Test 2) but better motivation later in the year (after Test 4).

The paths from PC-to-SC OEC to the motivation measures for students both low and high on the RCA measure were largely the same: emphasis shifts from PC to SC consistently predicted lower levels of subsequent motivation. For both groups, PC-to-SC OEC scores negatively predicted mastery orientation (after Tests 2 and 4), performance orientation (after Test 4), as well as both perceived success and expectations (after each test). These emphasis shifts negatively predicted perceived value as well, albeit only for the high-RCA group (after Tests 1 and 4). It is important to note, however, that the most negative effects on motivation resulting from switching from PC to SC were observed for individuals reporting low levels on the RCA measure. For example, for both mastery and

performance orientation after Test 4 (low/high β = -.27/-.10 and -.21/-.12, respectively) as well as perceived success and expectations after Test 1 (low/high β = -.41/-.28 and -.23/-.11, respectively), the negative paths were noticeably larger, in some cases over twice as large, for the low-RCA group.

With respect to the paths from the motivation to SC-to-PC OEC measures, mastery orientation predicted less subsequent shifts toward PC in both RCA groups (low: after Test 4; high: after Tests 1 and 3). However, for the high-RCA group, shifts from SC to PC were positively predicted by performance orientation (Times 1, 2, and 4), perceived success (Time 3), and perceived value (Times 2-4). Thus, although both RCA groups showed similar negative paths from mastery to SC-to-PC OEC scores, only high-RCA individuals showed higher motivation levels to otherwise positively predict emphasis shifts from SC to PC throughout the academic year. As for the motivation measures predicting emphasis shifts in the opposite direction, the low-RCA group showed only negative paths to the PC-to-SC OEC measures from mastery and perceived success at Time 3, and from expectations and perceived value at Times 3 and 4. These findings indicate that greater motivation consistently predicted less shifting from PC to SC during the second semester for these individuals.

Although similar findings were found for the high-RCA group for performance orientation (Time 2), perceived success (Times 2-4) and expectations (Times 3 and 4), mastery was found to *positively* predict PC-to-SC emphasis shifts (Times 1 and 2) as did perceived value (Time 1) for these individuals, with perceived value later *negatively* predicting these emphasis shifts (Time 4). These results demonstrate that although

individuals with higher motivation are generally less likely to shift from PC to SC (or conversely, that those with lower levels of motivation are more likely to switch to SC) later in the academic year, high-RCA individuals who are either mastery oriented or perceive greater value in their courses are in fact *more* likely to shift towards SC early in the first semester.

Academic emotions. The results for the academic emotion measures are presented in Figures M6 to M8 (Appendix M). Although no effects of SC to PC emphasis shifts were found on emotions for low-RCA individuals, an intriguing finding was found for boredom in the high-RCA group in that shifting to PC after success predicted *higher* boredom levels in the first semester (after Test 2) whereas the same emphasis shift resulted in *lower* boredom in the second semester (after Test 4). Considering that boredom was correlated negatively with all adaptive outcomes (performance, motivation, enjoyment, global health, self-esteem) and positively with all maladaptive outcomes (anxiety, illness symptoms, stress, depression) in each study phase, boredom is best understood as an undesirable academic indicator. As such, similar to the findings on the motivation measures, shifts from SC to PC early in the academic year were maladaptive in terms of boredom levels, yet the same emphasis shifts later in the year helped to reduce feelings of boredom.

Concerning PC to SC emphasis shifts, this OEC measure was found to predict higher boredom levels near the end of the academic year (after Test 4) in both RCA groups. This emphasis shift was also found to predict lower levels of enjoyment near the start and end of the academic year for the low-RCA group (after Tests 1 and 4) and

midway through the year for high-RCA students (after Tests 2 and 3). It is once again important to note that although enjoyment suffered some declines following emphasis shifts from PC to SC, the strongest and earliest negative effect on enjoyment was found for individuals the low-RCA group (after Test 1, $\beta = -.21$). Significant effects of PC-to-SC OEC on anxiety were found only for high-RCA individuals, with PC to SC emphasis shifts predicting *lower* anxiety in the first semester (after Test 2) yet *higher* anxiety in the second semester (after Test 4). As such, the effects of the PC-to-SC OEC measure on emotions parallel those for the motivation measures in that, although the emotional impact of shifting to SC after poor performance was generally negative, the effect of this emphasis shift was not only less detrimental (enjoyment) but also *beneficial* (anxiety) for emotions early on in the academic year if students perceived themselves as able to make adaptive shifts their control strategy emphasis.

The paths from emotions to SC-to-PC OEC scores were not significant for enjoyment, but showed that high-RCA individuals with more anxiety (Time 3) were less likely to shift from SC to PC and that both RCA groups were less likely to shift to PC if they were bored midway through the academic year (low: Time 3; high: Times 2 and 3). That is, although students experiencing negative emotions generally *decreased* their relative emphasis on PC after success, this trend was more evident for those who believed they could make congruent emphasis shifts. In contrast, the paths from emotions to the PC-to-SC OEC measures showed that when both RCA groups experienced feelings of anxiety, they were inclined to *increase* their relative emphasis on SC vs. PC. These results also revealed that only high-RCA individuals were able to switch to SC early in

the year if they experienced higher levels of negative affect (anxiety at Time 1, boredom at Time 2) or even positive affect (enjoyment at Time 1), whereas the low-RCA group was actually less likely shift from PC to SC if they were bored early on (Time 2). That is, students with high RCA levels showed more emphasis shifts toward SC after poor performance early on in the year if they were more emotional about their studies.

Perceived health. The results for perceived health status are presented in Figure M9 (Appendix M). Shifts in emphasis from SC to PC after success near the end of the academic year (after Test 4) were found to *negatively* impact self-rated health for students with low RCA levels. More encouraging, however, were the effects of PC-to-SC OEC scores for high-RCA students, with emphasis shifts from PC to SC after poor performance having a *positive* impact on health status later in the year (after Test 4). Although perceived health did not significantly predict subsequent SC-to-PC OEC scores for either group, results did show that high-RCA students with poorer health status (Time 4) were more likely to shift from PC to SC if they performed poorly later in the second semester - a change which subsequently improved their health status.

Overall adjustment. The results for the overall psychosocial adjustment measures are presented in Figures M10 to M12 (Appendix M). The modified cross-lagged models examining measures of adjustment (Times 1 and 5) showed that emphasis shifts from SC to PC after success predicted higher levels of year-end depression among low-RCA students as well as higher levels of year-end perceived stress in high-RCA students. No significant paths from PC-to-SC OEC scores to adjustment or from adjustment to SC-to-PC OEC scores were observed. However, higher levels of stress early in the year did

predict more subsequent emphasis shifts from PC to SC in low-RCA students, and higher levels of depression and self-esteem early on positively predicted shifts toward SC in high-RCA individuals.

To summarize the results on overall adjustment for high-RCA students, although the negative impact on year-end stress resulting from SC-to-PC emphasis shifts is not consistent with previous findings (see results for year-end perceived success, value, and boredom), the finding that these students shift more to SC if they are higher on the emotion-laden adjustment measures early on (i.e., depression and self-esteem) does parallel the emotion results. The results for low-RCA students are also in line with earlier findings in that these individuals experience more depression later in the year after shifting to PC and also shift more to SC if they are stressed early on in the academic year (see anxiety results). It should be noted, however, that because these modified cross-lagged models differ considerably from those described above in that they do not include the intermediate assessment periods (Times 2-4), the findings involving end-of-year effects (i.e., the maladaptive effects found on stress for high-RCA students and on depression for low-RCA students) should be interpreted with caution.

Academic performance. As noted in Appendix H, due to preliminary cross-lagged panel SEM analyses of performance resulting in unusually low yet significant Beta weights (due to including primarily manifest variables) and no fit indices, the results of regression analyses examining the effects of emphasis shifts on performance are presented below. Also, because the effects of performance on OEC was explored in previous analyses (see Figure 1), additional causal SEM analyses examining how

performance predicts subsequent congruent emphasis shifts were not required. Further, although regressions were sufficient to examine the effects of the OEC measures on performance, the cross-lagged panel analysis conducted (controlling for PC, SC, and Test 1, with each test error term correlated with the subsequent OEC score) showed similar results to those below, providing additional support for the regression analyses. These regression analyses were conducted separately for individuals low vs. high on the "Both" RCA measure, previous test scores and primary/secondary control from the preceding phase were included as covariates (see Appendix H for rationale), and the results are presented in Table 4.

Table 4

Regression analyses on performance by low/high RCA levels.

	Test 2		Test 3		Test 4		Test 5	
Predictor	Low	High	Low	High	Low	High	Low	High
Previous test	.56*	.61*	.88*	.87*	.76*	.82*	.45*	.48*
Primary control (PC)	.19*	.20*	.01	-.06	.10^	-.02	.21*	.15*
Secondary control (SC)	-.01	-.07	-.04	.00	-.02	.04	.00	-.01
SC-to-PC OEC	-.07	.16*	-.03	.01	-.05	-.04	-.06	-.08
PC-to-SC OEC	-.12	.12^	.09^	.01	-.02	-.03	-.14*	-.07
R^2	.48*	.42*	.73*	.74*	.64*	.68*	.38*	.31*

Note. Standardized β values presented unless otherwise indicated. Analyses on Tests 2

through 5 included students' performance on the preceding course test and primary/secondary control measures from the preceding phase as covariates. OEC = observed emphasis changes scores.

**$p < .01$ *p #.05 ^p #.10

With respect to the covariate effects observed, prior test performance was the strongest predictor of subsequent performance in both RCA groups, followed by primary control (i.e., on Tests 2 and 5), whereas secondary control did not significantly predict subsequent performance. Controlling for these effects, the only significant positive effect on subsequent performance was found for high-RCA students, with emphasis shifts from SC to PC after Test 1 success predicting better performance on Test 2 ($\beta = .16$, $p < .05$). Marginally significant effects on performance were also observed for low-RCA students, namely for PC-to-SC OEC on Test 3 ($\beta = .09$, $p = .10$), and unexpectedly, among high-RCA students for PC-to-SC OEC on Test 2 ($\beta = .12$, $p < .10$). The only other significant effect of OEC on test performance was for low-RCA students, who showed lower performance on Test 5 resulting from PC to SC emphasis shifts after poor performance on the preceding test ($\beta = -.14$, $p = .05$). To summarize, students with high RCA levels experienced better grades after congruent shifts from SC to PC early in the academic year, and although low-RCA students showed a similar trend early on, the only significant finding for these individuals was that shifting to SC later in the year led to poorer subsequent performance.

Discussion

As is evident from previous research examining the benefits and drawbacks of primary and secondary control from childhood (Band & Weisz, 1990; Langrock et al., 2002; Thomsen et al., 2002; Thurber & Weisz, 1997; Weisz et al., 1994) and young adulthood (Connor-Smith & Compas, 2002; Heckhausen & Tomasik, 2002; Petito & Cummins, 2000; Wadsworth & Compas, 2002) to old age (Chipperfield & Perry, in press; Lang & Heckhausen, 2001; Wrosch et al., 2000, 2002), the dual-process model of control proposed by Rothbaum et al. (1982) and elaborated on by Heckhausen and Schulz (1995) has contributed significantly to our understanding of how individuals adjust to normative developmental challenges and aversive life experiences across the life span. The findings of the present study serve to further underscore the importance of both primary and secondary control in an achievement setting, and further, to highlight the positive implications of individuals' ability to adaptively shift between the control processes in response to actual performance outcomes. Following from recent research showing the importance of using primary and secondary control strategies to bolster academic motivation and performance (Hall, Perry, Ruthig et al., in press; Hall, Perry, Chipperfield, et al., in press), these results demonstrate that some students not only perceive themselves as capable of changing their control strategy emphasis but also do so appropriately in congruence with their performance to improve their academic and personal development throughout their studies. The discussion below summarizes the main and supplementary findings in relation to each of the study hypotheses and outlines the strengths and limitations of the present research.

Hypothesis 1: Observed Emphasis Changes

Consistent with the original formulation of Rothbaum et al. (1982), Hypothesis 1 proposed that individuals should evidence a shift in relative emphasis from secondary to primary control following academic success (1a), and conversely, a shift in emphasis toward secondary relative to primary control following poor performance (1b). The present results provide empirical support for this hypothesis in showing that higher test scores did correspond with a greater subsequent emphasis shift toward primary vs. secondary control (e.g., after Test 4, see Figure I1), whereas poorer grades predicted a greater emphasis shift in favor of secondary vs. primary control (e.g., after Tests 1 and 4, see Figure 1). That is, when a student performed well on a test, any change over time involving these control process was more likely to result in a greater relative emphasis on primary as opposed to secondary control, with the opposite emphasis shift being more likely to occur after a student performed poorly. Following from these findings, subsequent analyses on observed shifts in relative emphasis multiplied these change scores by the preceding performance outcome in order to capture how *congruent* emphasis shifts predicted and were predicted by the other study measures.

Hypotheses 2 and 3: Reported and Observed Congruence

Preliminary causal analyses. The present study also provided convincing evidence in support of Hypotheses 2 and 3 which postulated that higher levels of both primary and secondary control should contribute to a belief in one's ability to shift from one process to the other in congruence with success and failure experiences (Hypothesis 2), perceptions which, in turn, should predict observed shifts in emphasis following

actual performance outcomes (Hypothesis 3). First, preliminary cross-lagged panel analyses were conducted to establish the causal ordering of the control-related measures under investigation. These analyses showed that although primary and secondary control did not predict each other, students' reported congruence ability significantly predicted their subsequent emphasis shifts, rather than vice versa. More specifically, these results revealed that the perceived ability to shift from primary to secondary control in failure situations (Hypothesis 3a; i.e., at Times 2 and 4) and from secondary to primary control in success situations (Hypothesis 3b; i.e., at Time 1) significantly predicted subsequent, congruent emphasis shifts in these respective directions.

In fact, a particularly intriguing finding was observed for the higher-order reported congruence ability measure in which students reported an ability to shift in *both* directions based on their performance. Whereas higher scores on this measure predicted shifts toward secondary control after poor grades in the first semester (Time 2), higher scores on this same measure predicted shifts toward primary control after better grades in the second semester (Time 4; Hypothesis 3c). Despite this encouraging finding, additional cross-lagged panel analyses exploring the interrelationships between these three reported congruence measures showed that they were best assessed in a hierarchical manner. That is, the perceived ability to shift back and forth was found to predict the more specific perceived abilities to shift to primary control with success and secondary control with failure.

Comprehensive analytical model. Based on these preliminary causal analyses of the control-related measures, Hypotheses 2 and 3 were subsequently assessed in the

context of a more comprehensive analytical model assessed in each study phase including primary/secondary control, reported congruence ability, and observed emphasis changes. The results of these analyses showed that as anticipated, primary and secondary control positively predicted the higher-order measure of reported congruence more strongly than they predicted the more specific emphasis shifts toward the same respective processes. This bidirectional reported congruence measure in turn strongly predicted higher levels of the directional self-report congruence measures. Each directional congruence measure then *positively* predicted actual subsequent emphasis shifts in the same direction and *negatively* predicted the opposing emphasis shift. Taken together, these results confirm Hypotheses 2 and 3 in providing both convergent and discriminant validity for the self-reported congruence measure developed for this study, and further, a fully mediated conceptual model controlling for ceiling effects that shows how primary and secondary control contribute to the perceived and demonstrated ability to shift one's emphasis between them in congruence with performance.

In addition to these main results, two additional findings from this comprehensive model warrant further discussion. First, negative paths from primary control to the perceived ability to shift toward secondary control were found in each study phase. In other words, when controlling for the indirect positive effect of primary control on this directional congruence subscale via the higher-order congruence measure, higher primary control levels were directly related to lower confidence in one's ability to shift one's focus to secondary control in failure situations. This finding suggests that aside from the benefits of primary control for thinking one can switch back and forth between primary

and secondary control, there is a maladaptive aspect of high primary control which fosters a belief that one cannot or will not shift to secondary control in failure situations. Although disconcerting, this finding is consistent with recent research highlighting the risks of overconfidence associated with high primary control in the absence of secondary control (Hall, Perry, Chipperfield., et al., in press; Hall, Perry, Ruthig, et al., in press). It should be noted, however, that primary control negatively predicted only the *perceived* ability to shift toward secondary control and was not significantly related to actual emphasis shifts from primary to secondary control following poor performance.

The second intriguing finding was that in each study phase, secondary control positively predicted emphasis shifts toward primary control following a success experience. That is, over and above the positive effect on these observed emphasis shifts mediated by the reported congruence measures, higher levels of secondary control (i.e., interpretive-control strategies after poor performance) were also found to directly correspond with higher subsequent emphasis shifts in favour of primary control after good performance throughout the academic year. This finding, in addition to the increasingly positive correlations and means analyses illustrating how secondary control increased and primary control decreased as performance declined, suggests that secondary control (i.e., interpretive control) acted as a back-up to failed primary-control efforts (i.e., failure) in serving to foster future shifts toward primary-control striving when success was possible (see Heckhausen & Schulz, 1995, 1998, for more information on the back-up role of compensatory secondary control).

Supplementary analyses. In addition to the above analyses examining Hypotheses

2 and 3, supplementary analyses conducted to explore the higher-order nature of the bidirectional reported congruence measure also provided intriguing results (Appendix I). First, these analyses illustrated that students with a stronger belief in their ability to make adaptive emphasis shifts were considerably more likely to increase their emphasis on secondary control following failure experiences as early as following their first course exam (Figure I1). Second, it was also revealed that students with higher perceived congruence levels were noticeably less likely to continue shifting toward secondary control if their poor performance early on remained unchanged or improved, or if continue shifting toward primary control if their good grades in the second semester performance stayed the same or declined. This capacity to adaptively respond to changes in their grades was further demonstrated by these individuals also being more likely to shift from focussing on secondary control after poor performance on their first test to increasing their emphasis on primary control if they performed well on their second test (Figure I2).

Third, students with a stronger belief in their congruence abilities also demonstrated less dramatic and more consistent congruent shifts back and forth based on success vs. failure throughout the academic year than students with lower congruence levels. Finally, a particularly intriguing finding was also observed for students with less confidence in their congruence abilities such that their perceived ability to shift in one direction (e.g., to primary control with success) had a consistently negative subsequent impact on their perceived capability to shift in the opposite direction (e.g., to secondary control with failure). It is important to note, however, that students with higher reported

congruence levels did not evidence this "either/or" pattern of thinking in that their beliefs in being able to shift in one direction had no appreciable effect on their perceived ability to shift in the other direction at any point throughout the academic year (Figure I3). Taken together, these supplemental analyses served to qualify the manner in which individuals with greater confidence in their ability to make congruent emphasis shifts not only think about but engage in this behaviour, and served to provide further empirical support for the higher-order nature of one's perceived ability to make adaptive emphasis shifts.

Hypotheses 4-6: Observed Congruence and Academic/Personal Development

With respect to the implications of observed congruent emphasis shifts for relevant outcomes involving both personal and academic development throughout the academic year, Hypothesis 4 predicted that these shifts should have positive effects on the self-report measures of academic and personal adjustment, and Hypothesis 5 postulated that shifts toward primary control should help performance (5a) whereas shifts toward secondary control should hurt performance (5b). Initial phase-specific analyses based on the comprehensive analytical model above provided empirical support for Hypothesis 4, showing the benefits of secondary to primary control emphasis shifts for motivation (performance orientation, value), emotions (anxiety, boredom), and overall adjustment (stress), as well as support for both Hypotheses 5a and 5b. However, the results of these analyses involving emphasis shifts from primary to secondary control on the self-report measures were all opposite to Hypothesis 4, with these observed emphasis shifts predicting *poorer* levels of motivation (perceived success, performance orientation,

expectations, value), emotions (anxiety, boredom), and health (illness symptoms). This pattern of results, in combination with two important limitations concerning (a) the unnecessary inclusion of the *self-report* congruence ability measures and (b) the exclusion of previous assessments of the dependent measures highlighted the need for additional causal analyses to assess the impact of observed emphasis shifts on adjustment and performance.

Cross-lagged panel SEM and regression analyses were conducted to examine Hypothesis 6 which proposed that for individuals with greater confidence in their congruence abilities, congruent emphasis shifts should be more beneficial for adjustment, shifts to primary control should enhance performance more, and performance deficits following shifts to secondary control should be more pronounced. In contrast to these individuals making emphasis shifts in a deliberate manner so as to optimize their motivation and performance, other students' emphasis shifts were expected to be less strategic and, as a result, less effective. The present findings provided partial support for this hypothesis as well as intriguing results showing how the same emphasis shifts could have opposite effects depending on the measures involved and the time of year at which they were employed.

Effects of shifts toward primary control. As anticipated, for students with high reported congruence levels, increased primary relative to secondary control after an initial success experience resulted in better grades early on as well as higher motivation (perceived success, value) and lower boredom later in the second semester. However, emphasis shifts toward primary control also unexpectedly predicted *poorer* levels of

motivation (mastery and performance orientation, expectations, value) and boredom in the first semester for these individuals. These results suggest that whereas deliberate shifts toward primary control after success did initially serve to help students improve their grades, this increased effort earlier in the year corresponded with a subsequent decrease in motivation and higher negative affect. That is, whereas shifts in favour of primary control were maladaptive for academic development in the first semester, with the notable exception of academic performance, increased emphasis on primary control for these students was actually helpful in the second semester, allowing those with higher perceived congruence levels to recover their sense of academic value and reduce their boredom as well as feel more successful. In contrast, although students with lower reported congruence also reported increased motivation following shifts to primary control after success midway through the year (mastery orientation, perceived success, expectations), these emphasis shifts were actually found to negatively affect these students' health status by the end of the second semester.

Effects of shifts toward secondary control. With respect to increased secondary relative to primary control after poor performance, most of the findings were opposite to those proposed in Hypotheses 4 and 5, however they were largely consistent with Hypothesis 6 in that they did show a more adaptive pattern of results for students with greater confidence in their congruence abilities. More specifically, despite these emphasis shifts resulting in decreased motivation throughout the academic year (mastery and performance orientation, perceived success, expectations) as well as greater boredom at year's end and lower enjoyment for students overall, individuals with higher scores on

the self-report congruence measure showed less of a negative impact on motivation as well as a delayed and less negative effect on learning-related enjoyment following shifts toward secondary control (allowing them to enjoy their courses more and for longer). Although perceived value was found to be negatively affected by these emphasis shifts only among those with higher reported congruence, these paths were also weaker than those generally observed following these shifts for their disadvantaged counterparts.

Consistent with Hypothesis 5b, shifts toward secondary control were also found to negatively predict subsequent test scores, albeit unexpectedly only for students with less confidence in their congruence abilities. That is, these results were contrary to Hypothesis 6 in that not only was there no significant negative effect of this emphasis shift on grades for individuals with high self-reported congruence, the effect of shifting toward secondary control after poor performance actually had a near significant *positive* effect on subsequent performance early in the first semester ($p = .10$). In sum, the above findings demonstrate that students with higher reported congruence levels have a noticeably *less negative* academic profile than students with lower congruence levels. Nonetheless, the results of this study also provided empirical support for both Hypotheses 4 and 6 with respect to high-congruence students showing *more positive* levels than their counterparts on important psychosocial adjustment variables, namely anxiety and health status.

Following shifts in emphasis toward secondary control following poor exam scores, improvements were observed among high-congruence students for learning-related anxiety in the first semester and for health status in the second semester. In other

words, when students strategically changed their focus from primary to secondary control after performing poorly, they experienced significant improvements in not only their academic anxiety but also their overall health status as assessed through reported illness symptoms and global health ratings. These findings are directly consistent with previous research on children (e.g., Thomsen et al., 2002), adolescents (e.g., Wadsworth & Compas, 2002), and adults with serious health problems (e.g., Thompson et al.,1994) in which both self-report anxiety and health measures have consistently been associated with the benefits of secondary control. However, it should be noted that shifts toward secondary control also had a detrimental effect on anxiety later in the second semester. As such, although these results do suggest that increased secondary relative to primary control after poor performance can help high-congruence individuals later in the academic year (i.e., mastery/performance orientation, health status), they more strongly indicate that deliberate emphasis shifts in this direction are in fact most effective for academic development early on (i.e., perceived success, expectations, enjoyment, anxiety, academic performance).

