Journal of Social and Clinical Psychology, Vol. 27, No. 10, 2008, pp. 1126-1164

SELF-REGULATION OF PRIMARY AND SECONDARY CONTROL IN ACHIEVEMENT SETTINGS: A PROCESS MODEL

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In the dual-process models of Rothbaum, Weisz, and Snyder (1982) and Heckhausen and Schulz (1995), the self-regulatory capacity to alternate between attempts to directly change (primary control) and psychologically adjust to one's environment (secondary control) in congruence with performance represents one of its most important yet unexplored theoretical tenets. The present longitudinal study (n = 568) explored individuals' perceived and demonstrated ability to shift between primary and secondary control in congruence with academic performance outcomes. Confirmatory analyses examining causal effects were evaluated using cross-lagged and mediational structural equation models. Results showed that individuals shift toward primary control after success and toward secondary control following failure, and supported the predictive validity of self-report measures for assessing one's capacity for congruent emphasis shifts. In sum, these findings highlight the significance of perceptions and behavior concerning the self-regulatory process of adaptively shifting between primary and secondary control in achievement settings.

Rothbaum, Weisz, and Snyder's (1982) initial reformulation of control theory as a dual-process model involving primary and sec-

This study was supported by doctoral and post-doctoral fellowships from the Social Sciences and Humanities Research Council of Canada, and is based on doctoral dissertation research conducted by the author at the University of Manitoba.

Special thanks to Raymond Perry, Judith Chipperfield, Dan Bailis, and Robert Renaud for their constructive feedback on earlier versions of this manuscript, and to Jarod Innis for technical support throughout data collection.

Part of this research was presented at the American Educational Research Association annual conference in San Francisco, April 2006.

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ondary control has guided psychological research in such fields as life-span development, health and well-being, and achievement settings. Theoretical developments by Heckhausen and Schulz (1995) concerning the use of control strategies have also contributed to the large-scale impact on primary/secondary control theory. 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), Chipperfield (e.g., Chipperfield & Perry, 2006), Compas (e.g., Wadsworth & Compas, 2002), Weisz (e.g., Weisz, McCabe, & Dennig, 1994), and others (e.g., Petito & Cummins, 2000; Thompson, Nanni, & Levine, 1994). More recently, this dual-process model has also been applied to achievement settings, specifically with respect to health, motivation, and performance in an academic achievement context (Hall, Chipperfield, Perry, Ruthig, & Goetz, 2006; Hall, Perry, Ruthig, Hladkyj, & Chipperfield, 2006; see Perry, Hall, & Ruthig, 2005, for review). The present study extends this research focus, providing a longitudinal analysis of how individuals regulate their use of primary and secondary control in achievement settings in response to success and failure experiences.

SELF-REGULATION OF PRIMARY AND SECONDARY CONTROL

Rothbaum et al. (1982) theorize that individuals are motivated to maintain a sense of personal control over their environment, and do so using two types of control-related behaviors. They propose a dual-process model in which perceived control is fostered by attempts either to proactively change the environment (primary control) by persisting and exerting effort, or to psychologically adapt to the environment (secondary control) through four distinct processes involving prediction, illusory correlation, vicarious alignment, and interpretation. Prediction enables one to avoid disappointment by attributing potential failure experiences to limited ability, whereas construing luck as a personal attribute, not unlike ability, can provide an illusory sense of control. Similarly, identification with powerful others permits vicarious control, and interpretive control is achieved through construing meaning in one's situational limitations.

According to Rothbaum et al. (1982), individuals are motivated to sustain their perceptions of personal control in success and failure situations through the balanced use of both primary- and secondary-control approaches. Whereas primary control is best suited for maximizing opportunities for future success, secondary control is most effective following the failure of primary-control efforts. However, Rothbaum et al. further suggest that people regulate their emphasis on these two control processes, and "shift from one method of striving for control to another" (p. 7) in response to their environment. More specifically, these authors define "Optimal Adaptation" as an appropriate relative emphasis on primary vs. secondary control based on the controllability of a given setting. In other words, optimal adaptation is defined as not simply being able to engage in primary and secondary control but being able to alternate between them in response to both favorable and aversive circumstances. This self-regulatory facet is described by Rothbaum et al. as the "knowledge of how and when to exert the two processes of control and how to integrate them" (p. 30), and is highlighted as "one of the most significant implications of the two-process model" (p. 29).

In their examination of control-related phenomena from a developmental self-regulation perspective, Heckhausen and Schulz (1995) provide an elaborated version of Rothbaum et al.'s (1982) dual-process model that captures how people adapt to developmental changes in opportunities for control striving across the life span. According to Heckhausen and Schulz, people are universally motivated to manipulate their environment through direct action (primary control), and as such, are threatened by events that challenge or decrease existing opportunities for control. 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 to sustain primary-control efforts and/or buffers the emotional and motivational impact of threats to primary control. Thus, in contrast to primary-control strategies such as persistence, exertion of effort, and attributions to effort, secondary-control strategies may include the downgrading of expectations or task importance, accepting limitations, or perceiving benefits from an otherwise adverse experience (Heckhausen & Schulz, 1995; Wrosch et al., 2000).