Optimizing emphasis shifts to improve academic development. The findings of this study suggest that not only are congruent shifts in relative emphasis between primary and secondary control more beneficial to those who do so in a deliberate and conscientious manner, but that the timing of these strategic emphasis shifts is particularly important, with shifts toward secondary control being more effective in the first semester and shifts favouring primary control being more adaptive later in the second semester. The results of earlier causal analyses also demonstrated that individuals with high

reported congruence levels are considerably more likely to make emphasis shifts to secondary control if they performed poorly early on, and conversely, significantly more likely to increase mainly in primary control if they did well later in the year compared to individuals with less confidence in their congruence capabilities. Taken together, these complimentary sets of findings indicate some individuals are more capable of making effective changes in their control strategy emphasis.

Although high-congruence individuals were found to benefit from early shifts to primary control for their performance and later shifts to secondary control in terms of their health, they were even more strongly inclined to maximize their academic motivation and emotions by shifting to secondary control after early setbacks and shifting to primary control after later success. In other words, these students were uniquely able to reap the expected rewards of emphasis shifts toward secondary control (health) and primary control (performance), and further, they were also able to optimize their motivational and affective resources by buffering the negative impact of early failure experiences through increased secondary control and reinvigorating their primary-control efforts later on if positive performance outcomes indicated a chance to succeed. It is also important to note that individuals with high reported congruence levels were also able to avoid the pitfalls of the less deliberate emphasis shifts employed by their low-congruence counterparts in terms of the observed declines in health and performance specific to these students, as well as the greater negative impact suffered to their academic motivation and performance. Although congruent emphasis shifts did negatively affect some motivation and emotion measures for high-congruence individuals, these effects were minimized not

only by the timely manner in which their emphasis shifts were made, but also by these students having had significantly higher levels on these outcome measures at the start and throughout the academic year (see Appendix F).

This set of findings also lends support for not only Rothbaum et al.'s (1982) micro-level model of everyday adaptation, but also the macro-level, developmental model of Heckhausen and Schulz (1995). According to Heckhausen and Schulz (1998), "compensatory secondary control buffers the potential negative effects of failure on the motivational resources of the individual, and thus promotes the *long-term* potential for primary control" (p. 57). In analyses of Hypothesis 3, results showed that secondary control consistently fostered later shifts toward primary control, with interpretive-control strategies positively predicting actual subsequent emphasis shifts toward primary control after success throughout the academic year (see Figure 5). Moreover, analyses of Hypotheses 3 and 6 also demonstrated that for students who reported a greater ability to make appropriate emphasis shifts, early shifts toward secondary control and later shifts toward primary control were not only more common (Figure 4) but also most beneficial for their motivation and affect (see Table 3 and Appendix M). Following from the above definition by Heckhausen and Schulz (1998), the strategic increase in interpretive-control strategies after initial failure experiences would be expected to not only foster better adjustment at that time, but also preserve one's ability to later engage in primary control if success became possible. The findings of the present study are directly consistent with this assertion and thus provide empirical support for not only Rothbaum et al.'s concept of optimization, but also the benefits of compensatory secondary control over time as

outlined by Heckhausen and Schulz (1995).

Effects of academic development on congruent emphasis shifts. Although not hypothesized, the moderation effects of reported congruence on how the academic adjustment variables impacted subsequent emphasis shifts also provided empirical support for one's ability to strategically shift between primary and secondary control. More specifically, four general patterns of results were observed for individuals with higher reported congruence levels that were more adaptive than those found for their low-congruence counterparts. The *first* set of findings for high-congruence individuals was that negative affect predicted fewer shifts toward primary control following success and more shifts toward secondary control following poor performance, with these effects occurring both more strongly and earlier in the year for these individuals relative to their disadvantaged counterparts. Whereas greater boredom and anxiety predicted less shifts to primary control, greater anxiety, boredom, and depression corresponded with significant shifts in favour of secondary control early in the year. A similar pattern of results was found for students with low reported congruence levels with boredom predicting decreased shifts to primary control and anxiety as well as perceived stress resulting in more shifts to secondary control. However, this trend was found for fewer measures, it manifested later in the academic year (e.g., anxiety and shifts to secondary control), and boredom was actually found to decrease the magnitude of shifts toward secondary control early on - all of which suggest that the low-congruence students are disadvantaged in terms of increasing in secondary control after failure when they experience negative emotions.

The *second* finding also involved an increased emphasis on secondary control after poor performance, specifically following from poor self-reported health status near the end of the second semester. Although the above results for negative affect were observed primarily in the first semester, this significant path suggests that individuals with high reported congruence levels can make adaptive emphasis shifts toward secondary control if they experience poorer health and performance later in the academic year. The above findings that high-congruence individuals who report more negative emotions or poorer health shift more to secondary than primary control after failure is directly consistent with previous research showing the adaptive nature of secondary control for people faced with declining health status (e.g., Chipperfield et al., 1999; Wrosch et al., 2002) or serious illness (e.g., Band & Weisz, 1990; Thompson et al., 1993, 1994) as well as individuals reporting stressful life circumstances (e.g., Wadsworth & Compas, 2002; Wrosch et al., 2000).

The *third* pattern of results in favour of high-congruence students was particularly intriguing and involved the same pattern of emphasis shifts early on, albeit predicted by positive and intrinsically motivating adjustment variables. That is, for individuals with greater confidence in their congruence abilities, higher levels of mastery orientation, perceived value, learning-related enjoyment, and self-esteem all predicted greater emphasis shifts toward secondary control early in the year, whereas higher mastery orientation levels predicted fewer subsequent increases to primary control (only this latter finding was observed for low-congruence students). These findings demonstrate that not only do students experiencing negative emotions early on shift less to primary control

after success and more to secondary control after failure in terms of magnitude (as opposed to frequency), so do students with a positive self-image who are motivated by the personal satisfaction of learning the course material. That is, whether high-congruence students were experiencing negative emotions or were intrinsically motivated early in the year, or perceived themselves as less healthy later in the year, they were more likely to shift to secondary control if they performed poorly presumably in order to preserve or improve their psychological well-being.

Finally, the *fourth* set of results showing the importance of high congruence levels demonstrated increased congruent emphasis shifts to primary control and decreased emphasis shifts to secondary control resulting from higher motivation levels later in the academic year. For high-congruence individuals, greater motivation in terms of performance orientation, perceived success, and perceived value predicted greater congruent shifts toward primary control throughout the year, whereas these same measures, in addition to academic expectations, corresponded to decreasingly significant congruent shifts toward secondary control as the year progressed. Worded conversely, this latter finding indicates that students with lower levels of motivation are increasingly more inclined to shift toward secondary control after poor performance - a pattern consistent with that found in recent research showing that students with lower grades often perceive their course performance as a low-control situation, and as such, are more inclined to engage in secondary-control strategies to buffer its negative motivational impact (Hall, Perry, Ruthig, et al., in press). Although low-congruence students were also found to shift more to secondary control after failure if they had lower motivation levels

(mastery orientation, perceived success, expectations, and value), these results were observed somewhat less often and later in the year (see perceived success and performance orientation). More importantly, however, the positive effects on emphasis shifts toward primary control resulting from higher motivation levels later in the year were found only for students reporting greater confidence in their congruence capabilities.

To summarize the effects of academic development on congruent emphasis shifts, which were evident primarily for individuals reporting high congruence levels, fewer shifts to primary control and more shifts to secondary control were found for students initially experiencing more negative affect and intrinsic motivation, more shifts toward secondary control later on were found following poor health status, and greater motivation predicted increasingly more shifts toward primary control and less shifts toward secondary control as the year progressed. These findings, together with earlier results showing that high-congruence individuals were more likely to make effective congruent shifts to secondary control in the first semester and toward primary control in the second semester, further demonstrate that these individuals are also capable of responding to initial threats to personal well-being through shifts to secondary control after failure, as well as capitalizing on higher motivation levels later in the year by shifting to primary control after a success experience. In fact, these results showed that many of the benefits of congruent emphasis shifts for these students following higher negative affect and intrinsic motivation early on, as well as poor health and higher motivation later on, were observed *by the next study phase*, whether it be a positive

impact (value following shifts toward primary control, anxiety and health following shifts to secondary control) or less negative effect on subsequent adjustment (mastery/performance orientation and enjoyment following shifts toward secondary control). Put simply, students who thought they could alternate adaptively between primary and secondary control not only made adaptive shifts in emphasis after failure and success experiences throughout the year, these shifts served to improve or maximize their psychological well-being particularly when these shifts were most effective.

Strengths and Limitations

Inherent in this study are numerous strengths that contribute to the internal and external validity of findings described above. First, with respect to the study sample, the present student sample was sufficiently large and showed demographic characteristics directly consistent with those found in previous pencil-and-paper questionnaire studies administered at this institution with respect to age, gender, English as second language, course load, and high school grades. The sample was also recruited from a large, multi-section course in order to keep the number and weight of tests completed equivalent across participants, however, the sample was notably heterogenous in terms of students' existing or intended faculty affiliations thus allowing the findings to generalize to students in various academic programs. Furthermore, supplemental analyses indicated considerable student engagement as demonstrated by low study attrition despite multiple study phases, few missing responses, positive or reflective student comments, and nearly all participants providing contact information to receive study updates. Finally, based on a five-part empirical rationale involving rate of responding and item-specific as well as

composite variable analyses, students who were not engaged in the web-based experimental protocol were excluded from the main study analyses so as to minimize unwanted error variance.

Second, concerning the utility of the web-based survey administration, the present study employed an Internet-based questionnaire format that was less intrusive than pencil-and-paper surveys used in traditional diary studies, and also did not allow students to retain their responses and thereby regulate their behaviour over time. This survey format was user-friendly, efficient, accurate, and secure in terms of the data collection process, with participants providing positive comments about completing the web survey such as "I had fun working on the survey itself," "being able to participate in this study on the computer is convenient," and "I enjoy how we get to do this survey on our own time." The web survey was administered in a controlled manner by restricting web access to campus computer facilities to reduce distraction and allow for campus technical support while completing the questionnaire, and by restricting access to the web survey outside of the allotted 10 days after course grades were posted. Finally, in response to the potential critique that this sample consisted primarily of students with better computer skills (i.e., excluding students disadvantaged by the "technological divide"), descriptive analyses revealed that more nontraditional students over age 30 chose to participate in this study than in previous pencil-and-paper studies conducted at this institution, indicating that an important demographic often characterized by lower computer literacy (e.g., Sax et al., 2003) was actually overrepresented in this study sample.

A *third* strength of the present study concerns the self-report and objective

measures employed. In order to more fully examine the impact of congruent emphasis shifts for overall academic development, various self-report measures with reliability levels often higher than observed in previous studies (e.g., secondary control, depression) were administered in five study phases to assess a range of psychosocial adjustment outcomes involving academic motivation and emotions, health, and overall well-being. Actual course grades were also obtained for all students so as to explore how students shifted their control strategy emphasis in response to actual performance feedback, and further, how these emphasis shifts predicted subsequent achievement. In so doing, this study was able to demonstrate consistent patterns of results across multiple study phases (e.g., four replications of phase-specific models were conducted) and a range of dependent measures, allowing for greater confidence in the findings observed. Moreover, by obtaining "gold standard" measures of actual academic performance, the present research provided a more ecologically valid perspective on how individuals make congruent emphasis shifts in real-life achievement settings.

Finally, a *fourth* strength of this research involves the manner in which the main and supplementary analyses were conducted. More specifically, this study employed a variety of statistical techniques ranging from repeated-measures ANCOVAs and regressions to well-fitting phase-specific and cross-lagged panel SEM models that minimized unwanted error variance (i.e., covariates, correlated errors) to provide a comprehensive analysis of the nature and effectiveness of congruent emphasis shifts. Moderation analyses and alternate theoretical models were also assessed throughout the main and supplemental analyses, thus rounding out an assortment of analytical methods

used to examine the study hypotheses and providing considerable confidence that these results were not due to statistical artifact or limited by an insufficiently in-depth level of analysis. In sum, inherent in the present study are multiple strengths concerning the study sample, experimental protocol, measures assessed, and analyses conducted that serve to bolster the internal as well external validity of the present findings.

In addition to these strengths, five limitations should be considered when interpreting these results. First, the initially poor reliability levels for the meta-level reported congruence measure (i.e., the "Both" RCA subscale) may have contributed to a lack of significant findings for this measure in analyses of its relationship at Time 1 to observed emphasis shifts (e.g., Figure 4, Hypothesis 3; see also Figure K1, Appendix K) and to a more specific, directional RCA subscale (e.g., Figure J1, Appendix J). It should be noted, however, that this subscale showed a statistically significant improvement in reliability over time, whereas other measures did not. Considering that the items in this subscale were more sophisticated than those of other study measures, this improvement over time may be because such higher-order thinking about control strategy emphasis becomes more developed only as students progress through their first year of college. It is also important to acknowledge that the effects of this lower reliability in early study phases were minimized due to latent SEM analyses allowing for the statistical removal of measurement error, and because the most reliable bidirectional RCA measure (Time 5) was employed in the critical moderation analyses of Hypothesis 6. Nonetheless, future research examining this optimization process utilizing an elaborated self-report measure is warranted.

Second, whereas the secondary-control measure used in the present study largely addressed students' use of deliberate control strategies involving a positive reinterpretation of negative events, the primary-control measure based on Perry et al. (2001) included items assessing students' more general beliefs concerning the effectiveness of their primary-control efforts. For example, in contrast to secondary-control items such as "Whenever I have a bad experience at university, I try to see how I can 'turn it around' and benefit from it," primary-control items such as "The more effort I put into my courses, the better I do in them" were included (for more information on the conceptual distinction between control-related beliefs and strategies, see Chipperfield, Campbell, & Perry, 2004). As such, the potential confounds involved in utilizing a primary-control measure based on perceived control research in combination with a secondary-control measure incorporating Heckhausen's strategy-based, developmental approach may have contributed to fewer significant findings for these variables as well as the OEC measures (see Skinner, 1996 for more on the importance of distinguishing perceived control from primary/secondary control). Future studies on observed emphasis shifts may benefit from the use of primary- and secondary-control measures comprising both belief- and strategy-oriented items in order to disentangle the implications of examining this phenomenon in terms of individuals' beliefs about the effectiveness of these strategies vs. their reported use of these strategies in achievement settings.

Third, because the measures of overall adjustment were examined only in the first and final phases of the study, the findings concerning the effects of observed emphasis shifts on perceived stress, self-esteem, and depression were not directly comparable with

those of the larger cross-lagged panel models assessed for the other dependent measures. Moreover, this discrepancy in study design may have contributed to the somewhat inconsistent results found for congruent emphasis shifts on these variables, namely the detrimental effects of shifts toward primary control on stress for high-congruence individuals and on depression for students overall (significant only for low-congruence students). Fourth, although the present student sample was particularly well-suited to the study of emphasis shifts in a academic environment, the extent to which the results of this study generalize to other achievement settings, such as the workplace or competitive athletics, is not known. Future research examining how emphasis shifts affect global adjustment measures longitudinally and are evidenced in other achievement settings is recommended.

Finally, although the present study has a strong conceptual basis in primary/secondary control theory from both a micro-level (Rothbaum et al., 1982) and macro-level perspective (Heckhausen & Schulz, 1995), these results could also be interpreted from a self-regulation paradigm involving the initiation and maintenance of one's progress towards a selected goal (Kruglanski et al., 2000). More specifically, self-regulation models involving the behavioral enactment of intentions (feedback loops, Carver & Scheier, 2000; locomotion vs. assessment, Kruglanski et al., 2000; action orientation, Kuhl, 1985) as well as the regulation of motivation during the academic learning process (self-regulated learning, Pintrich, 2000; "metamotivation," Wolters, 1998, 2003) should be particularly relevant. However, this research has been soundly criticized for having an almost exclusive focus on motivation and behavior towards

performance goals (i.e., approach vs. avoidance) as opposed to how people in everyday life find a balance between conflicting goals involving not only performance but psychological well-being (Csikszentmihalyi & Nakamura, 1999; Ryan & Deci, 1999). Although a dual-process model of self-regulated learning incorporating both learning and coping intentions has been proposed (Boekaerts 1993; see also Boekhaerts & Niemivirta, 2000), it has been primarily applied to children and is less developed than the theoretical models underpinning this study (i.e., Heckhausen & Schulz, 1995, 1998). Thus, although this study does overlap conceptually with self-regulation research, the primary/secondary control model provides a more comprehensive and conceptually sophisticated theoretical framework with which to examine the dual-process nature of the present research questions.

Conclusion

The results of the present study provide convincing empirical support for the previously unexplored, higher-order implications of Rothbaum et al.'s (1982) dual-process model of primary and secondary control in showing that people do indeed shift toward primary control in success situations and toward secondary control following failure experiences. This study also provides an elaborated theoretical model for understanding how primary and secondary control contribute to the belief that one can adaptively alternate between them, a perception which, in turn, translates in to actual congruent emphasis shifts. Furthermore, these findings suggest that some individuals are better able to recognize when these shifts in emphasis are most effective in terms of their performance as well as their psychological well-being, and strategically engage in

congruent emphasis shifts to maintain or improve their subsequent motivation, emotions, health, and performance. That is, whereas higher levels of primary and secondary control have both been found to contribute to better academic development, this study highlights the added benefit of an ability to adaptively, albeit deliberately, shift between these control processes in response to performance outcomes. To summarize the present research in the words of the well-known Prayer of Serenity, whereas primary control gives individuals the courage to change the things they can, and secondary control allows them to accept the things they cannot change, these findings demonstrate that there is a considerably effective yet relatively unexplored self-regulatory facet of control striving in achievement settings worthy of further investigation, namely "the wisdom to know the difference."

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Appendixes

Appendix A

Empirical rationale for participant exclusion.

Appendix B

Self-report study measures.

Appendix C

Overview of study measures.

Appendix D

Time analyses of descriptive data.

Appendix E

Debriefing information.

Appendix F

Correlation matrix.

Appendix G

Fit indices for SEM analyses.

Appendix H

Supplemental rationale for SEM analyses.

Appendix I

Supplemental RCA moderation analyses.

Appendix J

Supplemental cross-lagged panel SEM analyses.

Appendix A

Empirical Rationale for Participant Exclusion

Rate of responding. The range of elapsed times for the fastest 5% of participants does not reasonably correspond to the number of survey items in each phase. Although the number of survey items in each phase exceeded 100 items (Times 1-5: 156, 123, 116, 116, 149) , the *maximum* elapsed times (in minutes) for the fastest 5% were noticeably low (Times 1-5: 12.10, 8.82, 5.63, 4.40, 6.25). In contrast, the *average* survey completion time (in minutes) for each phase was over twice as long as the maximum time from the top 5% groups (Times 1-5: 23.48, 17.33, 14.63, 14.23, 15.93). With respect to how long students took per item (estimated in each phase by dividing the elapsed time by the number of items), the top 5% fastest students took a *maximum* of between 4.66 and 2.52 seconds per item (Times 1 and 5), whereas the *average* student spent between 9.03 and 6.41 seconds (Times 1 and 5) to read and respond to each item.

Participants' reading speed (words per minute) were also estimated by totalling the number of digits (i.e., found in the response option description) and words (i.e., instructions and survey items) per phase and dividing this number by the elapsed time for that phase. Although these figures are a conservative estimate to the extent that the participants required time to reflect and select a response, the top 5% groups demonstrated *average* "reading" speeds (words per minute) that was two to four times faster than the average for all participants (top 5%/average Times 1-5: 330/134, 393/151, 572/168, 713/173, 591/188). Moreover, considering that the average reading speed of high school graduates is 300-350 wpm (Carver, 1990), these results indicate that the top

5% groups were either reading *and* responding to items up to over twice as fast as the average reading rate, or most likely, were simply not reading or responding to the items carefully in order to finish the survey more quickly.

Item-specific descriptives. Assessments of responses to specific items in the first section of the Time 1 questionnaire also suggested that the top 5% group was more heterogenous in their responding than other participants. Looking only at descriptive information for items from the Time 1 measure of primary control (see Independent Measures), it was found that for the bottom 95% of the elapsed distribution, 8 of 10 items had a significantly leptokurtic distribution (kurtosis > 1) and 9 of 10 items were significantly skewed (skewness > K1). Items were skewed in the expected directions with positively worded items being negatively skewed (e.g., "The more effort I put into my courses, the better I do in them") and negatively worded items being positively skewed (e.g., "No matter what I do, I can't seem to do well in my courses"). In contrast, for the top 5% group, only 2 item distributions were leptokurtic, 3 distributions were actually playkurtic (kurtosis < -1), and only 5 of 10 items were significantly skewed in the expected directions (absolute value of skewness was .48 lower on average than for other students). The three leptokurtic items appeared at the start (item 1), middle (item 6), and end of the scale (item 10) and included both positively and negatively worded items. This findings suggests that the top 5% group were particularly heterogenous in terms of their pattern of responses to survey items, responding as a group to both positively and negatively phrased items as well as items throughout the entire scale in an inconsistent manner. It should be noted, however, that the reduced sample size of the top 5% group

(21 students) may have contributed to the unusual item distributions described above due to inadequate sampling.

Inter-item correlations. The top 5% group was also showed a pattern of correlations between the Time 1 primary control items which suggests that they were less likely to respond based on item content. For the bottom 95% group, all inter-item correlations between items of the same valence were positive, all correlations between positively and negatively phrased items were negative, 51% of correlations were over .30, and no correlations exceeded .50.

For the top 5% group, three *positive* correlations were found between positively and negatively phrased items (involving the first-two positively worded items and the second two negatively worded items), 45% of correlations were over .30, and 22% exceeded .50. Further, 7 of the 9 correlations between adjacent items were higher for the top 5% group, with two of the highest correlations found between adjacent items (.81 and .65). In addition, analyses on the differences between the 45 inter-item correlations for the top 5% and bottom 95% groups showed the correlations to be significantly more variable for the top 5% group (SD = .20) than for the bottom 95% group (SD = .10; Levene test statistic = 13.20, $p < .001$). Although the overall *t*-test was not significant, the pattern of inter-item correlations for the top 5% group shows a considerably higher degree of within-group variability, and further, that these students were more likely to base a response on their response to the previous question and were not attentive to significant item wording changes. To sum up, although strong inter-item correlations are required to produce a reliable self-report measure, the top 5% group showed positive

correlations between oppositely phrased items (should be negative), noticeably higher inter-item correlations between adjacent items, and a significantly wider range of inter-item correlations, all of which suggest that these students were more likely than other students to not read survey items carefully and simply answer questions based on their preceding item response.

Composite variable analyses. To illustrate the potential implications of the above response tendencies for the top 5% group for other study measures, *t*-tests contrasting this group with the bottom 95% group were conducted on key multi-item composite measures in each phase of the study. To summarize the findings observed, the top 5% group was found to have significantly lower levels of primary control and self-esteem in all applicable phases, a likely result of these individuals basing their responses on the first few positively worded items, but failing to notice that many of the subsequent scale items were negatively worded (60% of items for primary control and 50% for self-esteem were negatively worded). The top 5% group also reported higher levels on all learning-related emotion measures (enjoyment, anxiety, and boredom; see Dependent Measures), except for enjoyment in Time 5, with these students having similar means on these scales despite differing valences (e.g., all item means in Time 4 were 21, and in Time 5 were 18-19). This finding can be accounted for by the fact that the three emotion scales were presented in alternating order on the same questionnaire page and not grouped based on emotion type.

Finally, the top 5% group also reported significantly lower performance motivation that other students (Times 3 to 5), likely because these students had the same

means on the performance and mastery motivation items (presented in alternating order, mastery item first), whereas most other students noticed the different wording of the performance motivation items and had higher scores on this measure. In sum, the analysis of differences between the top 5% group and other students on composite variables throughout the study suggests that these students did not notice significant differences between survey items involving differently valenced constructs and were more likely to respond in a similar manner to dissimilar questionnaire items than other students.

Demographic characteristics. Analyses of demographic variables and number of students who were classified as belonging to the top 5% group in more than one phase (i.e., repeat offenders) also provide evidence for the exclusion of the top 5% group. First, *t*-test and chi-square analysis on multiple demographic characteristics, including age, gender, high school grades, course load, year in university, course professor, faculty designation, and English as first language were significant for only two variables, with males ($\chi^2(1, 1) = 4.97$, $p = .04$) and particularly English as second language students ($\chi^2(1, 1) = 9.99$, $p < .01$) more often classified *at least once* as belonging to the top 5% group. Second, over one-third of those identified as having completed at least one phase of the survey faster than 95% of other students did so multiple times, with approximately 34% of these participants having completed the survey very quickly on more than one occasion (twice: 15%, $n = 11$; three times: 11%, $n = 8$; four times: 8%, $n = 6$). As such, these analyses show that excluded participants were not only similar to other participants on most demographic characteristics but were also likely to be “repeat offenders”; findings which further support the exclusion of these individuals.

Appendix B

Self-report Study Measures

PRIMARY CONTROL

The following statements concern your beliefs about experiences in your psychology course at this very moment. The best approach is to ANSWER EACH ITEM FAIRLY QUICKLY. That is, don't try to count up the number of times you felt a certain way, but rather choose the alternative that seems to reflect your view most closely.

STRONGLY DISAGREE						STRONGLY AGREE
1	2	3	4	5	6	7

1. I have a great deal of control over my academic performance in my psychology course.
2. The more effort I put into my courses, the better I do in them.
3. I have little interest in determining how well I do in my psychology course.
4. No matter what I do, I can't seem to do well in my courses.
5. I see myself as largely responsible for my performance throughout my college career.
6. How well I do in my courses is often the "luck of the draw."
7. Giving your best in your courses makes little difference in the grand scheme of things.
8. There is little I can do about my performance in university.
9. When I do poorly in my psychology course, it's usually because I haven't given it my best effort.
10. My grades are basically determined by things beyond my control and there is little I can do to change that.

SECONDARY CONTROL

STRONGLY DISAGREE						STRONGLY AGREE
1	2	3	4	5	6	7

1. My academic performance and experience has given me a deeper understanding of my life than could be achieved without this experience.
2. Regardless of what my grades are, I try to appreciate how my university experience can make me a "stronger person" overall.
3. No matter how well I do on a test or in a course, I try to "see beyond" my grades to how my experience at university helps me to learn about myself.

4. Whenever I have a bad experience at university, I try to see how I can "turn it around" and benefit from it.

REPORTED CONGRUENCE ABILITY

The following statements concern your beliefs about experiences in your psychology course and in your life more generally. Although some of the items are similar, there are differences between them, so you should treat each one as a truly separate question. The best approach is to ANSWER EACH ITEM FAIRLY QUICKLY. Read each item carefully and respond using the scale provided.

STRONGLY DISAGREE						STRONGLY AGREE
1	2	3	4	5	6	7

1. It is important to persist when success is possible and change my thinking about a class when it is not.
2. I am able to switch my focus from being persistent to changing how I view a course if I'm not doing well in that class.
3. If I can't change my performance, I can easily change how I think about it.
4. When success is not likely, I can quickly switch from trying to change my performance to changing how I adjust to this situation.
5. It is important to know your limits and adapt to failure in a constructive way.
6. I am able to switch from adjusting to low grades to being more persistent if an opportunity for success arises.
7. I quickly realize when my effort is not paying off and am able to adjust my thinking accordingly.
8. It is important to adapt to both the controllable and uncontrollable aspects of one's studies.
9. I am able to constructively change how I think about my performance in a course when success is not likely.
10. When increasing my effort is not effective, I find it easy to change how I think about my studies.
11. If there was a chance to succeed in a very difficult class, I could easily shift my focus from changing how I think about the course to actually trying harder in that course.
12. Even when failure seems inevitable, I am able to easily switch from changing my attitude to changing my effort if there is an opportunity to do well.
13. I am able to quickly shift from changing my attitude about a difficult class to trying harder in that class if there is a chance to improve my grades.
14. I can switch back and forth between trying to succeed and adjusting to disappointment depending on how well I do in my studies.

ACHIEVEMENT MOTIVATION
(Mastery = odd; Performance = even)

The items below refer specifically to your psychology course and to your life more generally. Try to answer each item as accurately as you can.

Not at all true of me						Very true of me
1	2	3	4	5	6	7

1. I prefer course material that really challenges me so I can learn new things.
2. Getting good grades in my classes is the most satisfying thing for me right now.
3. In a class like psychology, I prefer course material that arouses my curiosity, even if it is difficult to learn.
4. The most important thing for me right now is getting good grades so that I have a high grade point average.
5. The most satisfying thing for me in my course is trying to understand the content as thoroughly as possible.
6. If I can, I want to get better grades in this class than most of the other students.
7. When I have the opportunity in my courses, I choose assignments that I can learn from, even if they don't guarantee a good grade.
8. I want to do well in my classes because it is important to show my ability to my family, friends, employer, or others.

PERCEIVED SUCCESS

1. How successful do you feel you are in your Introductory Psychology Course so far this year?

Very unsuccessful									Very successful
1	2	3	4	5	6	7	8	9	10

2. How successful do you feel you are in university overall so far this year?

Very unsuccessful									Very successful
1	2	3	4	5	6	7	8	9	10

Students can feel successful in some areas of university, but less successful in other areas. RATE YOUR OWN FEELINGS OF SUCCESS IN INTRODUCTORY PSYCHOLOGY FOR EACH ITEM BELOW USING THE FOLLOWING 10-POINT SCALE.

Not at all Successful									Totally Successful
1	2	3	4	5	6	7	8	9	10

How successful do you feel...

3. ...about the grades you got on tests and assignments?
4. ...in achieving the learning goals you set for yourself?
5. ...when it comes to knowing that you made an honest effort to make progress during the year?
6. ...in doing all the work, meeting deadlines, keeping up with the reading, studying, etc.?
7. ...in gaining new knowledge and understanding from your course?

PERCEIVED VALUE

(Importance = 1-2; Intrinsic Motivation = 3-4)

The following set of statements refer to aspects of your Introductory Psychology course and of university more generally.

STRONGLY DISAGREE									STRONGLY AGREE
1	2	3	4	5	6	7	8	9	10

1. It is important for me to do well overall at university this year.
2. It is very important for me to do well in my Introductory Psychology course.
3. I think that what we learn in my Introductory Psychology course is interesting.
4. I am motivated to do well in my Introductory Psychology course.

ACADEMIC EXPECTATIONS

Not at all true of me						Very true of me
1	2	3	4	5	6	7

1. I expect to do very well in my Introductory Psychology course this year.
2. I expect to do very well overall at university this year.

3. What percentage (%) do you expect to obtain in your Introductory Psychology course at the end of the year?

<students enter number from 0 to 99>

4. What percentage (%) do you expect to obtain on your next test in Introductory Psychology?

<students enter number from 0 to 99>

ACADEMIC EMOTIONS

(Enjoyment = 1, 4, 7, 10, 13, 16; Anxiety = 2, 5, 8, 11, 14, 17; Boredom = 3, 6, 9, 12, 15, 18)

The next set of 18 statements refers to the experiences you've had in your psychology course to date. Please read each statement carefully and respond using the following scale.

NOT AT ALL TRUE	A LITTLE TRUE	MODERATELY TRUE	LARGELY TRUE	COMPLETELY TRUE
1	2	3	4	5

WITH REGARD TO MY INTRODUCTORY PSYCHOLOGY COURSE:

1. I enjoy learning new things.
2. Before I start studying material in this course, I feel tense and anxious.
3. When studying for this course, I feel bored.
4. Some topics are so enjoyable that I look forward to studying them.
5. I feel queasy when I think of having to study and to do all the work for this course.
6. The things I have to do for this course are often boring.
7. After I finish studying, I am gratified that I know more than before.
8. When studying for this course, I worry that I won't be able to master all the material.
9. The content is so boring that I often find myself daydreaming.
10. After studying for this course, I feel relaxed and worry-free.
11. When studying the material in this course, my heart rate increases because I get anxious.
12. When studying, my thoughts are everywhere else, except on the course material.
13. Some topics are so fascinating that I am very motivated to continue studying them.
14. While I am studying, I sometimes want to distract myself in order to reduce anxiety.
15. The material in this subject area is so boring that it makes me exhausted even to think about it.
16. Because this course is fun for me, I study the material more extensively than is necessary.

17. When I have problems with learning the material in this course, I get anxious.
18. Often I am not motivated to invest effort in this boring course.

PERCEIVED HEALTH

1. How would you rate your physical health right now?

(1) very poor
(2) poor
(3) average
(4) good
(5) very good

2. How would you rate your psychological health right now?

(1) very poor
(2) poor
(3) average
(4) good
(5) very good

This next set of questions concerns your physical well-being during the last week. Read each statement carefully and respond to it using the scale provided.

Not at all a week	About once a week	About twice a week	About four times a week	5 or more times a week
1	2	3	4	5

DURING THE LAST WEEK, HOW MUCH WERE YOU BOTHERED BY:

1. sleep problems
2. headaches
3. feeling low in energy
4. muscle tension
9. constant fatigue
10. stomach pain (e.g. cramps)
11. heart pounding or racing
12. poor appetite

PERCEIVED STRESS

The items below concern your feelings and thoughts about various things that have happened in your life during the last month. In each case, you are asked to indicate how often you felt or thought a certain way. Use the following scale for each item:

Never	Infrequently	Sometimes	Frequently	Very Often
1	2	3	4	5

DURING THE LAST MONTH:

1. How often have you been upset because of something that happened unexpectedly?
2. How often have you felt that you were unable to control the important things in your life?
3. How often have you felt nervous and 'stressed'?
4. How often have you found that you could not cope with all the things that you had to do?
5. How often have you been angered because of things that happened that were outside of your control?
6. How often have you felt difficulties were piling up so high that you could not overcome them?

SELF-ESTEEM

Following is a set of items that refers to your life more generally. Please read each item carefully and respond to it as honestly as you can. Note that the response scale for these items is different than the one you used for the last set of items.

STRONGLY DISAGREE				STRONGLY AGREE
1	2	3	4	5

1. I feel that I'm a person of worth, at least on an equal plane with others.
2. I feel that I have a number of good qualities.
3. All in all, I'm inclined to feel that I am a failure.
4. I am able to do things as well as most other people.
5. I feel I do not have much to be proud of.
6. I take a positive attitude toward myself.
7. On the whole, I am satisfied with myself.
8. I wish I could have more respect for myself.
9. I certainly feel useless at times.
10. At times I think I am no good at all.

DEPRESSION

The items below refer to how you have felt and behaved DURING THE PAST WEEK.

For each item, indicate the extent to which it is true, by selecting one of options from the following scale:

Not at all	Just a little	Somewhat	Moderately	Quite a lot	Very much
1	2	3	4	5	6

1. I do things slowly
2. My future seems hopeless
3. It is hard for me to concentrate on reading.
4. The pleasure and joy has gone out of my life.
5. I have difficulty making decisions.
6. I have lost interest in aspects of life that used to be important to me.
7. I feel sad, blue, and unhappy.
8. I am agitated and keep moving around.
9. I feel fatigued.
10. It takes great effort for me to do simple things.
11. I feel that I am a guilty person who deserves to be punished.
12. I feel like a failure.
13. I feel lifeless -- more dead than alive.
14. My sleep has been disturbed -- too little, too much, or broken sleep.
15. I feel trapped or caught.
16. I feel depressed even when good things happen to me.
17. Without trying to diet, I have lost, or gained, weight.

DEMOGRAPHICS

1. What is your gender?

   (1) female
   (2) male

2. What is your age in years?

   <students entered number from 0 to 99>

3. Which Faculty are you currently registered in or do you intend to register in?

(1)	Arts	(6)	Science
(2)	Human Ecology	(7)	Physical Education
(3)	Engineering	(8)	Nursing
(4)	Management	(9)	Social Work
(5)	Education	(10)	Other

4. How many credit hours are you taking this year?
(Note: half courses = 3 credit hours, full courses = 6 credit hours)

(1)	3	(6)	18
(2)	6	(7)	21
(3)	9	(8)	24
(4)	12	(9)	27
(5)	15	(10)	30 or more

5. How many years have you been in university?

(1) This is my first year
(2) This is my second year
(3) This is my third year
(4) This is my fourth year
(5) I have been here longer than four years

6. What was your average (%) in your last year of high school?

<students enter number from 0 to 99>

7. Do you consider English to be your first language?

(1) yes (2) no

Appendix C

Overview of Study Measures

Measures	No. of items	Anchors	Range of alphas	Range of *M*s	Range of *SD*s	Range of ranges
Test performance (x 5)	1	Percentage	N/A	67.55-73.32	13.99-19.68	13.20-100
Primary control (PC)	10	1 = strongly disagree 7 = strongly agree	.80-.87	56.31-58.42	7.62-8.70	14-70
Secondary control (SC)	4	Same	.77-.85	18.51-19.13	4.30-4.53	4-28
RCA: PC-to-SC	6	Same	.75-.89	25.67-26.26	5.35-6.13	6-42
RCA: SC-to-PC	4	Same	.73-.83	19.92-20.98	3.68-4.01	4-28
RCA: Both	3	Same	.41-.68	15.54-15.96	2.70-2.86	4-21
Orientation - mastery	4	1 = not at all true of me 7 = very true of me	.70-.81	18.63-20.49	3.82-4.48	4-28
Orientation - performance	4	Same	.72-.83	22.46-23.12	3.89-4.63	4-28
Perceived success - specific	4^, 5	1 = not at all successful 10 = totally successful	.89-.92	29.75^-34.72	6.04-9.30	4-50
Perceived success - global	2	1 = not at all 10 = very much so	.65-.71*	13.33-13.83	2.99-3.51	2-20
Expectations - specific	2	Percentage	.75-.86*	159.96-165.62	14.32-17.69	90-198
Expectations - global	2	1 = not at all true of me 7 = very true of me	.71-.75*	10.94-11.91	1.72-2.16	2-14

Overview of Study Measures (continued)

Measures	No. of items	Anchors	Range of alphas	Range of *M*s	Range of *SD*s	Range of ranges
Value - importance	2	1 = strongly disagree 10 = strongly agree	.72-.80*	17.23-18.34	2.10-2.89	6-20
Value - intrinsic motivation	2	Same	.59-.73*	15.11-17.16	2.58-3.64	2-20
Enjoyment	6	1 = not at all true 5 = completely true	.74-.80	18.83-20.77	3.83-4.50	7-30
Anxiety	6	Same	.84-.87	12.47-15.36	4.99-5.19	6-30
Boredom	6	Same	.88-.92	11.79-13.04	4.38-5.48	6-30
Health - global	2	1 = very poor 5 = very good	.49-.56*	7.13-7.53	1.52-1.64	2-10
Health - illness symptoms	8	1 = not at all 5 = 5 or more times	.82-.87	17.46-18.33	6.72-7.11	8-40
Stress	6	1 = never 5 = very often	.89	17.95-18.45	5.07-5.16	6-30
Depression	17	1 = not at all 6 = very much	.93-.94	37.32-38.76	15.74-16.34	17-97
Self-esteem	10	1 = strongly disagree 5 = strongly agree	.90-.91	38.69-38.95	7.95-8.30	12-50

Note. RCA = reported congruence ability.

^ Time 1 assessment of specific perceived success did not include grades item assessed in later phases, lowering the maximum scale range. *Range of correlations reported for two-item measures.

Appendix D

Time Analyses of Descriptive Data

Reliability analyses. To examine the degree of change in reliability levels over time and address potential concerns about including additional participants in Time 2 (i.e., greater practice effects for 5-part participants), analyses of internal reliability were conducted for the 4-part and 5-part participants both separately and combined. All three sets of Cronbach's alpha coefficients for all scales consisting of three or more items are presented in Table D1. To examine whether the two-stage recruitment process influenced scale reliability, repeated-measures ANOVAS on reliability values for 12 scales in Table D1 were conducted (analyses excluded scales assessed only in Times 1 and 5 and the total RCA measure, the latter replaced by the three factor-derived RCA subscales). First, the ANOVA findings for the each group revealed significant linear time effects on reliability values for 4-part participants, $F(11) = 7.49$, $p < .05$, $\eta_p^2 = .41$, and especially 5-part participants, $F(11) = 20.75$, $p = .001$, $\eta_p^2 = .65$, showing reliability levels to steadily increase over time.

Second, a repeated-measures ANOVA including both time and study (4-part vs. 5-part) as the within- and between-subjects factors, respectively, as well as the study x time interaction was conducted with reliability levels from Time 2 through Time 5 as dependent measures. Although results did show a significant linear time effect, $F(11) = 28.92$, $p < .001$, $\eta_p^2 = .57$, they did not show a significant main effect for study membership, $F(11) = .18$, $p = .68$, or a significant study x time interaction effect, $F(11) = .13$, $p = .22$. The mean reliability levels per phase for the 4-part and 5-part participants

Table D1

Scale reliability values by recruitment phase.

	T1	T2			T3			T4			T5		
	P5	*Al*	*P5*	*P4*	*Al*	*P5*	*P4*	*Al*	*P5*	*P4*	*Al*	*P5*	*P4*
Primary control (PC)	.80	.83	.83	.84	.84	.82	.86	.84	.83	.86	.87	.86	.88
Secondary control (SC)	.77	.77	.78	.75	.80	.82	.71	.83	.84	.78	.85	.85	.84
RCA: Total	.81	.85	.86	.82	.88	.89	.83	.90	.90	.87	.89	.90	.86
RCA: PC-to-SC	.75	.84	.85	.76	.87	.88	.83	.88	.90	.83	.89	.90	.82
RCA: SC-to-PC	.73	.79	.79	.80	.78	.77	.79	.79	.79	.80	.83	.84	.80
RCA: Both	.41	.51	.51	.51	.62	.65	.53	.65	.66	.62	.68	.69	.64
Orientation - mastery	.70	.73	.71	.77	.79	.80	.74	.80	.78	.81	.81	.81	.79
Orientation - performance	.72	.73	.73	.75	.79	.79	.80	.79	.80	.77	.83	.82	.84
Perceived success - specific	.89	.91	.90	.91	.91	.92	.89	.92	.92	.92	.91	.91	.90
Enjoyment	.75	.74	.73	.77	.75	.75	.76	.78	.77	.79	.80	.82	.74
Anxiety	.84	.86	.85	.87	.86	.86	.86	.87	.88	.85	.87	.87	.87
Boredom	.88	.90	.89	.91	.90	.90	.92	.91	.91	.91	.92	.92	.93
Illness symptoms	.82	.83	.84	.82	.84	.84	.83	.86	.87	.84	.87	.88	.83
Stress	.89	-	-	-	-	-	-	-	-	-	.89	.90	.89
Depression	.93	-	-	-	-	-	-	-	-	-	.94	.94	.93
Self-esteem	.90	-	-	-	-	-	-	-	-	-	.91	.91	.90

Note. T1 = Time 1, T2 = Time 2, T3 = Time 3, T4 = Time 4, T5 = Time 5, P4 = 4-part participants, P5 = 5-part participants, RCA = reported congruence ability. The Both RCA subscale excludes item 14.

are presented in Figure D1. Although a visual inspection of the reliability means in Table D1 and Figure D1 suggest a delayed pattern of reliability improvement for those recruited to the study in the second phase, it is important to note that both groups have

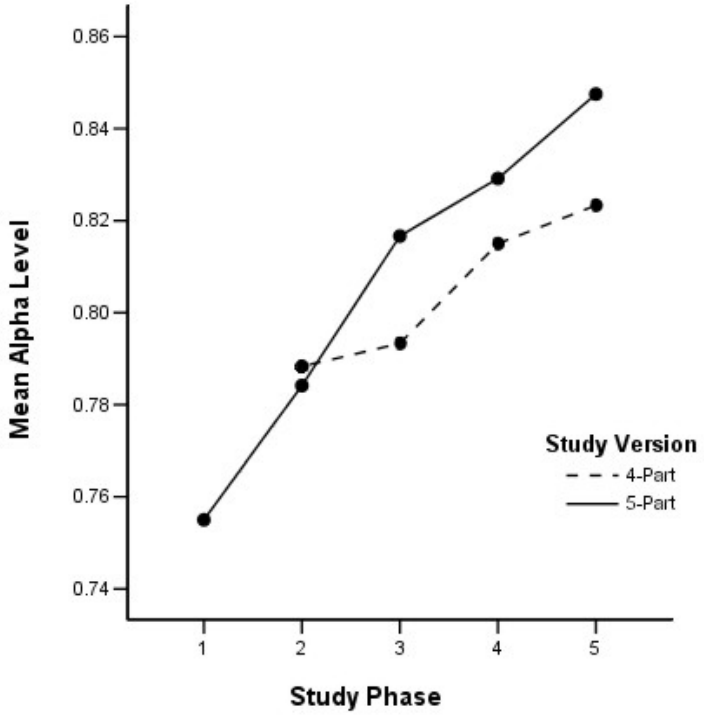


Figure D1. Mean Reliability Level by Study Version (4- vs. 5-part Participants).

virtually identical average reliability levels in Time 2 and do not significantly differ in subsequent phases with respect to changes in reliability over time. Thus, these results showing that 4-part participants did not show significantly different practice effects from 5-part participants with respect to scale reliability levels over time suggests that the study measures had equivalent internal reliability for all participants regardless of when they were recruited.

Means analyses. In examining the extent to which mean levels of the study variables changed over time, and to assess potential differences between 4-part and 5-part participants on changes in these constructs, repeated-measures ANOVAs were conducted

on all measures (including OEC scores). Means and standard deviations for all study variables are presented in Table D2. First, in order to rule out the possibility that delayed study recruitment had an impact on mean levels of the study measures, repeated-measures ANOVAs including time, study (4-part vs. 5-part), and the study x time interaction as predictors were conducted for each scale in Table D2.

Results revealed significant study main effects ($p < .05$) on the PC-to-SC RCA subscale, $F(416) = 5.57$, $p < .05$, $\eta_p^2 = .01$, illness symptoms, $F(414) = 5.10$, $p < .05$, $\eta_p^2 = .01$, specific percentage expectations, $F(415) = 6.57$, $p < .05$, $\eta_p^2 = .02$, and specific perceptions of success, $F(416) = 6.96$, $p < .01$, $\eta_p^2 = .02$, as well as significant interaction effects on boredom, $F(413) = 2.92$, $p < .05$, $\eta_p^2 = .01$, and global perceived success, $F(416) = 3.14$, $p < .05$, $\eta_p^2 = .01$. However, based on the classifications of partial eta squared values by Huberty (2002) as small (.01), moderate (.04), or large (.10), these effects were considered of little importance. Thus, because study recruitment procedures had no practically significant main effect or interaction with time on either scale reliability or mean levels, the 4-part and 5-part participants are considered equivalent and were not assessed separately in subsequent analyses.

Repeated-measures ANOVAs were also conducted on each study variable for 5-part participants in order to assess mean level changes throughout the duration of the study. Surprisingly, analyses revealed significant time effects ($p < .05$) on all except two measures (PC-to-SC RCA subscale, OEC scores), with all except four measures showing significant *linear* trends indicating significantly *poorer* levels on the study variables over time. Measures with moderate to large effect sizes showing this significant linear trend

Table D2

Scale means and standard deviations.

	Time 1		Time 2		Time 3		Time 4		Time 5	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Test performance	71.24	18.97	67.63	19.06	67.55	18.61	69.12	19.68	73.32	13.99
Primary control (PC)	58.42	7.62	57.55	7.86	56.74	8.08	56.38	7.93	56.31	8.70
Secondary control (SC)	19.10	4.49	18.87	4.30	18.51	4.48	18.82	4.44	19.13	4.53
OEC	-	-	0.09	9.79	-0.62	9.52	-1.22	9.42	-1.19	8.90
RCA: Total	67.62	10.00	66.55	10.36	65.73	10.93	66.61	11.23	66.21	11.39
RCA: PC-to-SC	26.26	5.35	26.09	5.67	25.67	6.02	26.16	6.13	26.21	6.13
RCA: SC-to-PC	20.98	3.70	20.47	3.84	20.16	3.68	20.26	3.70	19.92	4.01
RCA: Both	15.96	2.70	15.55	2.74	15.54	2.78	15.61	2.76	15.57	2.86
Orientation - mastery	20.49	3.82	19.82	3.98	19.65	4.37	19.54	4.21	18.63	4.48
Orientation - performance	23.12	3.89	22.99	4.00	22.93	4.29	22.95	4.27	22.46	4.63
Perceived success - specific*	29.75	6.04	34.72	8.89	33.66	9.30	34.26	8.89	34.43	8.47
Perceived success - global	13.83	2.99	13.66	3.29	13.33	3.51	13.67	3.28	13.71	3.05
Expectations - specific	164.52	14.32	165.62	14.63	162.83	16.02	161.44	16.37	159.96	17.69
Expectations - global	11.91	1.72	11.69	1.82	11.09	2.10	11.06	2.09	10.94	2.16
Value - importance	18.34	2.10	17.96	2.37	17.52	2.54	17.39	2.68	17.23	2.89
Value - intrinsic motivation	17.16	2.58	16.53	3.02	15.82	3.42	15.57	3.44	15.11	3.64
Enjoyment	20.77	3.87	20.03	3.83	19.37	4.07	19.04	4.20	18.83	4.50
Anxiety	15.36	5.18	14.11	5.19	13.12	4.99	12.71	5.04	12.47	5.01
Boredom	11.79	4.38	12.04	4.69	12.19	4.82	12.70	5.20	13.04	5.48
Health - global	7.53	1.52	7.36	1.56	7.13	1.64	7.25	1.64	7.15	1.60
Health - illness symptoms	18.00	6.72	18.33	6.73	18.30	6.81	17.46	6.90	17.78	7.11
Stress	17.95	5.16	-	-	-	-	-	-	18.45	5.07
Depression	37.32	15.74	-	-	-	-	-	-	38.76	16.34
Self-esteem	38.95	7.96	-	-	-	-	-	-	38.69	8.30

Note. RCA = reported congruence ability, OEC = observed emphasis change. Test performance values reflect students' first five test scores. OEC scores reflect actual shifts in emphasis from the preceding phase. The Both RCA subscale excludes item 14.

*Perceived success at Time 1 consisted of four items, whereas Times 2 to 5 included five items.

included primary control, $F(303) = 39.19$, $p < .001$, $\eta_p^2 = .12$, SC-to-PC RCA, $F(306) = 16.75$, $p < .001$, $\eta_p^2 = .05$, mastery, $F(304) = 43.31$, $p < .001$, $\eta_p^2 = .13$, specific perceived success, $F(304) = 40.63$, $p < .001$, $\eta_p^2 = .12$, specific expectations, $F(303) = 33.47$, $p < .001$, $\eta_p^2 = .10$, global expectations, $F(306) = 66.49$, $p < .001$, $\eta_p^2 = .18$, perceived importance, $F(305) = 63.23$, $p < .001$, $\eta_p^2 = .17$, intrinsic motivation, $F(304) = 140.97$, $p < .001$, $\eta_p^2 = .32$, enjoyment, $F(303) = 72.82$, $p < .001$, $\eta_p^2 = .19$, boredom, $F(303) = 41.37$, $p < .001$, $\eta_p^2 = .12$, global health status, $F(304) = 35.42$, $p < .001$, $\eta_p^2 = .10$, and depression, $F(318) = 16.04$, $p < .001$, $\eta_p^2 = .05$. Although a significant linear trend was also found for anxiety, $F(303) = 125.80$, $p < .001$, $\eta_p^2 = .29$, students were actually found to become considerably *less* anxious over time. Taken together, these findings show that as the academic year progressed, students reported lower primary control, lower motivation (especially intrinsic motivation), lower motivating emotions (enjoyment, anxiety), greater demotivating emotions (boredom), poorer health, as well as poorer overall psychosocial adjustment. Scale means for primary control, intrinsic motivation, and anxiety are presented in Figure D2.

Nonetheless, the repeated-measures ANOVA analyses also showed three study variables to have only a significant *quadratic* or U-shaped effect over time, namely test performance, $F(487) = 124.93$, $p < .001$, $\eta_p^2 = .20$, secondary control, $F(304) = 13.74$, $p < .001$, $\eta_p^2 = .04$, and performance motivation, $F(305) = 12.52$, $p < .001$, $\eta_p^2 = .04$ (see

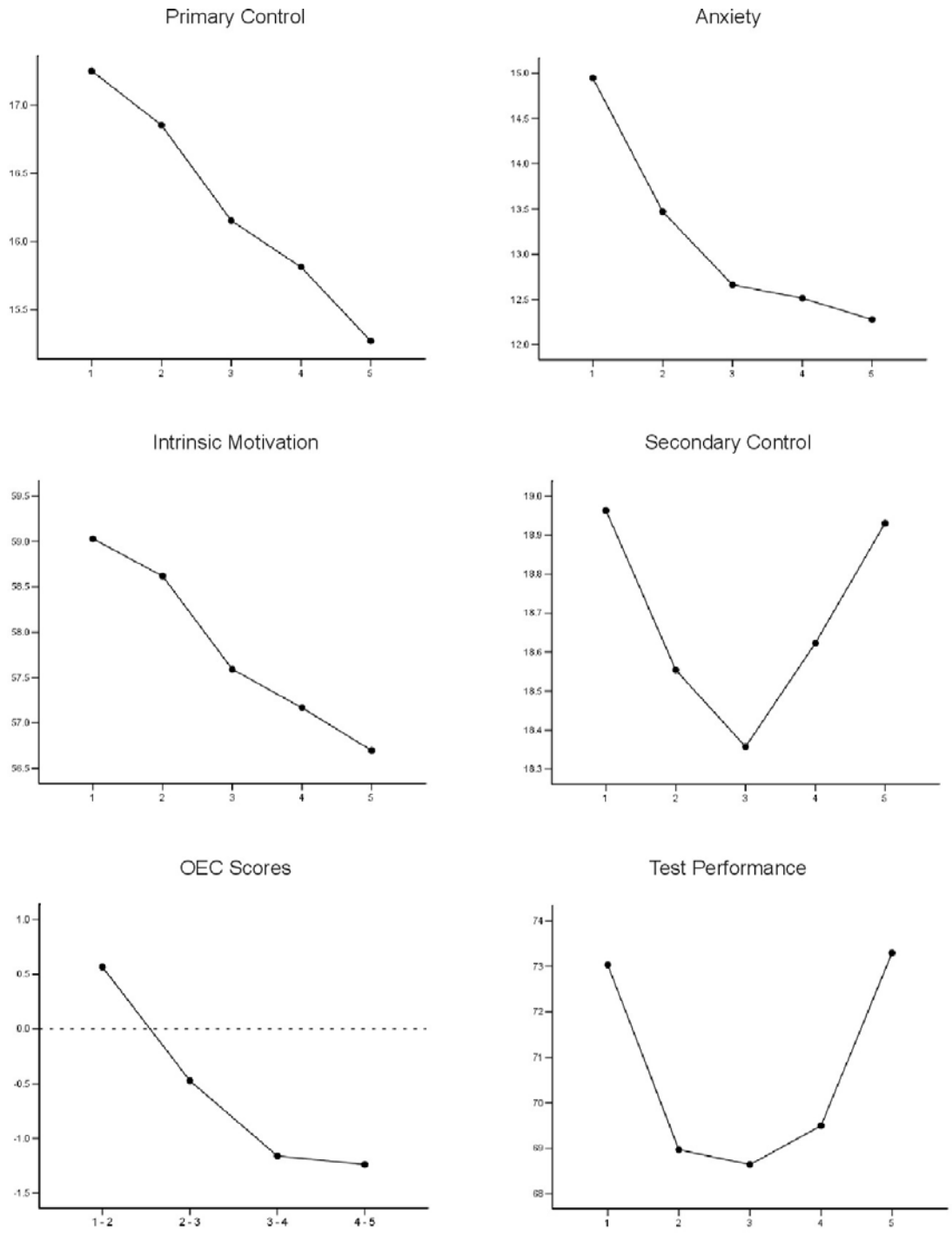


Figure D2. Mean Levels for Selected Self-report Measures from Times 1 through 5, OEC Scores from Times X to X + 1, and Course Tests 1 through 5.

Figure D2 for secondary control and test performance means). For test performance, although the means for tests 1 and 5 were over 73%, the average for tests 2 through four were all approximately 4% lower. The quadratic effect was especially clear, albeit weaker, with respect to secondary control, with a steady decline observed from Time 1 to Time 3, and an increase of the same magnitude found from Time 3 to Time 5. This finding is particularly notable in that of all the self-report measures assessed in the present study, only secondary control levels were found to improve following the initial decline observed on most other variables, demonstrating the unique nature of this process relative to other academic constructs and the importance of having secondary control when faced with continued poor performance. In contrast, the opposite U-shaped pattern for performance motivation was observed, with slightly higher levels observed in Times 2 through 4 than in Times 1 and 5. Thus, although students showed an initial increase in their focus on performance outcomes following the initially higher Test 1 grades, these levels showed a marked drop in Time 5 following a steady decline in performance on Tests 2 through 4.

Although the overall within-subjects time effect on OEC scores did not reach significance, $F(301) = 2.04$, $p = .11$, a statistically significant linear contrast was also observed on this measure, $F(301) = 8.35$, $p < .01$, $\eta_p^2 = .03$, such that OEC scores changed from being positive from after the first test (increased relative emphasis toward PC vs. SC) to becoming increasingly negative after each of the next three tests (increasing relative emphasis on SC vs. PC; see Figure D2). Considering that most students performed noticeably better on Test 1 than on Tests 2 through 4, that students

initially shifted from SC to PC with success and then from PC to SC with poorer performance is directly consistent with the study hypotheses and provides preliminary empirical support for the use of OEC scores to assess changes in relative PC/SC emphasis over time.

Appendix E

Debriefing Information

RESEARCH ON ACADEMIC MOTIVATION & ACHIEVEMENT

Dear Student,

We would like to take a final opportunity to again thank you for participating in our research. As you already know from the time you consented to participate last term, our research is aimed at uncovering some of the complex relationships between a number of variables that can and do affect students' grades and their overall university experience. We have been conducting this research for several years, and in this brief handout we would like to share with you in a bit more detail some of the results and patterns that seem to be emerging. Although the results are only preliminary and tentative, they provide food for further thought, and we hope that you will think about them.

All researchers have "core ideas" (i.e., a philosophy, hypotheses, theories, etc) that guide their research. One of the core ideas that has guided our research can be expressed by the idea that **you do not need to be an "Einstein" to do well in university.** For example, using high school grades as an indicator of background ability, our past research suggests that one's natural ability only "accounts for" about 25% of the variability in university grades. While 25% is certainly a significant amount, it is important to keep in mind that this means that the remaining 75% of the variability in grades is due to "other things" besides natural ability! In the broadest sense, our research aims at trying to find out what these "other things" are and how they all "fit together."

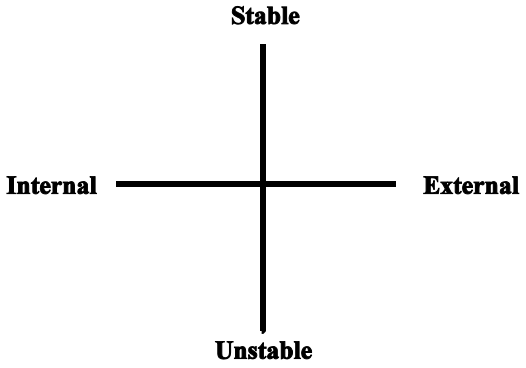
One of these important "other things" that we are finding (and are quite excited about as researchers), is the importance of what we call **"perceived control."** Without getting too "technical" - what we mean by "perceived control" is the feelings that people have that they can influence what happens to them, that they have some control over their experience. At different times in our lives, we all sometimes feel that things are "out of control," and at other times, we feel that "things are in control." Research in other areas has shown that feelings of control can make quite a difference in important outcomes. For example, in the area of health research, giving hospital patients just a little bit of control - for example, control over when visiting hours are -- can speed their recovery. Other research in health has even gone so far as to show and suggest that feelings of control can actually increase the production of "killer T-cells" in the immune system! In our own ongoing research in the university setting, we are getting indications that the perception of control accounts for about 10% of the variability in grades. While 10% doesn't sound like much - think of it this way: if we convert this 10% into a letter grade - it can make the difference between a "C" and a "B," or a "B" and an "A."

So the question is: How do we minimize feeling "out of control" and maximize feelings of being "in control"?

The best place to begin is at the beginning. Whenever something bad or undesirable happens to us, we mentally shift into a mode of thinking that psychologists call a **causal search**: we want to know "why" it happened, we search for the reasons that caused the negative event, hopefully so we can prevent it from happening again.

There are **two main dimensions** that we use to "classify" the causes we find: One dimension is what is called **locus** -- which refers to the "location" of the cause ("internal" - that is - "inside" of ourselves vs. "external" or "outside" of ourselves). The second dimension is called **stability** --

which refers to whether the cause or reason is "fixed" or "permanent" vs. "temporary" or "unstable." We can represent these two dimensions by drawing the chart below.
Using the two dimensions, you can see that any cause for a negative event can be classified as having one of four different combinations of **attributional qualities**:

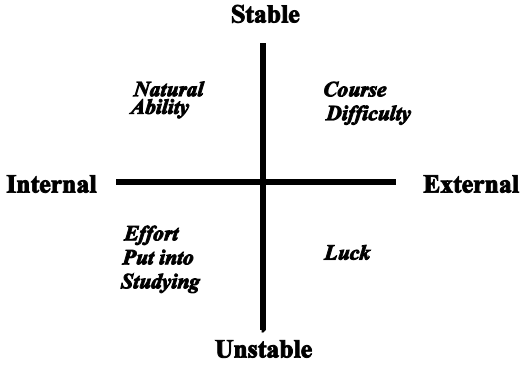


The cause can be:

Internal and Stable (upper left square)
External and Stable (upper right square)
Internal and Unstable (lower left square)
or **External and Unstable** (lower right square)

For example, if after being in a car accident -- you determine that it was because the road was slippery and ice covered -- then you would be making an **external-unstable attribution** -- external, because it was not you that caused the accident, and unstable because the road is not slippery all the time.

Consider the kinds of attributions that could be made for **getting a bad mark on a test: We might think the bad mark as due to:**



- **Low Natural Ability:** internal-stable because it is what we were born with and is "inside" us.

- **Course Difficulty:** external-stable because of the difficulty level set by the instructor and/or because of the inherent complexity of the course subject matter.

- **Luck:** external-unstable because the laws of probability are "outside" us and unpredictable (e.g., we can occasionally "luck out" guessing on tests, but we can't count on it).

- **Effort put into studying:** internal-unstable because the effort comes from "inside" ourselves, and because our effort levels go up and down and change over time or in different situations.

What is important to understand is that of the four types of "attributions" for doing poorly on a test ONLY EFFORT is CONTROLLABLE. We cannot control our natural ability (we were born with it), we cannot control how difficult the course is (or how difficult the instructor makes it), and we can't control luck (laws of probability).

A good exercise is to recall the last time you scored less than you expected on a test and evaluate your reasons for your performance in terms of this classification method. For example, you may have determined that the course material was difficult (external-stable), plus you may have guessed on a couple of answers (external-unstable), plus you didn't study as much as you could have (internal-unstable). The important part of this exercise though is not simply to classify your reasons -- but to go one step further and determine which reasons you can get some future control over and which you cannot.

An important point here is that the kinds of attributions that are made affect motivation. For example, if all of our attributions are to reasons that we believe are uncontrollable then this can demoralize us so much that we simply "give up" and stop trying. Consider this example: A student believes he or she did poorly on a test because of "low ability," and in believing this, decides that there is no point in putting more effort into studying. As a consequence, the student does even more poorly on the next test, which in turn confirms or "proves" his or her original belief in low ability. This turns into a "vicious circle" or a downward spiral that psychologists call a "self-fulfilling prophecy." On the other hand, if the student decided to **take control of the situation and put more effort into studying** and got a better mark as a result, then this could do the reverse: Create an upward spiral of cause-and-effect that increases motivation.

THE PROBLEM OF EFFORT:

Sometimes though, no matter how hard we try, we just can't seem to make any progress. In this situation it is often not so much the amount of effort as it is the **kind and quality of effort that matters.** In our research, we have looked at several different types of study techniques which we call **metacognitive strategies.** The simplest way of defining what we mean by this term is that metacognitive strategies involve a **self-directed process** which is kind of like "stepping outside" of ourselves, observing ourselves to see how we do something (in this case, study), and then, from this "detached" perspective, **consciously and intentionally** directing (that is , taking control) of how we study.

Two important metacognitive strategies that we have looked at are called **self-monitoring of knowledge** and **elaboration**. These categories of metacognition refer to a number of different study techniques related to (a) checking and verifying our understanding of what we are studying (self-monitoring of knowledge) and (b) "making connections" between all the little bits of information that we are learning and organizing them into an increasingly larger "network" of knowledge (elaboration).

Self-monitoring of knowledge: Examples of self-monitoring are such techniques as periodically stopping when reading the text (say, after each section), and asking yourself if you really understand what you just read. If your answer to yourself is "no" - then your strategy might be to re-read the section and identify exactly which part you don't understand. If after several re-reads, something is still not clear, then you could make a specific note of it and ask the instructor during the next class or during office hours. Additionally, after using this strategy for some time, you may start to recognize the kinds of material that give you trouble, and by recognizing these, give extra attention to them the first time you study the material, in effect dealing with them early on rather than later on in the course or closer to the test date. Another self-monitoring strategy is to see if you can summarize the material in your own words: For example, after reading each section in the text, can you write a one- or two-sentence paragraph about the main points of the section? A third technique is to try to explain the material to someone else (another student in the class, for example). This can be one of the most revealing ways of testing your knowledge, because sometimes even though you might "feel" you understand the material, your feelings are non-verbal and could mislead you. A good test of your "feelings of knowing" is by trying to put your understanding into words and explaining it to someone else.

Elaboration: Elaboration is a metacognitive strategy in which fragments of information are connected into larger "networks" of knowledge. It is one thing to memorize a bunch of disconnected facts, but quite another to connect them into a "big picture" of understanding. Elaboration often happens spontaneously as a natural consequence of learning. For example, you might read something that reminds you of something else and suddenly "make a connection" between them. However, you can go beyond the spontaneous elaboration of

knowledge and intentionally do things to speed the process along. For example, you could periodically stop in your reading (say, after each section), and ask yourself how what you just read relates to other material you learned about in the course: In other words - to **intentionally try** to find links and connections. Another way of using elaboration is to try to find examples from your own experience. For example, if you just finished reading a section in your psychology text on "conditioned reflexes" - could you think of an example of a conditioned reflex in your own life?

Self-monitoring and **elaboration** are just two metacognitive strategies we have done research on. There are many others (such as time-management & organization, critical thinking, etc.). **The important point we want to stress is that what all metacognitive strategies have in common is that they are ways in which we can gain increasing amounts of personal control over our learning processes.**

EMOTIONS: THE PROBLEM OF "BEING BORED"

Our research also looks at emotions. Boredom is one important emotion that affects learning: If we are bored by what we are learning, we do not learn it as well. Our research suggests that "being bored" can in some cases affect final grades by as much as 10%. However, we believe that being bored, like all emotions, can be brought under control by the person, although at this stage in our research we are not quite sure how. What we *can* say is that we have found that students who use metacognitive learning strategies report being both less bored with course material and find learning more enjoyable than students who do not use metacognitive strategies. Does being less bored cause the use of metacognition, or is it the other way around -- does the use of metacognition cause reduced boredom? This is one of the questions we will be trying to answer in the future.

SUMMARY: In this handout, we have only touched the surface of some of the questions we are trying to find answers to in our research. One of our long-term goals is to eventually "untangle" and understand as many of the complexities of university learning as we can, in the hope of developing practical teaching and learning techniques that instructors and students can use to enhance students' success in university. Despite this long-term aim, a cautionary note is in order: Psychological science rarely, if ever, comes up with any "magic solutions" or "quick fixes." Because individuals differ so widely from one another, there is no "sure fire" way that applies to everyone or works all the time. Each student must find what works for him or her and what doesn't. One thing though that we feel fairly certain of is that, on average, students who **persist in trying to gain control over and responsibility for their own learning processes** (e.g., through trying different metacognitive strategies, etc.) stand a chance of doing better in the long run than students who rely only on their natural ability alone.

Again, we would like to thank you for participating in our research, adding that If you have any further questions about the research, please feel free to contact Nathan Hall in the Department of Psychology.

Also, if you are more generally interested in improving your learning and studying, there are many good guidebooks in the library and in the bookstore on various topics and strategies related to learning (e.g., from organizing your time, reducing stress before exams, tips and techniques for studying alone or in groups, techniques for note-taking, strategies for reading, etc.).

Finally, Counselling Services (Room 474, Fourth floor, University Centre) also has a wide variety of expertise, information, and resources related to improving learning that are available to you as a student at the University of Manitoba.

Appendix F

Correlation Matrix

	1	2	3	4	5	6
1. Test performance	–					
2. Primary control (PC)	.33, .34, .31, .32, .36	–				
3. Secondary control (SC)	-.17, -.06, -.02, .07, .05	.06, .09, .20, .18, .23	–			
4. OEC*	-.01, .01, -.04, .11	-.19, -.17, -.17, -.04	.33, .34, .31, .34	–		
5. RCA: PC-to-SC	-.12, -.08, -.14, -.11, -.08	.00, .08, .04, .02, .07	.38, .38, .42, .43, .48	.05, .01, .10, -.02	–	
6. RCA: SC-to-PC	.09, .12, .10, .16, .23	.22, .43, .42, .40, .44	.27, .33, .40, .38, .37	.08, -.07, .06, .08	.44, .37, .40, .44, .41	–
7. RCA: Both	.07, .09, .10, .11, .11	.24, .25, .31, .33, .30	.41, .39, .42, .47, .45	.07, .05, .05, .04	.39, .46, .50, .57, .56	.33, .40, .42, .48, .40
8. Orientation - mastery	.02, .16, .13, .19, .25	.27, .27, .34, .31, .36	.36, .34, .46, .40, .47	-.06, -.01, .08, .00	.20, .18, .22, .24, .17	.32, .40, .37, .39, .36
9. Orientation - performance	.05, .16, .17, .21, .28	.14, .17, .21, .22, .26	.02, -.04, .01, .06, .02	.02, -.03, -.04, .01	.03, -.04, -.04, -.03, -.07	.32, .22, .25, .29, .22
10. Perceived success - specific	.20, .43, .43, .36, .51	.34, .38, .38, .36, .42	.22, .14, .25, .29, .28	-.09, -.04, -.03, .04	.13, .14, .12, .17, .07	.27, .25, .26, .32, .31
11. Perceived success - global	.28, .46, .48, .40, .53	.12, .07, .16, .25, .29	.12, .07, .16, .25, .29	.04, -.01, -.04, .02	.06, .06, .05, .12, .07	.18, .28, .27, .33, .34
12. Expectations - specific	.31, .45, .47, .50, .66	.22, .40, .45, .43, .51	.04, .03, .13, .12, .14	-.06, -.06, -.08, .06	-.01, -.01, -.04, .01, -.03	.18, .32, .29, .31, .33
13. Expectations - global	.11, .27, .28, .36, .46	.25, .39, .48, .41, .46	.21, .21, .25, .29, .30	.02, -.03, -.07, .08	.06, .08, .09, .14, .12	.28, .42, .35, .40, .39
14. Value - importance	.18, .23, .21, .28, .35	.37, .35, .39, .43, .43	.05, .02, .10, .10, .09	-.02, -.05, .02, .05	.01, -.03, -.04, .01, -.01	.33, .26, .28, .32, .30
15. Value - intrinsic motivation	.17, .30, .27, .28, .38	.37, .40, .41, .42, .44	.17, .17, .25, .32, .30	-.04, .02, -.01, .05	.06, .06, .07, .10, .05	.27, .31, .28, .37, .36
16. Enjoyment	-.06, .13, .10, .17, .13	.15, .17, .26, .22, .26	.37, .34, .36, .40, .37	.00, .04, -.04, .08	.23, .11, .19, .19, .12	.28, .23, .29, .30, .22
17. Anxiety	-.34, -.28, -.27, -.22, -.25	-.35, -.47, -.46, -.48, -.48	-.04, -.07, .00, .01, -.02	-.01, -.06, .05, .03	-.02, -.11, -.05, -.01, .05	-.09, -.25, -.21, -.19, -.23
18. Boredom	-.23, -.33, -.28, -.22, -.30	-.28, -.36, -.36, -.46, -.43	-.11, -.11, -.08, -.15, -.16	-.02, -.10, .00, .01	.01, .05, .02, .02, .03	-.14, -.21, -.19, -.22, -.26
19. Health - global	.09, .10, .07, .06, .06	.11, .14, .17, .15, .19	.11, .14, .17, .15, .19	.02, -.02, .09, -.00	.16, .12, .12, .14, .07	.25, .25, .23, .25, .20
20. Health - illness symptoms	-.07, -.08, -.10, -.09, -.06	-.05, -.15, -.19, -.23, -.21	-.13, -.11, -.07, -.13, -.12	-.09, -.09, .01, .00	-.11, -.01, .00, -.10, -.10	-.08, -.14, -.09, -.18, -.13
21. Stress	-.05 / -.07	-.17 / -.31	-.15 / -.13	-.05 / .04	-.14 / -.09	-.09 / -.16
22. Depression	-.18 / -.18	-.35 / -.50	-.11 / -.22	-.03 / .01	-.13 / -.13	-.18 / -.32
23. Self-esteem	.19 / .16	.36 / .46	.19 / .28	.03 / -.02	.18 / .19	.24 / .30

	7	8	9	10	11	12
1. Test performance						
2. Primary control (PC)						
3. Secondary control (SC)						
4. OEC						
5. RCA: PC-to-SC						
6. RCA: SC-to-PC						
7. RCA: Both	–					
8. Orientation - mastery	.25, .28, .28, .31, .27	–				
9. Orientation - performance	.08, .14, .17, .16, .15	.27, .25, .30, .31, .25	–			
10. Perceived success - specific	.23, .18, .24, .32, .22	.36, .34, .36, .37, .43	.19, .16, .24, .29, .40	–		
11. Perceived success - global	.14, .20, .23, .31, .23	.25, .22, .27, .32, .39	.21, .13, .15, .22, .27	.55, .72, .80, .79, .76	–	
12. Expectations - specific	.11, .16, .23, .24, .16	.11, .26, .32, .31, .35	.28, .32, .34, .35, .47	.35, .42, .51, .54, .60	.36, .52, .57, .64, .69	–
13. Expectations - global	.12, .22, .25, .28, .24	.26, .38, .39, .36, .43	.35, .33, .38, .32, .39	.44, .39, .53, .60, .68	.33, .43, .55, .67, .72	.53, .60, .66, .66, .68
14. Value - importance	.17, .15, .24, .25, .25	.27, .27, .37, .35, .31	.57, .61, .63, .67, .73	.32, .23, .31, .37, .49	.26, .21, .26, .31, .37	.23, .36, .43, .42, .51
15. Value - intrinsic motivation	.23, .15, .25, .29, .26	.46, .42, .52, .45, .53	.39, .31, .37, .37, .44	.46, .40, .47, .55, .64	.34, .35, .41, .50, .53	.20, .36, .47, .45, .54
16. Enjoyment	.20, .14, .24, .26, .19	.52, .52, .56, .60, .54	.22, .21, .25, .27, .29	.35, .34, .34, .39, .40	.36, .33, .33, .29, .35	.19, .23, .26, .29, .30
17. Anxiety	-.09, -.13, -.11, -.10, -.06	-.14, -.08, -.06, -.07, -.12	.08, .08, .05, .02, -.04	-.32, -.39, -.30, -.27, -.27	-.15, -.25, -.22, -.24, -.36	-.15, -.29, -.27, -.30, -.39
18. Boredom	-.16, -.08, -.15, -.18, -.16	-.27, -.28, -.32, -.33, -.37	-.10, -.10, -.16, -.26, -.27	-.36, -.37, -.34, -.39, -.43	-.22, -.24, -.25, -.29, -.40	-.16, -.24, -.30, -.33, -.44
19. Health - global	.09, .12, .12, .17, .12	.16, .15, .17, .17, .16	.14, .03, .00, -.02, .07	.35, .29, .30, .23, .23	.25, .23, .21, .21, .24	.19, .18, .18, .20, .19
20. Health - illness symptoms	-.08, -.06, -.07, -.13, -.12	-.11, -.12, -.05, -.09, -.07	-.02, .04, .03, -.01, -.03	-.22, -.26, -.21, -.21, -.18	-.20, -.19, -.17, -.21, -.23	-.20, -.13, -.13, -.23, -.17
21. Stress	-.05 / -.07	-.17 / -.11	.05 / .06	-.26 / -.16	-.16 / -.19	-.17 / -.17
22. Depression	-.07 / -.15	-.18 / -.23	-.01 / -.10	-.39 / -.35	-.25 / -.36	-.17 / -.29
23. Self-esteem	.12 / .16	.17 / .25	.00 / .11	.39 / .35	.21 / .39	.13 / .27

	13	14	15	16	17	18
1. Test performance						
2. Primary control (PC)						
3. Secondary control (SC)						
4. OEC						
5. RCA: PC-to-SC						
6. RCA: SC-to-PC						
7. RCA: Both						
8. Orientation - mastery						
9. Orientation - performance						
10. Perceived success - specific						
11. Perceived success - global						
12. Expectations - specific						
13. Expectations - global	–					
14. Value - importance	.36, .45, .48, .38, .47	–				
15. Value - intrinsic motivation	.37, .43, .50, .46, .56	.56, .54, .57, .55, .60	–			
16. Enjoyment	.36, .33, .33, .29, .35	.27, .25, .34, .32, .28	.50, .53, .56, .58, .61	–		
17. Anxiety	-.15, -.25, -.22, -.24, -.36	-.08, -.06, -.13, -.16, -.16	-.15, -.18, -.16, -.19, -.23	-.01, -.02, .02, .03, -.01	–	
18. Boredom	-.22, -.24, -.25, -.29, -.40	-.25, -.25, -.33, -.37, -.41	-.57, -.60, -.62, -.64, -.70	-.34, -.37, -.35, -.38, -.42	.35, .43, .47, .46, .44	–
19. Health - global	.25, .23, .21, .21, .24	.08, .11, .05, .07, .07	.13, .17, .12, .09, .12	.14, .10, .06, .08, .13	-.31, -.31, -.29, -.31, -.31	-.14, -.19, -.13, -.13, -.08
20. Health - illness symptoms	-.20, -.19, -.17, -.21, -.23	.07, .01, -.02, -.09, .02	.01, -.05, -.03, -.06, -.08	-.04, -.03, -.02, -.02, .00	.31, .39, .37, .36, .37	.12, .20, .17, .13, .11
21. Stress	-.16 / -.19	.08 / .03	-.07 / -.05	-.04 / -.03	.44 / .42	.16 / .12
22. Depression	-.25 / -.36	-.05 / -.18	-.18 / -.25	-.09 / -.11	.49 / .51	.33 / .27
23. Self-esteem	.21 / .39	.08 / .21	.18 / .26	.15 / .18	-.47 / -.45	-.26 / -.22

	19	20	21	22	Test-retest
1. Test performance					.82, .83, .78, .55
2. Primary control (PC)					.71, .77, .75, .79
3. Secondary control (SC)					.69, .69, .70, .75
4. OEC					-.32, -.40, -.46
5. RCA: PC-to-SC					.64, .65, .71, .75
6. RCA: SC-to-PC					.56, .65, .65, .65
7. RCA: Both					.55, .63, .65, .69
8. Orientation - mastery					.71, .73, .72, .75
9. Orientation - performance					.71, .77, .74, .77
10. Perceived success - specific					.46, .65, .75, .74
11. Perceived success - global					.54, .71, .81, .81
12. Expectations - specific					.67, .81, ..85, .87
13. Expectations - global					.68, .73, .73, .70
14. Value - importance					.69, .70, .74, .76
15. Value - intrinsic motivation					.69, .67, .76, .77
16. Enjoyment					.68, .72, .75, .79
17. Anxiety					.76, .75, .81, .82
18. Boredom					.70, .74, .76, .81
19. Health - global	–				.74, .80, .74, .73
20. Health - illness symptoms	-.43, -.51, -.52, -.51, -.51	–			.72, .76, .72, .71
21. Stress	-.46 / -.46	.60 / .59	–		.57
22. Depression	-.62 / -.56	.60 / .60	.68 / .64	–	.72
23. Self-esteem	.59 / .47	-.42 / -.36	-.56 / -.51	-.73 / -.74	.81

Note. ■ = more positive / less negative, ■ = more negative / less positive, ▤ = stable, ▥ = fluctuating / curvilinear, □ = weak, nonsignificant, or not applicable. $p < .10$ for $|r| > .08$ (Time 1), .07 (Times 2-5). $p < .05$ for $|r| > .10$ (Time 1), .08 (Times 2-4), .09 (Time 5).

*OEC correlations are with preceding tests, scales from the preceding phase, and between the first/last OEC and Time 1/5 of measures 21-23.

Appendix G

Fit Indices for SEM Analyses

Figure no.	CFI	TLI	RMSEA
1	N/A	N/A	N/A
2	.88	.86	.05
3	.80	.77	.07
4	.70	.66	.08
5	.85/.89/.89/.88	.81/.87/.87/.85	.05/.05/.05/.06
I1	N/A	N/A	N/A
I2	.67	.59	.09
I3	.81	.79	.04
J1	.88	.87	.04
J2	.87	.86	.04
K1	.85/.89/.89/.88	.81/.87/.87/.85	.05/.05/.05/.06
K2	.85/.90/.91/.89	.85/.88/.88/.86	.05/.05/.05/.06
K3	.89/.88/.88/.88	.85/.84/.85/.84	.05/.06/.06/.06
L1	.83/.88/.88/.84	.80/.86/.85/.81	.06/.05/.05/.06
L2	.85/.89/.88/.88	.82/.87/.86/.86	.04/.05./05./05
L3	.81/.84/.85/.84	.78/.82/.82/.81	.06/.06/.06/.06
L4	.85/.87/.87/.87	.83/.85/.86/.85	.04/.05./05./05
L5	.87/.90/.90/.89	.85/.88/.88/.87	.04/.04/.04/.05
L6	.86	.84	.05
M1	.69	.64	.06
M2	.69	.65	.07
M3	.70	.67	.06
M4	.71	.67	.07
M5	.68	.64	.07
M6	.66	.63	.06
M7	.70	.67	.06
M8	.73	.70	.06
M9	.68	.64	.07
M10	.79	.74	.06
M11	.79	.75	.07
M12	.75	.71	.06

Note. Forward slashes separate fit indices for consecutive phase-specific models.

Appendix H

Supplemental Rationale for SEM Analyses

Rationale for correlated errors. As recommended by Marsh and Hau (1996), all cross-lagged panel SEM models were first evaluated including all correlations between the error terms for the same scale items to control for systematic measurement error (e.g., between the error terms for the first and second assessments of the first PC item, between the error terms for the second and third assessments of the first PC item, etc., for each item of each study measure). However, for the sake of model parsimony and because many of these paths were not significant, all nonsignificant correlations ($p > .10$) between the error terms among the main variables or covariates were removed. For the same reasons, correlations between the covariates and main variables in the cross-panel analyses that were not significant at $p < .10$ were also removed. Nonsignificant correlations among the error terms and between the covariates and main variables were removed in an iterative fashion in that, following the initial removal of nonsignificant correlations, the model was repeatedly analysed and re-run until no nonsignificant correlation paths remained. The residuals for the test performance variables were not correlated with each other in the cross-lagged panel analyses because although students did complete each test in a multiple choice format, test items varied from one test to the next (in contrast, the content of the scale items was identical in each phase).

Rationale for covariates. With respect to what covariates were included, test performance was controlled for in SEM analyses assessing the multiplicative OEC scores (unless otherwise indicated) to ensure that the OEC x test performance variable did not

primarily represent performance but rather the extent to which individuals shifted their emphasis between PC and SC over time in congruence with actual performance outcomes. Including test performance as a covariate in analyses on muliplicative OEC is equivalent to including the main effect of a variable in regression analyses so as to more accurately evaluate the significance of a multiplicative interaction based on that measure (i.e., statistically removing this *confound effect*). Consistent with previous research from this laboratory in which control processes are examined controlling for academic performance (Perry et al., 2005), correlations were also included between the test performance covariates and the other latent variables in order to control for potential aptitude differences. Because the correlations between test performance and the multiplicative OEC scores did not indicate multicollinearity (*r*s < .30), the OEC measures were not transformed (i.e., mean centered) before being included in the SEM analyses below. Also, because the multiplicative OEC scores do not represent a typical interaction in that they are not comprised of two measured variables but one measured variable and a difference score, including both primary and secondary control as covariates in each analysis to control for their confounding main effects was not required.

Nevertheless, primary and secondary control were included as covariates in the cross-lagged panel SEM analyses (unless otherwise indicated) in order to control for *ceiling effects* observed in the analyses below (i.e., Hypotheses 2 and 3) showing that those high in PC or SC were less likely to subsequently switch to that control process. When assessed as a covariate, primary control was represented by two parcelled manifest variables consisting of the positively-worded (items 1, 2, 5, and 9) and negatively-

worded PC items respectively (items 3, 4, 6-8, 10). This decision was based on factor analyses conducted in each phase consistently showing these groups of items to fall into these two factors, and was done in order to significantly reduce the number of parameters to be estimated (reducing 10 manifest PC variables per phase to 2) and allow the model to iterate in a more timely manner. Secondary control was assessed both as a main variable and covariate using all scale items as manifest variables. Finally, based on the suggestions of Finkel (1995), the covariates included in the cross-lagged panel analyses did not simply consist of initial levels of PC, SC, or test performance, they included the covariate variable from each phase of the study (and Tests 1 through 4), with each covariate variable predicting the next of the same and the covariate item errors (i.e., for PC and SC) correlated with the next of the same.

Thus, although not presented in the figures below, the cross-lagged models included (a) the autoregressive paths between each assessment of the covariate, (b) correlations between the error terms of the same items both for the main variables and covariates, (c) direct paths from PC and/or SC to the appropriate multiplicative OEC score (e.g., Time 1 PC to Time 1-2 OEC), (d) correlations between the covariates within each phase (e.g., Time 1 PC with Time 1 SC), and (e) correlations between the covariates and main variables within each phase (e.g., Time 1 PC with Time 1 enjoyment). An exception to this last set of correlations was test performance (Tests 1-4) which although was correlated with the appropriate OEC variable in each phase (e.g., Test 1 with Time 1-2 OEC), was correlated with the latent main and covariate variables from the subsequent phase (e.g., Test 1 with Time 2 PC, Test 1 with Time 2 enjoyment). Test performance

was also correlated with the latent variable covariates from the subsequent phase in SEM analyses of Hypothesis 1 where performance was not a covariate but a main variable. Because the first phase of the study occurred before Test 1 and Test 5 occurred after the study was complete, only Tests 1 through 4 were assessed as covariates. Thus, correlations between the Test 1 covariate and Time 1 levels of the main and covariate latent variables were also included in order to assess these Time 1 measures with test performance controlled for. Once again, all nonsignificant ($p > .10$) correlations between item errors and involving covariates were subsequently removed.

Rationale for parcelling and regression analyses. Just as the primary control measure was parcelled to reduce the number of parameters to be estimated as well as model estimation time, the illness symptoms and depression measures were also assessed using parcels comprising multiple survey items. It should be noted that in addition to making the large-scale models more parsimonious, parcels have also been shown to have a stronger relationships with latent variables, more likely to meet assumptions of normality, and be less affected by method effects (Marsh, Hau, Balla, & Grayson, 1998; see also Landis, Beal, & Tesluk, 2000). Items in the depression and symptom scales were parcelled based on numerical order as they respectively comprised two highly reliable, unidimensional scales (depression αs = .93-.94; symptoms αs = .82-.87) that unlike the primary control items, could not be grouped based on factor analyses. First, due to depression being the longest study measure consisting of 17 items, the scale items in both the phase-specific and cross-lagged panel SEM models were grouped into 6 parcels based on numerical order (Parcel 1 = items 1-3, Parcel 2 = items 4-6, ..., Parcel 6 = items 16-

17). Second, although illness symptoms were assessed in the phase-specific SEM analysis using all 8 items, scale items were parcelled into two groups based on numerical order when symptoms were assessed in combination with global health in the cross-lagged panel analyses (Parcel 1 = 1-4, Parcel 2 = 5-8).

Finally, because cross-lagged panel SEM analyses with test performance as the dependent measure (i.e., Tests 2-5; controlling for PC and SC) resulted in significant yet unusually low Beta weights (e.g., $\beta = .03$, $p < .05$) for the paths between the main variables, as well as a lack of fit indices (due to the inclusion of too many manifest variables), regression analyses on each test performance outcome were conducted controlling for PC, SC, and previous test performance with the directional, multiplicative OEC scores as predictors in order to obtain more accurate Beta weights for the OEC variables.

Figure information. In each figure, Beta values significant at $p < .05$ are bolded and paths with at least one significant value are also bolded. Grey values indicate that the Beta weight was not significant at $p < .05$ and dashed lines represent paths where no Beta value was significant. Paths significant at $p < .10$ are noted in the text below. Error terms, correlations, and covariates are not presented in the figures in order to minimize visual complexity and allow the hypothesized causal relationships to be more clearly depicted.

In the figures for phase-specific SEM analyses (i.e., not cross-lagged), Beta values for each phase are separated by a forward slash (Times 1 / 2 / 3 / 4), the OEC variables represent the four difference scores assessed (Times 1-2 / 2-3 / 3-4 / 4-5), and the final adjustment measures (Hypotheses 4 and 5) are assessed in the phase following

that of the PC, SC, and RCA measures. For example, one fully mediated path in a model assessing adjustment would be from PC (Time 1) to RCA - Both (Time 1) to RCA - PC to SC (Time 1) to OEC - SC to PC (Time 1 to 2) to mastery orientation (Time 2). In the figures depicting the cross-lagged panel model results from supplemental analyses in Appendix I conducted separately for low vs. high RCA groups, path coefficients for the *low RCA group* are presented *above* the horizontal paths and to the *left* of vertical or diagonal paths. Conversely, path coefficients for the *high RCA group* are indicated *below* horizontal paths and to the *right* of vertical or diagonal paths. Finally, figures for the last set of cross-lagged panel analyses on outcome measures for Hypothesis 6 also showed the results for the *low vs. high RCA group* on the *top vs. bottom* of horizontal paths and to the *left vs. right* of vertical or diagonal model paths, respectively.

Appendix I

Supplemental RCA Moderation Analyses

Test performance and OEC. Whereas analyses of Hypotheses 2 and 3 revealed that the Both RCA subscale mediated the influence of PC and especially SC on the directional RCA subscales, it was expected that this bidirectional RCA measure should moderate the causal relationships between test performance and the original OEC scores proposed in Hypothesis 1. More specifically, it was anticipated that individuals having a greater perceived ability to switch back and forth between PC and SC should demonstrate stronger congruent shifts in emphasis between these control processes in response to their test performance throughout the year. To examine this hypothesis, the model presented in Figure 1 was assessed separately for students reporting low vs. high levels on the Both RCA subscale, with this low/high classification based on a median split of the Time 5 Both RCA measure due to it being the final and most reliable measure of students' bidirectional switching capacity (Low RCA: $M = 13.22$, $SD = 1.97$, Range = 4-15; High RCA: $M = 17.71$, $SD = 1.59$, Range = 16-21; $t(452) = 26.74$, $p < .001$).

The results of the present analysis for both the low RCA group (top/left values) and high RCA group (bottom/right values) are presented in Figure I1. As in the previous cross-lagged panel analysis, PC and SC were included as covariates and no fit indices were obtained due all main variables being manifest as opposed to latent in nature. Also, in order to maintain model consistency when assessing the two groups, correlation paths between item errors and involving covariates were removed only if the path was not significant for both groups. That is, if one such correlation was significant for the low

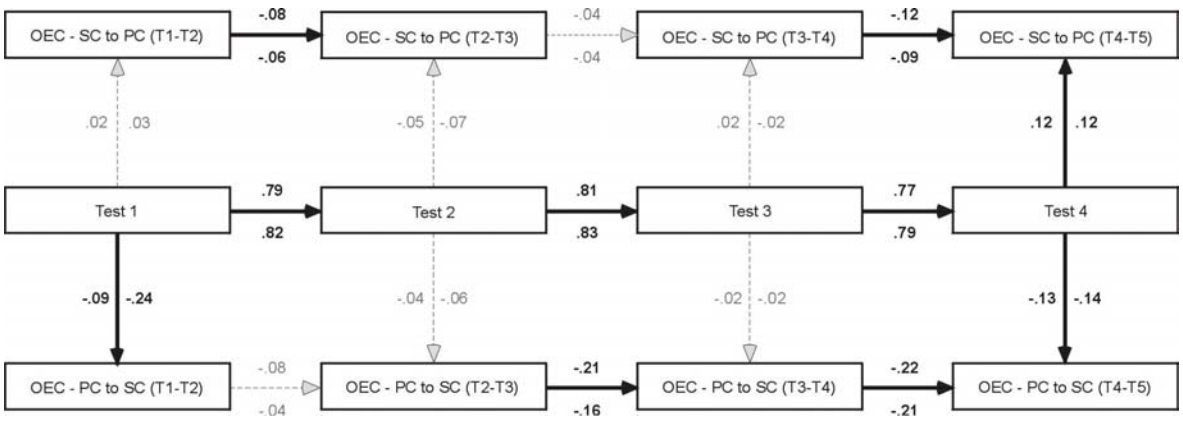


Figure I1. Causal Analysis of Test Performance and OEC for Low/High "Both" RCA Groups.

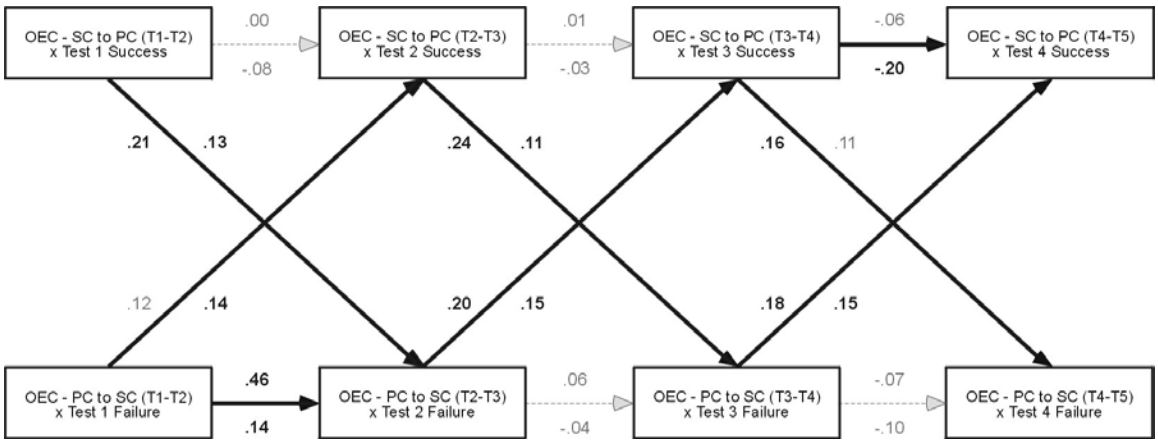
RCA group but nonsignificant for high RCA individuals, it was retained so as to evaluate the same model for both groups. This same rationale was employed in all subsequent analyses on the OEC, RCA, and dependent measures in which the low and high RCA groups were compared.

Results of this analysis showed that, similar to the previous findings, both the low and high RCA individuals showed significant shifts in emphasis from PC to SC following poor performance on Tests 1 and 4. However, this analysis also revealed two intriguing findings in showing (a) that the high-RCA individuals were almost *three times* more likely to switch from PC to SC if they performed poorly on Test 1, and (b) that both groups were also found to demonstrate a significant shift from SC to PC if they performed well on Test 4. Therefore, these results provide partial support for our hypothesis in showing that those who perceived themselves as better able to switch

actually showed a greater capacity to shift from PC to SC early in the academic year, and also further support the use of both the multiplicative PC-to-SC x Failure and SC-to-PC x Success OEC variables in the preceding and subsequent analyses.

Directional OEC measures. Whereas the above analyses concerned only how low vs. high RCA individuals switched between PC and SC in response to test performance, a second supplemental analysis examined how both groups switched from making congruent shifts in one direction (e.g., PC to SC after poor performance on Test 1) to making congruent shifts in the other direction (e.g., SC to PC after success on Test 2). In this analysis, a cross-lagged panel model was assessed in which each multiplicative OEC term predicted the next of the same and of the other OEC variable, controlling for all PC, SC, and test performance measures. Although this model including both the low and high Both RCA groups provided a mediocre fit to the data, the results showed that both groups of students shifted from increasing their emphasis on PC after success to increasing their emphasis on SC after poor performance, and vice versa, throughout the academic year. The results for this analysis are presented in Figure I2.

Nevertheless, these findings also showed an intriguing pattern of results for the low vs. high RCA groups. First, the low-RCA group was noticeably more likely to switch from increasing their emphasis on PC to focussing more on SC if their performance decreased from either Test 1 to 2 or from Test 2 to 3. In contrast, although the high-RCA group had relatively lower and more consistent cross-path values (e.g., the path from SC-to-PC OEC after Test 3 to PC-to-SC OEC after Test 4 was significant only at $p < .10$),



these students were more likely to shift from focussing on SC following poor *Figure I2.* Causal Analysis of Multiplicative OEC Measures for Low/High "Both" RCA Groups.

performance on Test 1 to increasing their emphasis back to PC if they did well on Test 2 (this path for low-RCA students was not significant). This analysis also revealed that the high-RCA group was less likely than the low-RCA group to keep switching to the same control strategy when faced with repeatedly poor or positive performance outcomes. That is, the low-RCA group was over three times more likely to continue to switch toward SC if they performed poorly on both Tests 1 and 2, and only the high-RCA group was significantly less likely to continue to shift toward PC if they performed the same or poorer on Tests 3 and 4.

These results suggest that those who reported being able to switch between PC and SC in congruence with course performance actually showed more adaptive changes in congruent emphasis shifts than did other students. Students with high RCA levels were less likely than low-RCA students to switch from focussing on PC to increasing their

emphasis on SC if their grades decreased early in the first academic semester. Moreover, students reporting higher RCA levels were also more likely than low-RCA students to refocus their efforts from increased emphasis on SC to increased emphasis on PC if their grades improved. Considering that performance is "most fostered by primary control and most jeopardized by secondary control" (p. 29; Rothbaum et al., 1982), with PC being most adaptive early in the control-striving process and SC most beneficial after repeated failure experiences, that high-RCA students were less likely to turn to SC after one or two poor test scores but more likely to switch back to PC after performing well highlights the potential performance implications of this RCA subscale to be assessed in subsequent analyses.

This analysis also demonstrates that high-RCA students were considerably less likely than low-RCA students to keep switching toward SC if their performance did not change or improved, and were also less likely to keep increasing their emphasis on PC if their grades stayed the same or declined. This important finding indicates that students with higher levels on the Both RCA subscale were actually better able than those with lower scores on this measure to notice when their performance remained unchanged or was contrary to their previous performance and respond to this outcome by not continuing to switch in that direction. Taken together, this supplementary analysis further illustrates the academic importance of the higher-order perceived ability to switch back and forth between PC and SC in showing that those who believe they can do so are actually better able early in the academic year to increase their emphasis on the complimentary control process and decrease their overemphasis on the same control

process in congruence with changes (and stability) in test performance.

Directional RCA subscales. A third supplemental analysis involving RCA moderation effects, the causal relationships between the directional RCA subscales were assessed for students with low vs. high Both RCA levels to test for different patterns of causality between perceptions of being able to switch in one direction vs. the other. As such, a cross-lagged panel model including the latent directional RCA subscales from each phase was conducted with results presented in Figure I3. Whereas PC and SC were included as covariates to ensure that the RCA measures reflected the perceived ability to switch toward a control process and not simply having higher or lower levels of that process, test performance was not controlled for as it was only weakly correlated with each RCA subscale in each study phase (*M* of *r*s with PC-to-SC = -.11; *M* of *r*s with SC-to-PC = .14).

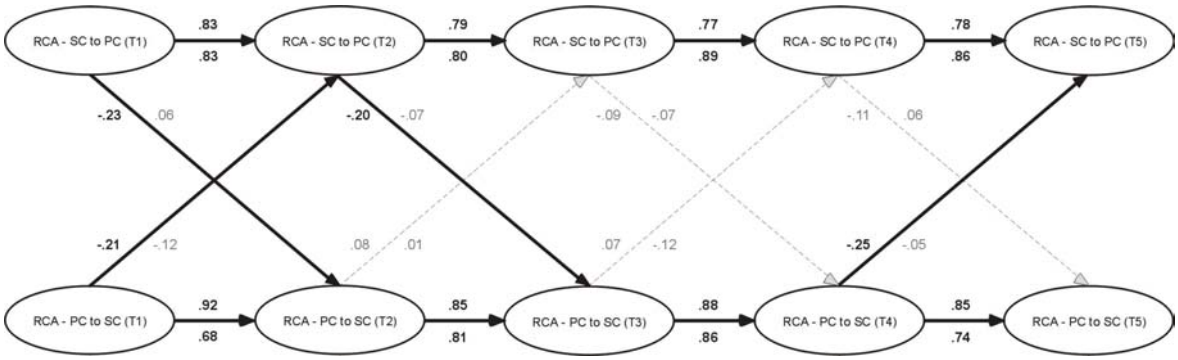


Figure I3. Causal Analysis of Directional RCA Measures for Low/High "Both" RCA Groups.

Results of this analysis showed significant cross-paths only for the low-RCA group, with the perceived ability to switch from PC to SC at Times 1 and 4 negatively predicting subsequent SC-to-PC RCA levels, and higher levels of SC-to-PC RCA in Times 1 and 2 negatively predicting subsequent PC-to-SC RCA levels. This intriguing set of findings illustrates that students who felt less able to switch back and forth between PC and SC demonstrated an "either/or" approach concerning the more specific, directional RCA measures, with half of the cross-path coefficients for this group showing if they believed that they could switch in one direction (e.g., SC to PC with success), they were less likely to think they could shift their emphasis in the reverse direction if their performance changed (e.g., PC to SC with failure). In contrast, *no significant cross-paths were observed for students with high levels on the Both RCA measure*, a finding that clearly shows that for students who believe they can adaptively shift their emphasis between PC and SC based on their performance, believing one can shift in one direction does not compromise the belief that one can switch back in congruence with changes in course grades. In sum, the supplemental cross-panel SEM analyses examining the moderation effects of the Both RCA subscale provide further support for the higher-order nature of this self-report measure with respect to not only the observed but also perceived ability to switch back and forth in response to actual performance outcomes.

Appendix J

Supplemental Cross-lagged Panel SEM Analyses

Primary and secondary control. Before examining the interrelationships between the measures of PC, SC, RCA, and OEC proposed in Hypotheses 2 through 5, preliminary analyses assessing the causal ordering of these constructs were conducted to establish the nature of the causal relationships between these measures and constructing subsequent analytical models that most accurately represented the patterns of causality observed in the present data. Although no direction of causality was proposed concerning primary and secondary control, the pattern of correlations, mean change analyses, and phase-specific SEM results suggested that secondary control may act as a back-up to primary control and serve to bolster future primary control levels, a premise consistent with the model of primary/secondary control proposed by Heckhausen and Schulz (1995). In examining the validity of this interpretation and potential implications for causal ordering of these measures in subsequent analyses, a cross-lagged panel model including only SC (all items) and PC (parcelled) from each phase was assessed, with each construct predicting the other and the same in the next phase.

Results showed that the model fit the data well (CFI = .92, TLI = .90, RMSEA = .06) and also showed strong and significant autoregressive paths between each of the PC measures (βs = .81-.86) and SC measures (βs = .85-.98). However, this analysis revealed only one significant and *negative* path from secondary to primary control from Time 3 to Time 4 (β = -.08, $p < .05$). This finding that all except one cross-path was non-significant and that SC negatively, albeit weakly, predicted future PC levels does not provide

support for causal ordering of the control measures based on Heckhausen's developmental model (i.e., SC to PC). It should be noted, however, that although this causal analysis did not provide evidence of causality, it may not have been as sensitive as the phase-specific SEM analyses in detecting how secondary control predicts a greater *relative emphasis toward primary control* over time. Nonetheless, based on this causal analysis, the relationship between primary and secondary control in subsequent analyses was not modelled in a directional manner but instead as a nondirectional correlation.

RCA subscale hierarchy. Because of the birdirectional nature of the Both RCA subscale in constrast to unidirectional nature of the PC-to-SC and SC-to-PC RCA measures, it was possible that the Both subscale predicted the directional subscales in a hierarchical manner, with the perceived ability to switch back and forth between PC and SC predicting the more specific perceptions of being able to switch one way vs. the other. As such, two cross-lagged panel models investigating the causal ordering of the bidirectional and two unidirectional RCA subscales were assessed in order to most accurately represent the interrelationships between these variables in subsequent analyses. These models controlled for both PC and SC but not test performance, because (a) performance was only weakly correlated with the three RCA measures and (b) the multiplicative OEC scores were not included in this analysis. Aside from the afore-mentioned correlations involving covariates and item errors, correlations were also included between the two RCA variables within each phase in accordance with the significant correlations observed between these variables in each study phase (*r*s = .33 - .57).

The results for the SC to PC RCA subscale are presented in Figure J1. As found in previous analyses, strong auto-regressive paths were found between the RCA subscales, with stronger path coefficients observed between the Both RCA subscale measures. Concerning the cross-paths of interest, only a significant positive path from Time 1 Both RCA to Time 2 SC-to-PC RCA and a significant, albeit weaker, negative path from Time 4 SC-to-PC RCA to Time 5 Both RCA were found. Thus, although the perceived ability to shift from SC to PC led students to feel slightly less able to switch back and forth between PC and SC near the end of the academic year, a stronger positive causal path was observed at the start of the year from higher-order perceptions of one's ability to switch bidirectionally to the more specific SC-to-PC RCA subscale. Similar results were found for the PC to SC RCA subscale as outlined in Figure J2.

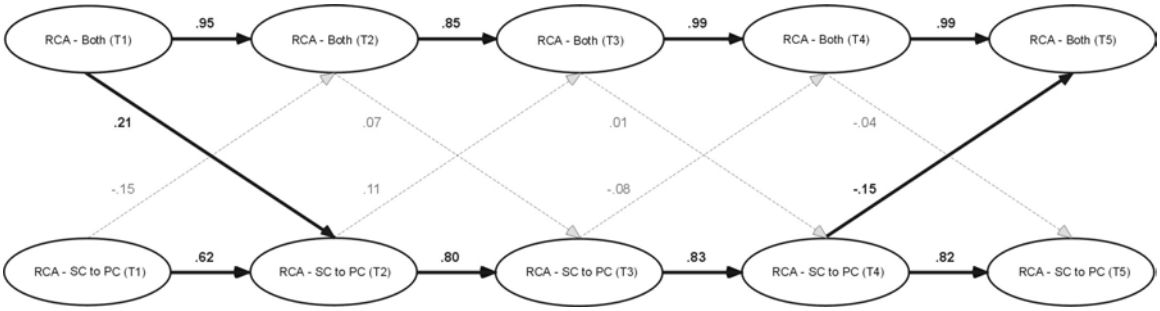


Figure J1. Causal Analysis of "Both" RCA and SC-to-PC RCA Subscale.

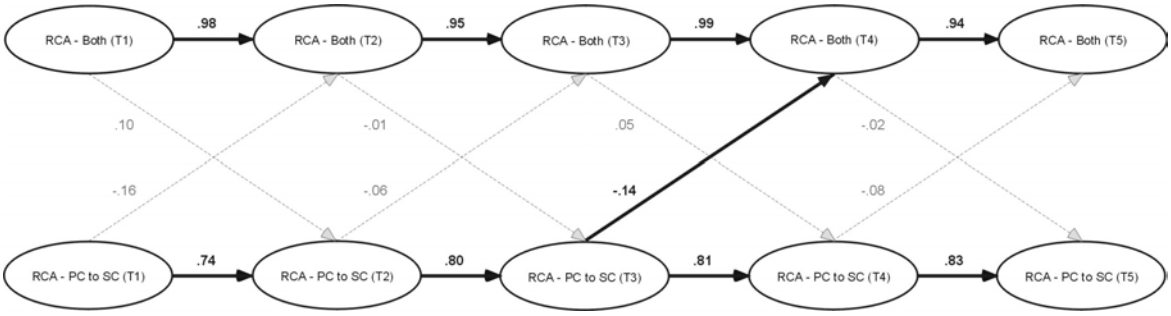


Figure J2. Causal Analysis of "Both" RCA and PC-to-SC RCA Subscale.

Whereas PC-to-SC RCA negatively predicted Both RCA in the second semester, the strongest positive path ($\beta = .10$, ns) was once again observed from Both RCA at Time 1 to PC-to-SC RCA at Time 2. Therefore, the present cross-lagged panel models provide preliminary evidence in support of the hierarchical structure of the RCA subscales, in showing the Both RCA subscale to not only be more be more consistent over time than the directional subscales, as would a higher-order construct, but also to more strongly and positively predict these two subscales as opposed to vice versa.

Appendix K

Supplemental Phase-specific SEM Analyses

Non-hierarchical RCA model. A non-hierarchical version of the comprehensive SEM model in Figure 5 was also conducted including PC, SC, the three RCA subscales, and two OEC measures. This model, presented in Figure K1, was similar to the first but replaced the directional paths from the Both RCA subscale to the directional RCA subscales with correlations and included direct paths from the Both RCA subscale to the OEC measures. Despite comparable findings, only the hierarchical model is discussed in the Results section for three reasons. First, the hierarchical model more accurately reflects the causal ordering of the bidirectional and unidirectional RCA subscales

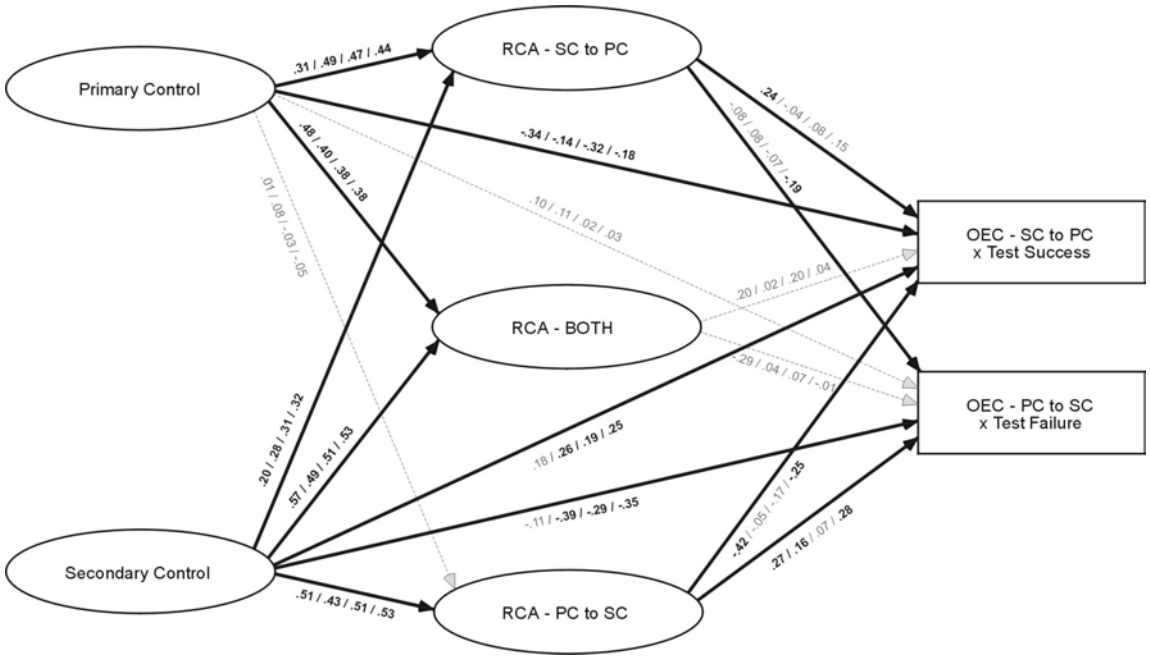


Figure K1. Phase-specific Analyses of PC, SC, RCA (Non-hierarchical), and OEC Measures.

indicated in supplementary cross-lagged panel analyses (Appendix G). Second, fit indices for both models were identical in each phase, thus supporting the adoption of the more parsimonious hierarchical model. Finally, despite earlier findings to the contrary, no paths from the Both subscale to either OEC measure were found to be significant.

RCA subscale-specific models. To further explore the phase-specific validity of the RCA subscales, specifically the "Both" RCA measure which was significant in an earlier cross-lagged panel model (Figure 4) but not in the preceding analysis (Figure K1), follow-up analytical models assessed the bidirectional and unidirectional subscales separately. Incorporating the same model and covariates (test performance) as in the previous section, the SEM analyses assessing the PC-to-SC and SC-to-PC RCA subscales together and the Both RCA measure alone are presented in Figures K2 and K3, respectively. The model including only the unidirectional RCA subscales showed a

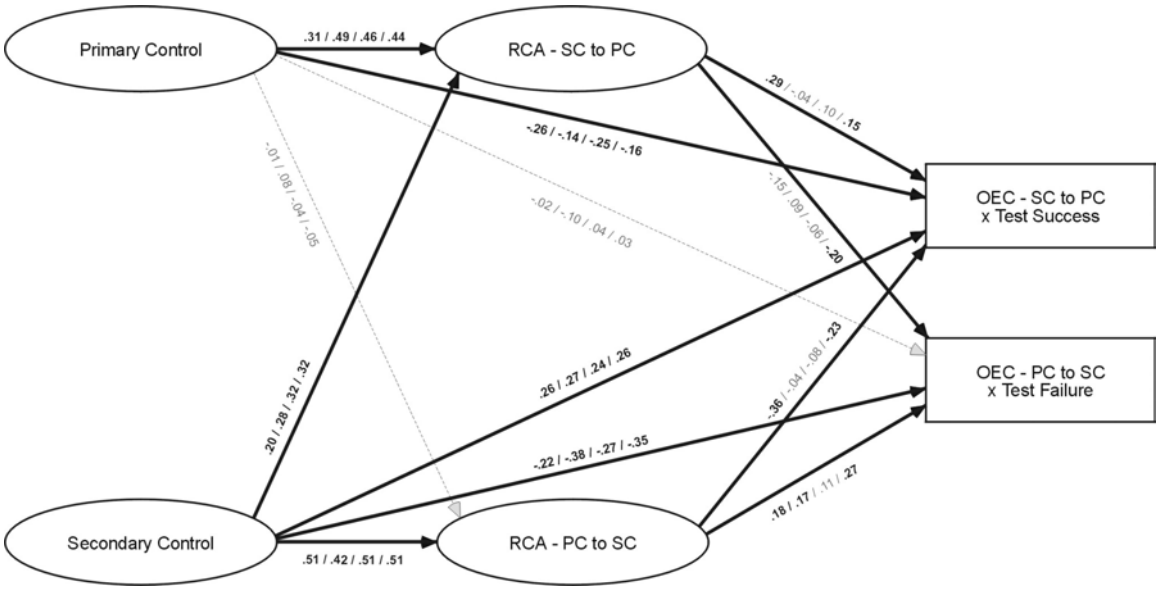


Figure K2. Phase-specific Analyses of PC, SC, RCA (Directional), and OEC Measures.

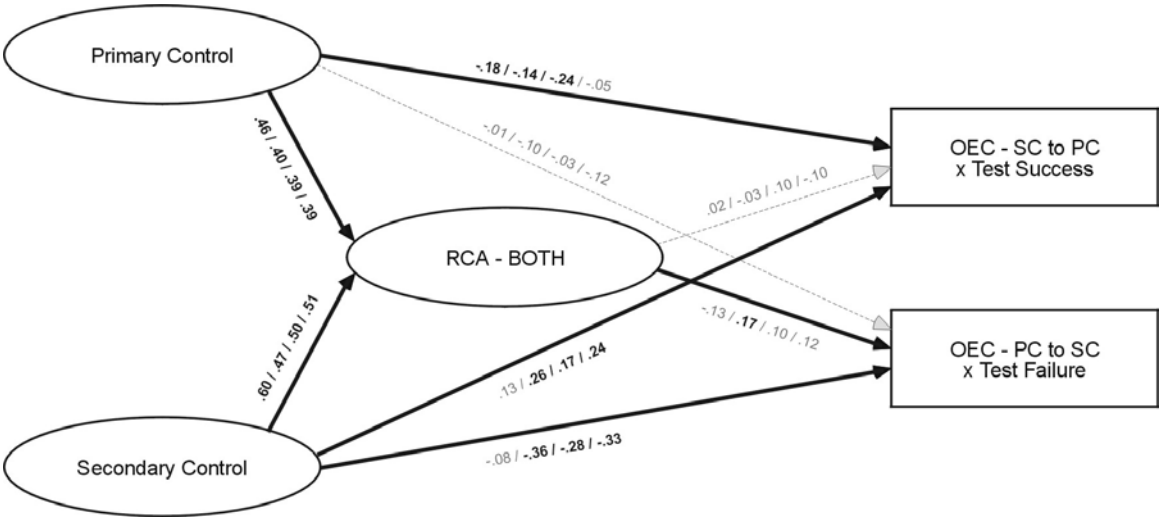


Figure K3. Phase-specific Analyses of PC, SC, RCA (Bidirectional), and OEC Measures.

pattern of results similar to that found in the non-hierarchical model shown in Figure K1. More specifically, these results showed that removing the Both RCA measure resulted in stronger paths from PC and SC to the RCA scale involving a shift to that process, presumably due to the strong mediational effects of the Both RCA subscale. Moreover, this model was also unable to produce any significant paths from PC to the PC-to-SC RCA measure, likely because of the indirect positive effects (i.e., through the Both RCA subscale) and direct negative effects cancelling each other out. Most importantly, this model provided further empirical support for the convergent validity of the SC-to-PC RCA subscale in showing the Time 4 path from this RCA measure to the corresponding OEC variable to be statistically significant.

The model including only the Both RCA measure and excluding the directional RCA measures was similar to the non-hierarchical model above (Figure K1) in that the

paths from Time 1 SC to both OEC measures was not significant. More importantly, however, this model was also consistent with the earlier cross-lagged panel analysis (Figure 4) in showing a significant and positive path from the Both RCA subscale at Time 2 to subsequent PC-to-SC OEC scores. Taken together, the supplementary phase-specific SEM analyses in which the directional and bidirectional subscales were assessed separately revealed further empirical support for the validity of these RCA measures specifically in terms of additional significant paths being observed from SC-to-PC RCA to the same OEC at Time 4 and from the Both RCA measure to PC-to-SC OEC scores at Time 2.

Alternate OEC measures. Supplementary phase-specific SEM analyses were also conducted in order to address a potential criticism concerning the extent to which the present RCA measures might also predict *incongruent* emphasis shifts. As such, the phase-specific model presented in Figure K1 was also assessed with all RCA measures directly predicting not only the two congruent OEC variables depicted in that figure, but also the two incongruent OEC measures not assessed in this study based on the SEM analyses of Hypothesis 1, namely *SC-to-PC with failure* and *PC-to-SC with success*. A non-hierarchical SEM model was employed in this analysis in order to assess the paths from all RCA subscales to each of the four OEC scores.

Although the fit indices for the model incorporating all four OEC variables showed a good fit to the data (Times 1-4: CFI = .87, .91, .91, .89; TLI = .84, .88, .88, .86; RMSEA = .05), fit levels were equivalent to those observed for the more parsimonious model presented in Figure K1. First, the paths from each directional RCA subscale to the

new OEC measure that involved the same emphasis shift (e.g., PC-to-SC) but a different and incongruent performance outcome (e.g., PC-to-SC OEC x success) were compared with the paths from these RCA measures to the proper OEC variables (see Figure K1). Results showed the path coefficients from the directional RCA subscales to the proper OEC measures (PC-to-SC RCA to same OEC x Failure in Times 1-4: .27, .16, .08, .28; SC-to-PC RCA to same OEC x Success in Times 1-4: .24, -.04, .08, .14) to be stronger and more positive in each phase than the paths from these RCA measures to the *incongruent* OEC variables (PC-to-SC RCA to same OEC x Success in Times 1-4: .19, .11, .04, .16; SC-to-PC RCA to same OEC x Failure in Times 1-4: .13, -.10, .05, .10). Moreover, all paths from these RCA subscales to the incongruent OEC scores were not significant, whereas the significance levels of the paths from these RCA measures to the proper OEC measures were the same in Figure K1.

Concerning the paths from the directional RCA measures to the OEC scores involving emphasis shifts in the other direction, each directional RCA measure still negatively predicted the proper OEC measure corresponding to the other directional RCA subscale with the same significance as indicated in Figure K1 (e.g., PC-to-SC RCA to SC-to-PC OEC x Success). Further, all except one path from the directional RCA subscales to the opposite and *incongruent* OEC score were not significant. The single intriguing *positive* and significant path observed from Time 3 PC-to-SC RCA to the incongruent SC-to-PC OEC x Failure variable ($\beta = .22$, $p < .05$) does suggest that the belief that one can switch to SC with failure at Time 3 contributed to actual shifts in emphasis to PC following poor performance. It is also of interest to note that the Both

RCA subscale also significantly predicted this incongruent OEC measure at Time 3, with those feeling better able to switch back and forth between PC and SC being *less* likely to switch to PC if they subsequently performed poorly. However, because Time 3 was the only phase of the study that for many students was completed more than 10 days after the grades were posted, these unusual findings from this phase should be interpreted with caution. In sum, the results of follow-up SEM analyses on alternate OEC scores do provide empirical support for the convergent and discriminant validity of the present RCA measures as well as the exclusion of incongruent emphasis-change scores.

Appendix L

Phase-specific SEM Analyses on Dependent Measures

The phase-specific SEM analyses below examined the implications of the PC, SC, RCA, and OEC variables on all dependent measures based on the comprehensive, hierarchical model presented in Figure 5. To reduce model complexity, dependent measures were not assessed simultaneously but in groups of conceptually similar study variables. More specifically, the models below controlled for test performance and were evaluated for six sets of measures including (1) actual and perceived academic success, (2) mastery and performance motivational orientation, (3) expectations and perceived value, (4) learning-related emotions, (5) and global health and illness symptoms, and (6) overall psychosocial adjustment.

In a further attempt to increase model parsimony, the weakest and nonsignificant paths in the analyses presented in Figure 5 were not included in the present models, namely the paths from SC to the directional RCA measures and from PC to the PC-to-SC OEC variable. As well, the general and specific items assessing perceived success, expectations, and perceived value were all included as manifest variables predicting the more general respective construct. Because all interrelationships except those involving the dependent measures were previously discussed, only the paths from PC, SC, RCA, and OEC to the performance and self-report outcomes are described here. Finally, because the main analytical models required the OEC measures to compete with the RCA subscales in predicting the dependent measures, notable changes in the path values from the OEC to outcome variables observed in supplementary analyses excluding the direct

paths from the RCA to outcome measures are also discussed below. The results for each of the six complete models (RCA to outcome paths included) are presented in Figures L1 through L6 and described in greater detail in the respective sections below.

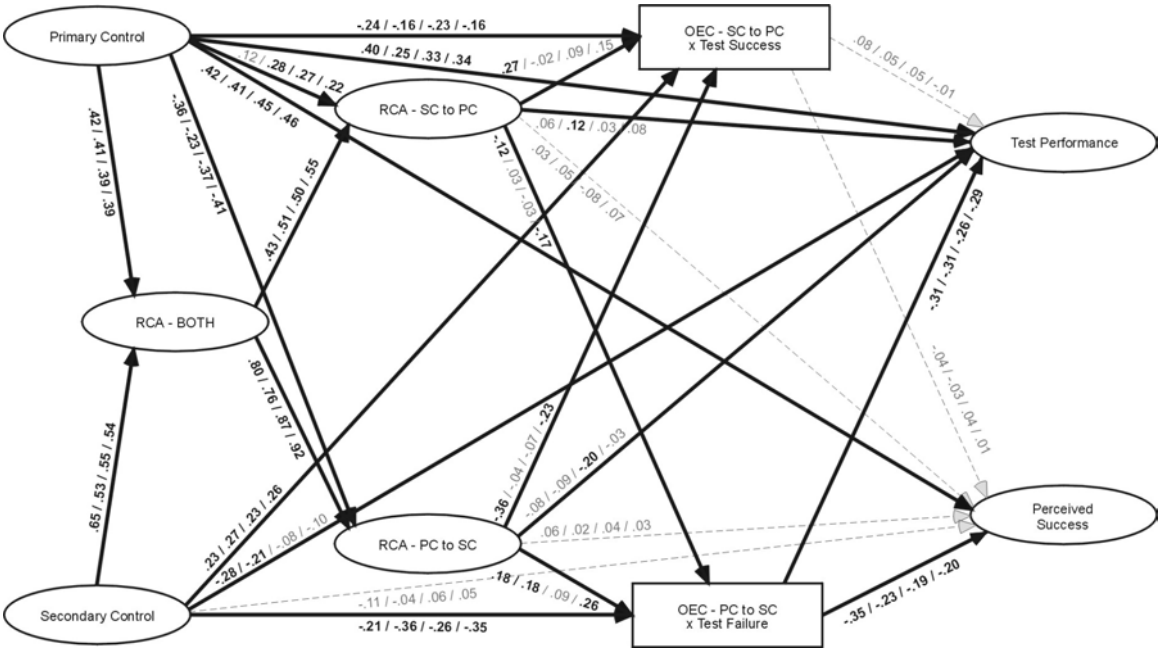


Figure L1. Phase-specific Analysis of PC, SC, RCA, OEC, and Actual/Perceived Success.

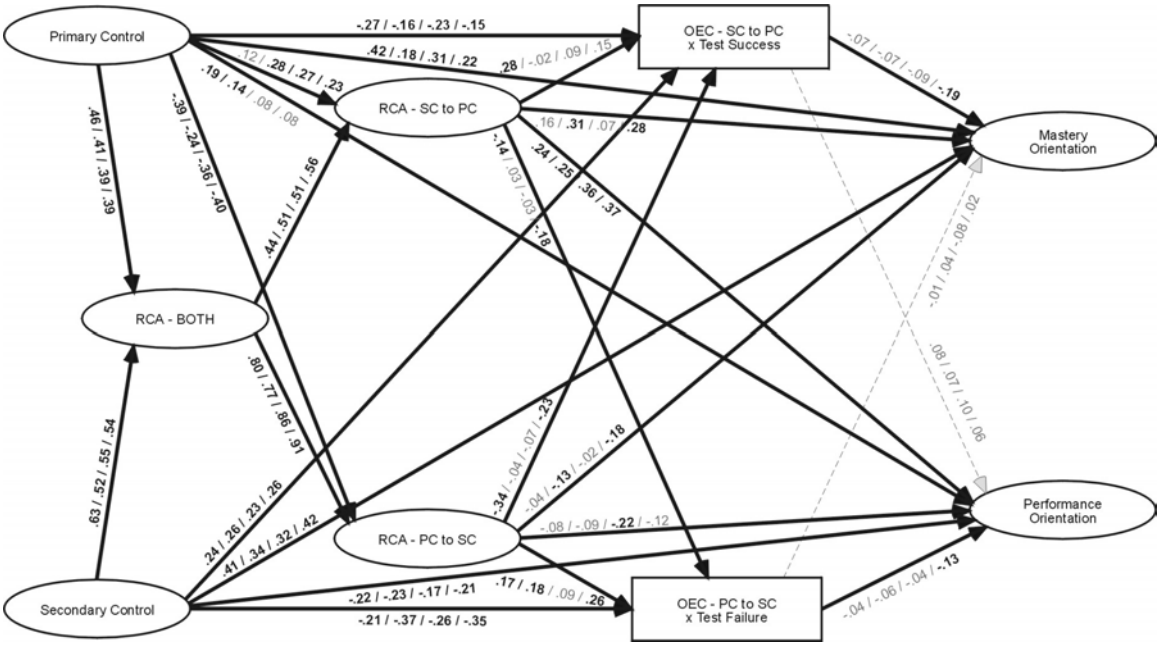


Figure L2. Phase-specific Analysis of PC, SC, RCA, OEC, and Motivational Orientation.

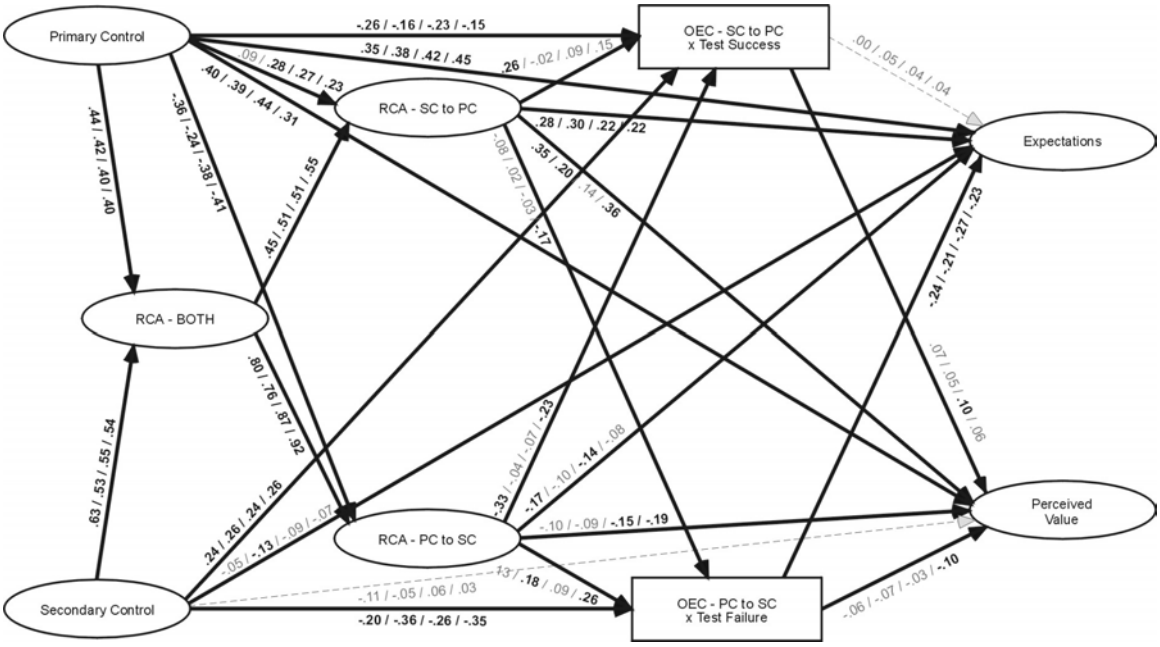


Figure L3. Phase-specific Analysis of PC, SC, RCA, OEC, and Expectations/Perceived Value.

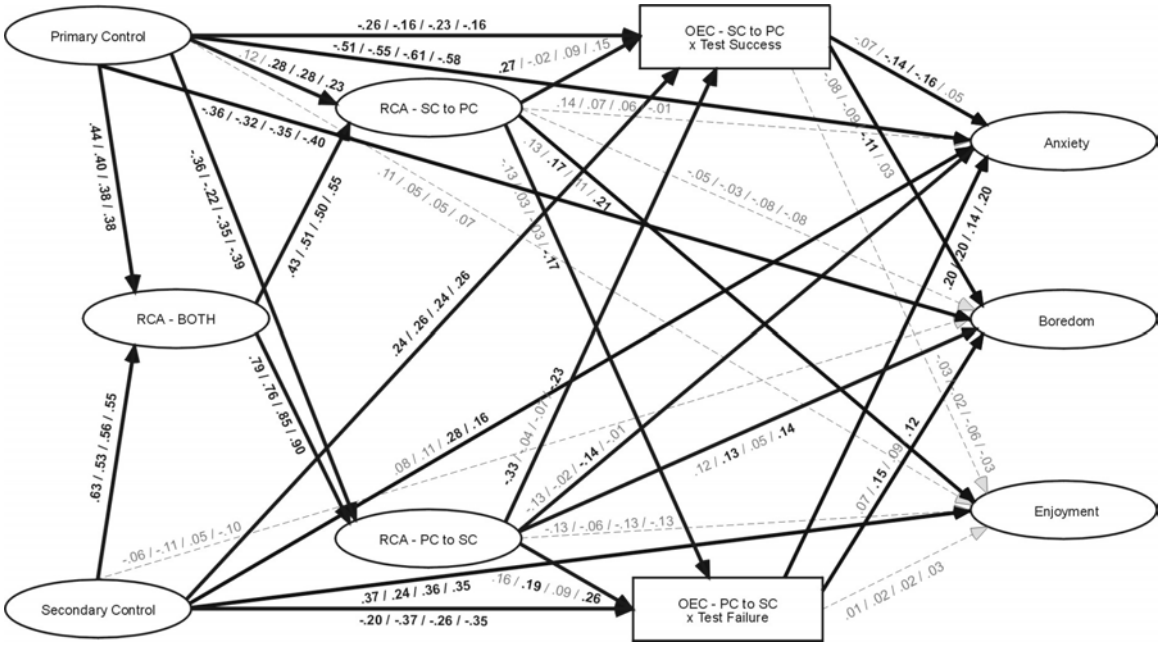


Figure L4. Phase-specific Analysis of PC, SC, RCA, OEC, and Emotions.

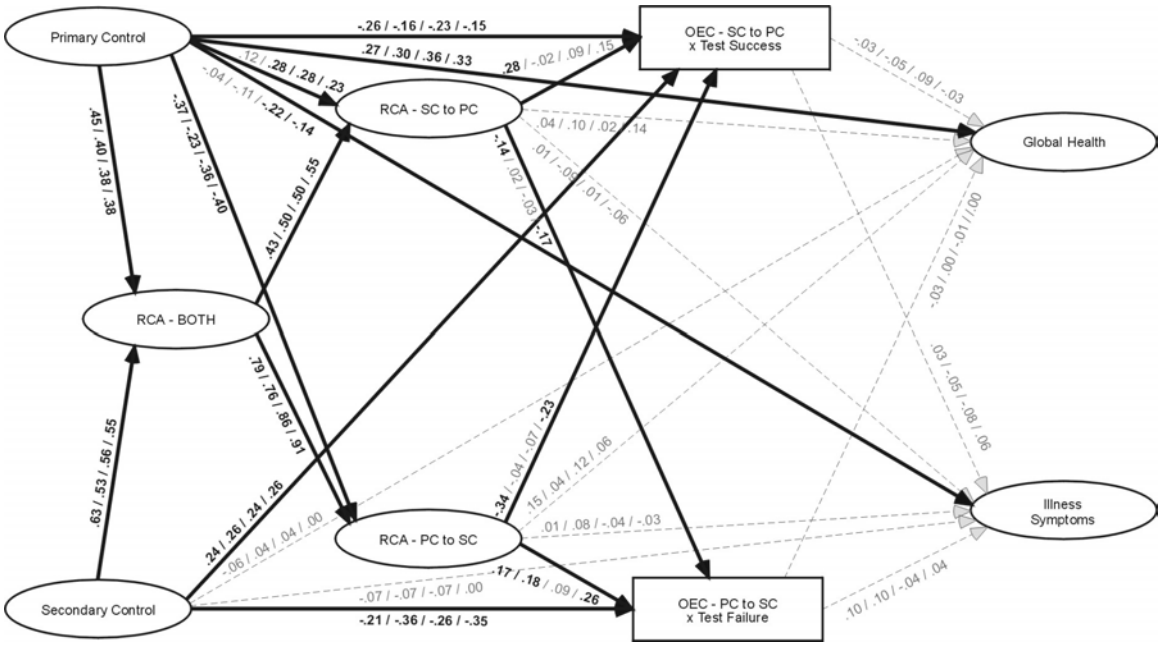


Figure L5. Phase-specific Analysis of PC, SC, RCA, OEC, and Global Health/Illness Symptoms.

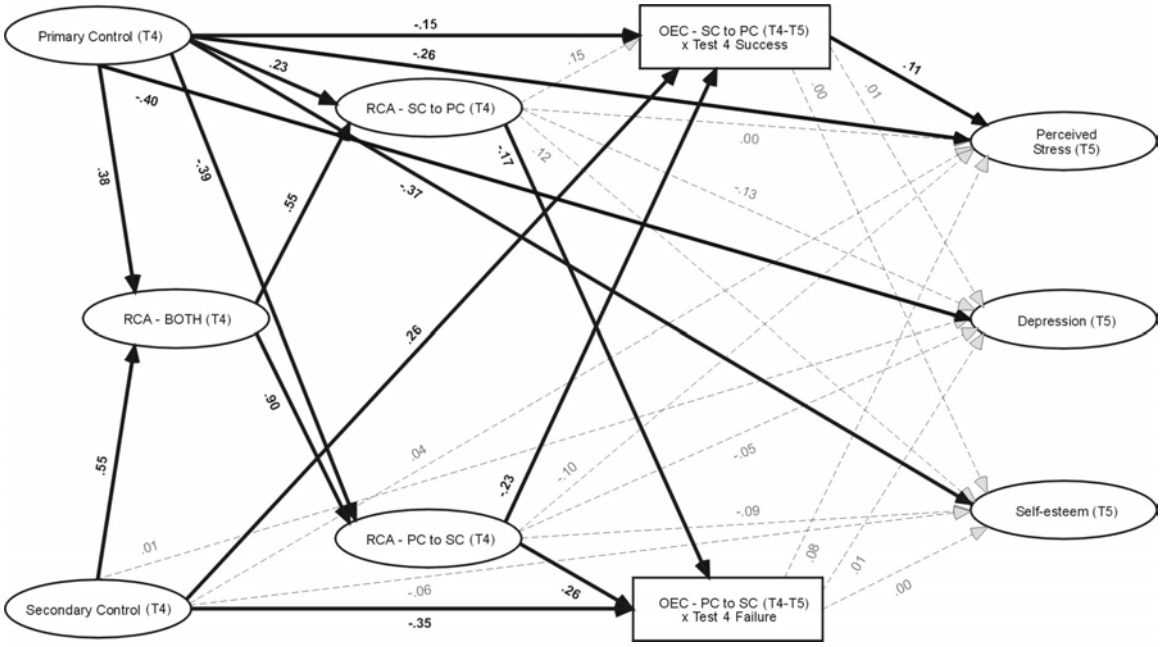


Figure L6. Phase-specific Analysis of PC, SC, RCA, OEC, and Overall Adjustment Measures.

Test performance and perceived success. Whereas PC positively predicted test performance and perceived academic success in each phase, SC in Times 1 and 2 was found to *negatively* predict course grades as predicted by Rothbaum et al. (1982). It is important to note, however, that SC did not predict perceptions of academic success in any study phase and also did not significantly predict course performance in Times 3 or 4, suggesting that higher overall SC levels were not inconsistent with course performance by the second academic semester. Similar findings were also observed for the directional RCA measures, with Time 2 SC-to-PC RCA positively predicting test grades and Time 3 PC-to-SC RCA negatively predicting subsequent performance. Neither RCA measure

significantly predicted perceived success.

Although the SC-to-PC OEC measure did not predict either actual or perceived success in the model shown in Figure 16, supplemental analysis found actual shifts from SC to PC after Test 1 to significantly predict future performance ($\beta = .10$, $p < .05$) when the direct path from SC-to-PC RCA to performance was omitted. Higher PC-to-SC OEC levels predicted both lower course grades and feelings of success in each study phase. These results provide support for Hypothesis 5b in showing that actual shifts in relative emphasis toward PC following initial success contributed to better subsequent grades whereas emphasis shifts toward SC following poor performance resulted in continued declines in course grades. Moreover, these analyses provided some evidence that the perceived ability to switch toward PC positively predicted grades whereas believing one could switch to SC negatively predicted test performance, a pattern of results similar to those predicted for the OEC measures.

Motivation: Mastery and performance orientation. Analysis of the motivational orientation measures showed PC to correspond to higher levels on both dependent measures, SC was found to positively predict mastery orientation and *negatively* predict performance orientation in each study phase. Also intriguing is that the paths from PC and SC to mastery were stronger than those to performance orientation, and also that because the paths from PC and both motivation measures tended to decline over time (e.g., paths from PC in Times 3 and 4 to performance orientation were not significant), SC was found to more strongly predict orientation levels in the second academic semester. These results highlight the increasingly important role played by SC as the

academic year progressed.

The results for the SC-to-PC RCA measure were similar to those of PC, with significant positive paths to mastery orientation observed in two phases and to performance orientation in all study phases. Although the corresponding SC-to-PC OEC measure did not predict performance orientation in the model controlling for directional RCA effects, supplemental analyses excluding these paths found that SC-to-PC OEC after Test 3 positively predicted subsequent performance orientation ($\beta = .12$, $p < .05$; this path from OEC after Test 2 also approached significance: $\beta = .11$, $p < .10$). In contrast, this OEC measure was shown to actually have a significant *negative* impact on subsequent mastery orientation following Test 4. These findings also showed the PC-to-SC RCA subscale to negatively predict both orientation measures in at least one study phase, with the PC-to-SC OEC measure being unrelated to performance orientation and also predicting lower mastery orientation in Time 4.

Taken together, these results suggest that although knowing one is able to switch from SC to PC contributed to a greater motivation, actually switching in this direction encouraged performance orientation but was increasingly negatively related to mastery orientation. Similarly, whereas believing one could shift from PC to SC negatively predicted subsequent motivation levels, actual emphasis shifts in this direction were negatively related to performance orientation. As such, these findings underscore the point that even though beliefs and behaviours involving emphasis shifts can have similar effects on academic outcomes (e.g., test performance, performance orientation), these perceptions and beliefs can in some cases have different and even opposite effects (e.g.,

PC-to-SC on perceived success; SC-to-PC on mastery orientation).

Motivation: Expectations and value. Analysis of the final set of motivation items based on expectancy-value theory found PC to positively predict both academic expectations and perceptions of value in each phase, and SC to be unrelated to perceived value, and in Time 2, negatively yet weakly predict subsequent expectations. Thus, although PC positively predicted all performance and motivation measures in most study phases, SC positively predicted only mastery-oriented motivation and either did not predict (i.e., perceived success and value) or negatively predicted other motivation measures (i.e., performance orientation and expectations) and subsequent achievement. The results for the directional RCA measures largely parallelled those of analogous control measures, with SC-to-PC RCA positively predicting both expectations and value in most phases, and the PC-to-SC RCA measure negatively, albeit less strongly, predicting both motivation variables in two study phases.

The paths from the OEC measures in this analysis resembled those of the RCA measures. More specifically, SC-to-PC OEC scores positively predicted perceived value after Test 3, the PC-to-SC OEC measure negatively predicted perceived value after Test 4, and most notably, higher PC-to-SC OEC levels predicted lower expectations in each study phase. Supplementary analyses in which direct paths from the RCA to dependent measures were omitted showed the SC-to-PC OEC measure to also positively predict perceived value after Test 1 ($\beta = .12$, $p < .05$; this OEC positively predicted value after Test 4 at $p < .10$). Observed shifts from SC to PC with success were unrelated to expectations in each study phase. As such, the results of analyses on expectancy-value

motivation measures once again revealed that both the perceptions and behaviour involving a shift in emphasis from SC to PC corresponded with greater motivation (perceived value only for OEC), whereas the perceived and actual PC to SC switching capacity measures predicted lower motivation levels (particularly lower expectations for OEC).

Academic emotions. The phase-specific analyses including the three learning-related emotions as dependent measures once again showed a consistent pattern of results for PC, which negatively predicted both anxiety and boredom in each phase, and more complicated results for SC, which although positively predicted enjoyment was in Times 3 and 4 *positively* related to anxiety levels. PC was unrelated to enjoyment and SC was unrelated to boredom in each study phase. Similarly, whereas the SC-to-PC RCA measure positively predicted enjoyment in two phases, the Time 3 PC-to-SC RCA measure negatively predicted subsequent anxiety yet *positively* predicted boredom levels in two study phases. Concerning the OEC measures, shifts in emphasis from SC to PC with success contributed to lower anxiety (after Tests 2 and 3) and lower boredom (after Test 3; $p < .10$ after Test 2), but shifts from PC to SC with poor performance predicted *higher* levels of subsequent anxiety (after each test) and boredom (after Tests 2 and 4). Thus, although some encouraging results were found with respect to the RCA measures on anxiety and enjoyment, and for the SC-to-PC OEC variable on anxiety and boredom, both the PC-to-SC RCA and OEC measures predicted higher levels of boredom and the latter OEC measure consistently predicted greater subsequent anxiety levels.

Global health and illness symptoms. Although no direct effects of SC on the

health outcomes were observed, PC was found to positively predict global health status in each study phase and negatively predict illness symptoms in the second academic semester. No other significant paths from the RCA or OEC measures to the health-related dependent measures were observed. However, one significant OEC path did emerge in supplementary analyses excluding the direct paths from the RCA to health measures, showing that actual emphasis shifts from PC to SC after poor performance on Test 2 weakly predicted *higher* reporting of subsequent illness symptoms ($\beta = .11$, $p < .05$).

Overall psychosocial adjustment. Because the measures of perceived stress, depression, and self-esteem were assessed only in Times 1 and 5, only one phase-specific model was assessed that included the Time 5 adjustment variables as dependent measures. Results of this model showed that once again, PC was significantly related to each of the dependent measures whereas SC was related to none. However, although the expected negative relationships were observed between PC and perceived stress and well as depression, an unexpected negative path was also found from PC to self-esteem. The only other significant path from an RCA or OEC measure to adjustment was also in an unexpected direction, with actual shifts in emphasis from SC to PC with success corresponding to higher subsequent levels of perceived stress. Supplementary analyses revealed no additional significant effects when the direct paths from RCA to the dependent measures were omitted.

Inconsistency with correlational results. In addition to the two limitations of the above phase-specific analyses described in the results section, it is also important to note that the path values from PC, SC, and the RCA subscales to the dependent measures are

often inconsistent with and even opposite of the relations observed in the preliminary intra-phase correlational analyses (Appendix E). Although these discrepancies may be due to the inter- vs. intra-phase nature of the SEM and correlational analyses, it is also possible that controlling for the effects of all control-related variables (including OEC) on the outcome measures in the phase-specific analyses contributed to these inconsistencies. Although most discrepancies between the path values and correlations involved one set of values being significant and the other not (e.g., the relations between SC as well as the PC-to-SC subscale with nearly all dependent variables), some significant paths in the phase-specific SEM analyses were found to actually have different *valences* than the correlations found in the Appendix E. Examples include the relations between Time 4 PC and self-esteem ($\beta = -.37$, $r = .46$), Time 2 SC and expectations ($\beta = -.13$, rs = .03/.21 for specific/global), and the PC-to-SC RCA measure with mastery orientation (Times 2/4 RCA: βs = -.13/-.18, rs = .18/.24) and expectations (Time 3 RCA path to total expectations: $\beta = -.14$; Time 3 RCA correlation with global expectations: $r = .09$).

Appendix M

Cross-lagged Panel SEM Analyses on Dependent Measures: Figures

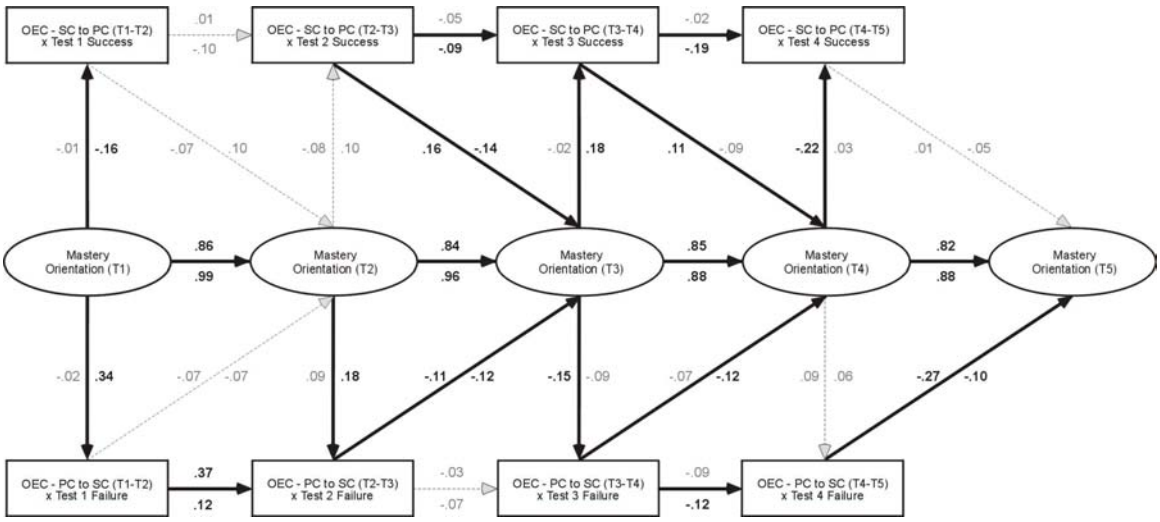


Figure M1. Causal Analysis of OEC and Mastery Orientation for Low (Top/Left) and High (Bottom/Right) Both RCA Groups.

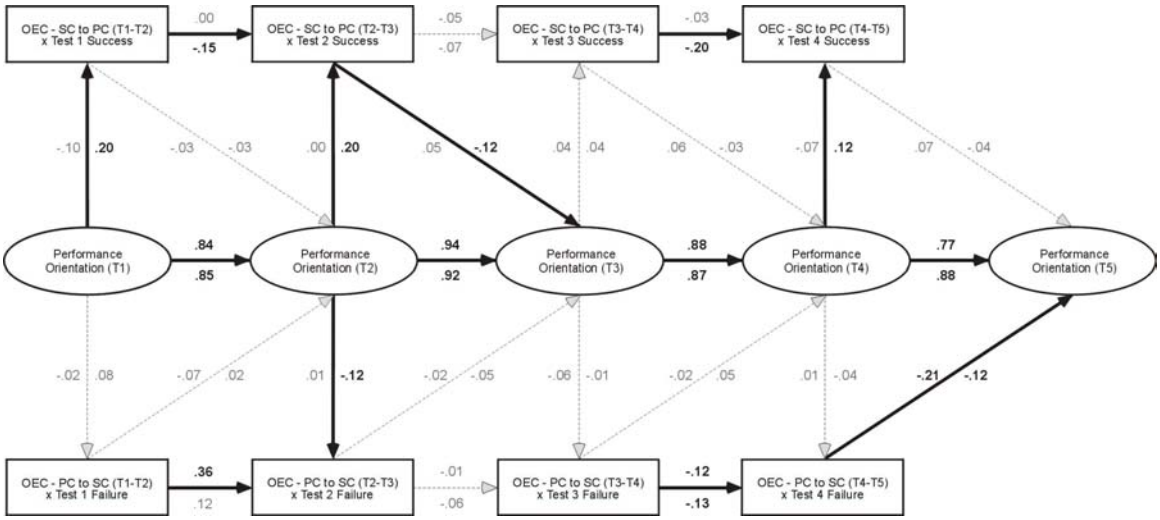


Figure M2. Causal Analysis of OEC and Performance Orientation for Low (Top/Left) and High (Bottom/Right) Both RCA Groups.

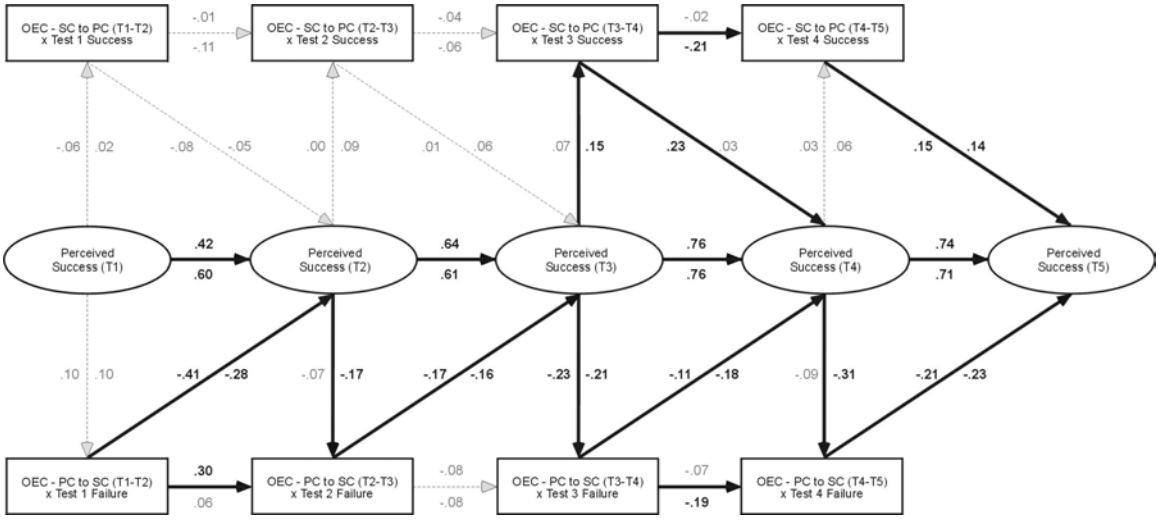


Figure M3. Causal Analysis of OEC and Perceived Success for Low (Top/Left) and High (Bottom/Right) Both RCA Groups.

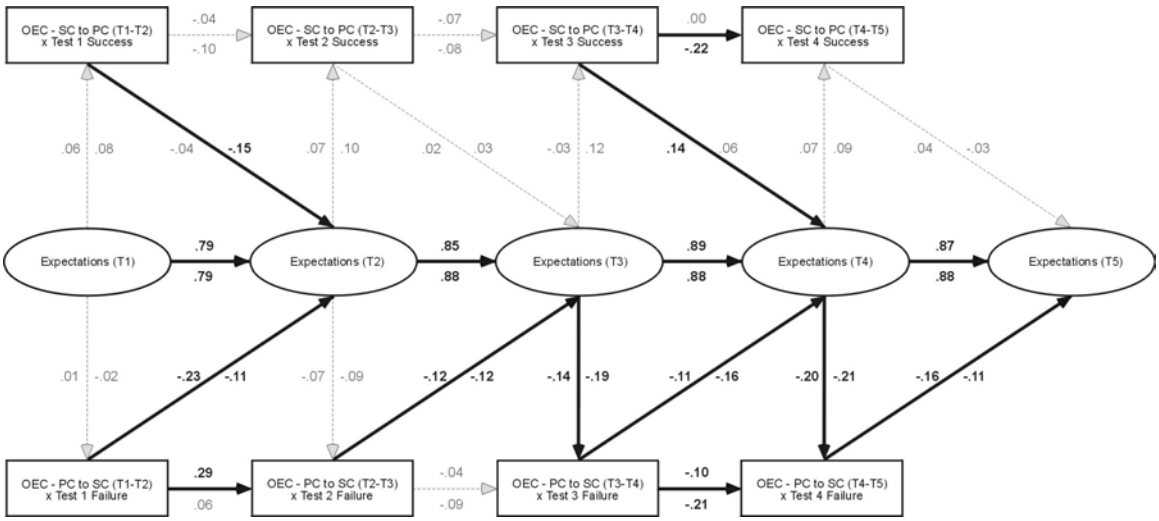


Figure M4. Causal Analysis of OEC and Expectations for Low (Top/Left) and High (Bottom/Right) Both RCA Groups.

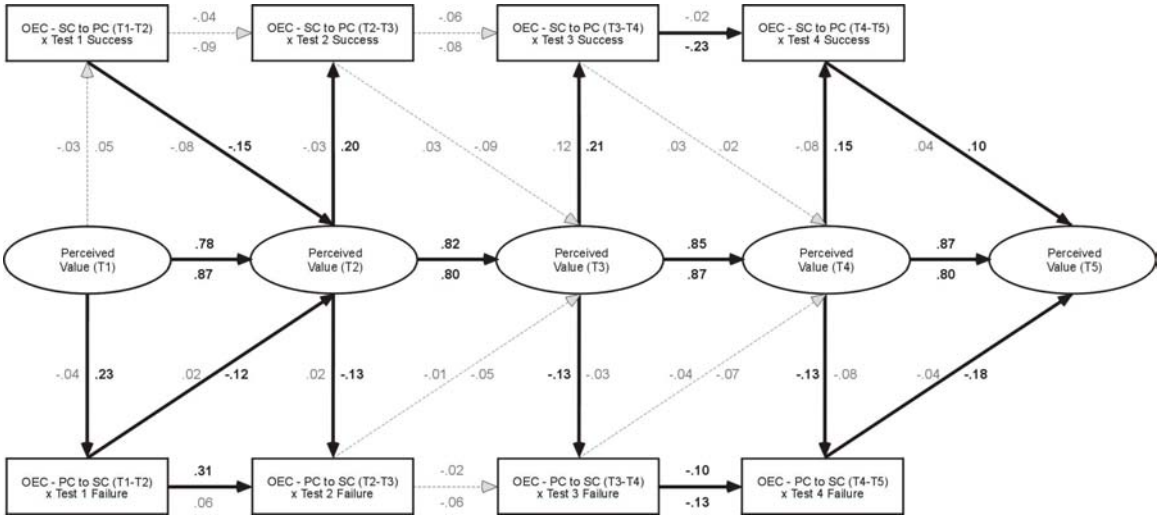


Figure M5. Causal Analysis of OEC and Perceived Value for Low (Top/Left) and High (Bottom/Right) Both RCA Groups.

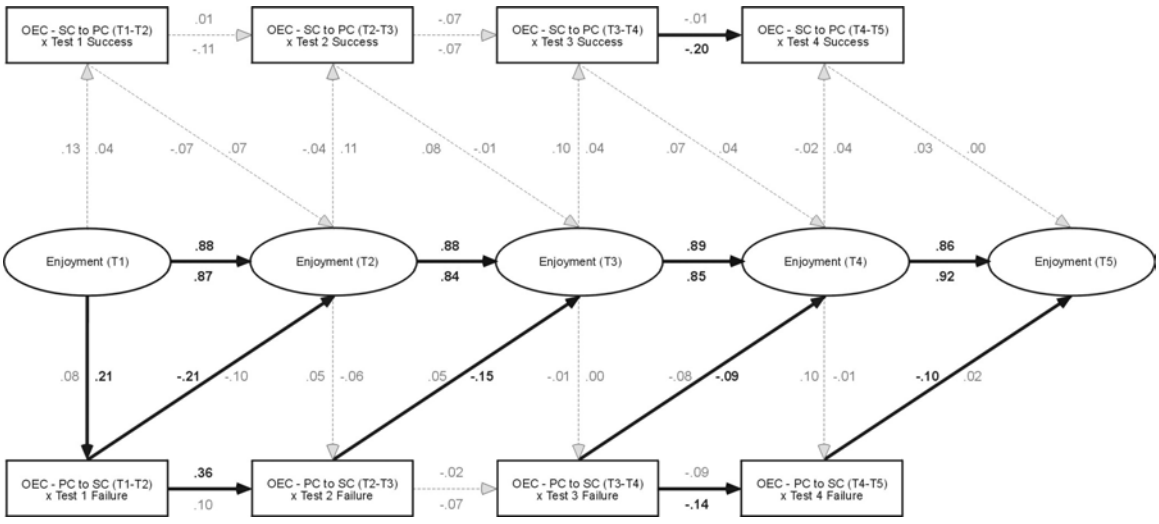


Figure M6. Causal Analysis of OEC and Enjoyment for Low (Top/Left) and High (Bottom/Right) Both RCA Groups.

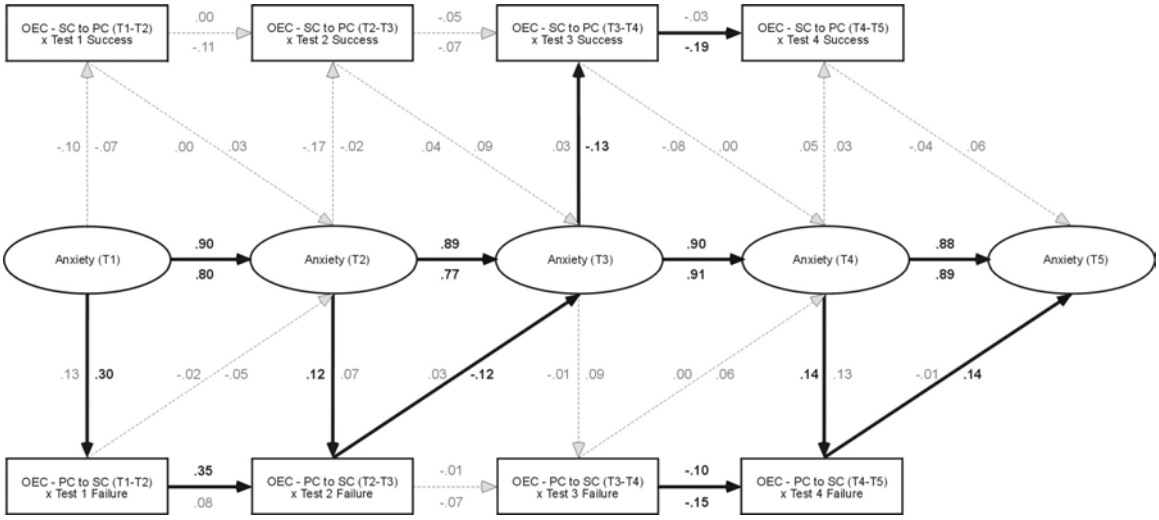


Figure M7. Causal Analysis of OEC and Anxiety for Low (Top/Left) and High (Bottom/Right) Both RCA Groups.

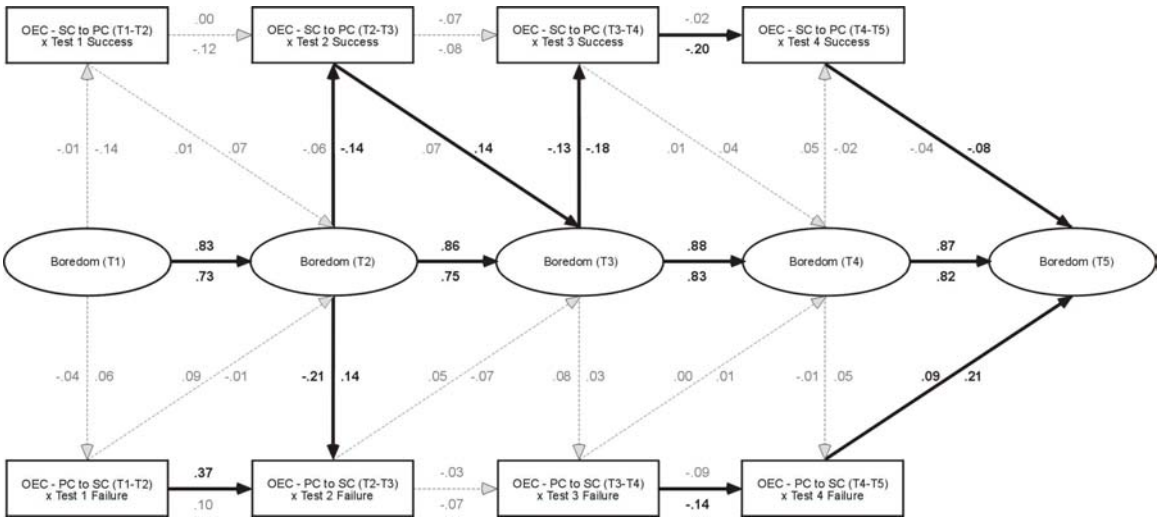


Figure M8. Causal Analysis of OEC and Boredom for Low (Top/Left) and High (Bottom/Right) Both RCA Groups.

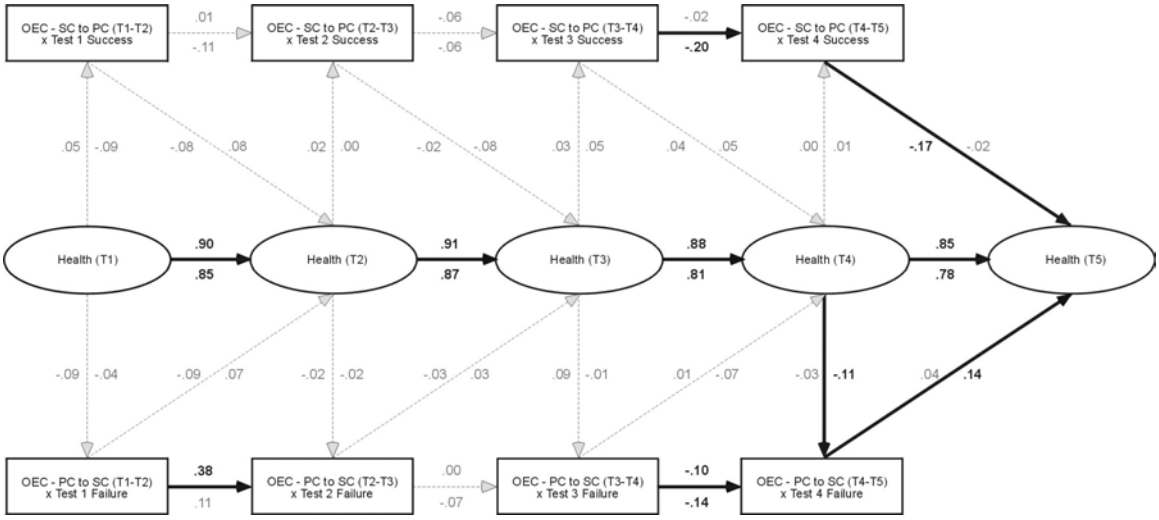


Figure M9. Causal Analysis of OEC and Global Health / Illness Symptoms for Low (Top/Left) and High (Bottom/Right) Both RCA Groups.

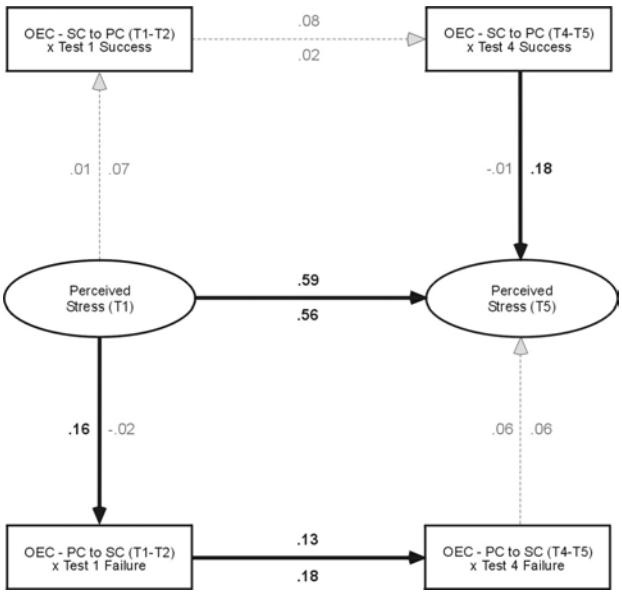


Figure M10. Modified Causal Analysis of OEC and Perceived Stress for Low (Top/Left) and High (Bottom/Right) Both RCA Groups.

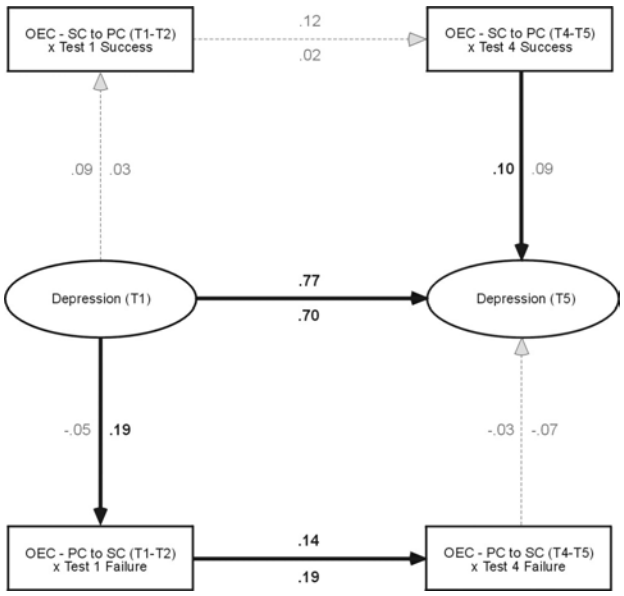


Figure M11. Modified Causal Analysis of OEC and Depression for Low (Top/Left) and High (Bottom/Right) Both RCA Groups.

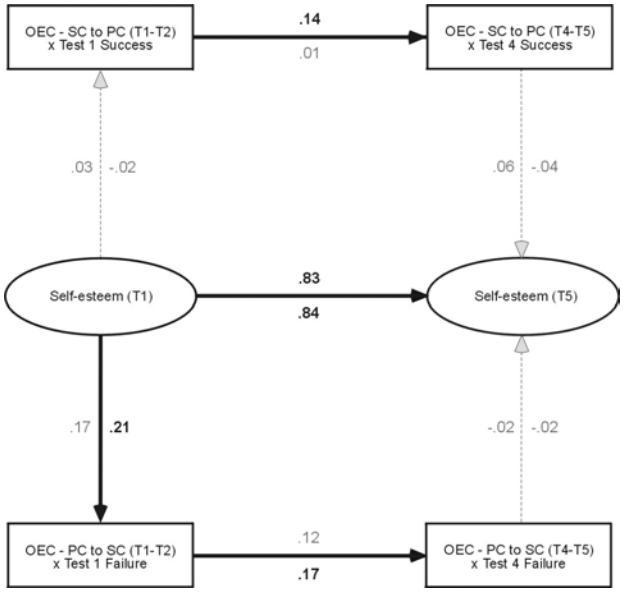


Figure M12. Modified Causal Analysis of OEC and Self-esteem for Low (Top/Left) and High (Bottom/Right) Both RCA Groups.