The self-regulation model proposed by Heckhausen and Schulz (1998) further suggests that a higher-order self-regulation process referred to as Optimization, is required for maintaining a balance between these strategies and promoting successful development. Specifically, these authors propose that there are three general principles involved in optimizing developmental regulation: selecting appropriate goals, participating in a variety of goal-striving domains, and calibrating one's control striving in congruence with situational constraints. Whereas the first and second principles are global in nature, concerning the selection of tasks and domains that maximize opportunities for control, the third principle is domain specific and focuses on the importance of regulating one's control-striving behavior "in accordance with the structure of opportunities and constraints encountered in a given developmental ecology" (p. 57). Although the ultimate goal of this optimization process in Heckhausen's model involves fostering actual opportunities for primary-control striving in that domain (Schulz, Wrosch, & Heckhausen, 2003), rather than perceptions of personal control, this principle is otherwise consistent with the concept of optimization as initially proposed by Rothbaum et al. (1982).

PRIMARY/SECONDARY CONTROL IN ACHIEVEMENT SETTINGS

Achievement settings represent an ideal domain in which to examine self-regulation and control striving, due to the greater frequency and salience of both success and failure outcomes relative to non-achievement settings (e.g., leisure activities; Perry et al., 2005). In particular, the first few years of post-secondary education represent a highly challenging achievement context, in which individuals contend with various academic challenges including more frequent failure experiences, increased pressure to succeed at unfamiliar tasks, greater academic competition, and important career decisions (Perry, 1991, 2003). From a developmental perspective, control-striving is of critical importance in young adulthood, during which achievement goals (e.g., educational, occupational) are vigorously pursued to maximize opportunities for control later in life (Heckhausen & Schulz, 1995, 1998; see also Heckhausen & Tomasik, 2002). More specifically, the transition to higher education represents a particularly challenging developmental task for young adults, during which control striving is more variable due to a threatened sense of personal agency (Perry, 2003) and uncertainty as to how to best select achievement domains (e.g., choosing a major; see Schulz & Heckhausen, 1999). Enhanced cognitive receptiveness is also typical at the beginning of critical transition phases (Heckhausen et al., 2001), making students' responses to early performance outcomes especially important with respect to their long-term academic career (Perry, Hechter, Menec, & Weinberg, 1993).

Recent research on the benefits of primary and secondary control for college student development is encouraging. For example, Connor-Smith and Compas (2002) found both control strategies to reduce anxiety among socially anxious students during their first year of college. A study by Hall, Chipperfield, Clinton, and Haynes (2006) illustrated the health benefits of primary and secondary control for first- and second-year students, showing both approaches to contribute to lower illness symptoms and behaviors (e.g., physician visits), as well as better self-rated health. Recent longitudinal research by Hall, Perry, Ruthig, et al. (2006) further demonstrated how primary and secondary control contribute to optimal academic emotions, motivation, and performance, most notably among unsuccessful freshmen (cf., secondary control and career-related decision-making in German adolescents; Haase, Heckhausen, & Koeller, 2006; Heckhausen & Tomasik, 2002). A follow-up study by Hall, Perry, Chipperfield, et al. (2006) also found a writing-based intervention encouraging both primary and secondary control to promote significant long-term improvements in academic development particularly for first- and second-year students experiencing academic difficulty.

RESEARCH HYPOTHESES

Following from this research, the present longitudinal study represents a domain-specific examination of people's perceived as well as actual ability to alternate between primary and secondary control in response to achievement outcomes. This five-phase study was conducted over a six-month period with primarily first- and second-year university students and explored how their relative emphasis on primary- and secondary-control approaches changed in congruence with actual test performance throughout the academic year (i.e., the optimization process). Consistent with the model of optimization proposed by Rothbaum et al. (1982), *Hypothesis 1* proposed that students should rely more on primary relative to secondary control following successful outcomes, and conversely, shift their emphasis from primary to secondary control after failure experiences.

The predictive utility of self-report scales measuring one's perceived ability to make performance-based emphasis changes was also assessed. *Hypothesis 2* proposed that two self-report measures concerning one's ability to shift either toward primary control after success, or toward secondary control following poor performance, should predict actual emphasis changes in congruence with real performance outcomes. In a similar manner, *Hypothesis 3a* asserted that a third self-report measure assessing one's perceived ability to shift bidirectionally (back and forth) based on one's performance should predict actual, congruent emphasis changes in both directions over time. However, *Hypothesis 3b* further proposed that this relationship between the third, bidirectional scale and observed emphasis changes should be mediated by a hierarchical relationship involving the two more specific self-report measures. That is, the perceived ability to shift back and forth should predict more specific beliefs involving one's ability to (i) shift toward primary control with success, and (ii) shift toward secondary control with failure, with each directional measure, in turn, predicting actual corresponding emphasis changes.

Concerning the overall effects of primary and secondary control on emphasis change variables, *Hypothesis 4a* suggested that when assessing the effects of these measures on *actual* emphasis changes, ceiling effects should be found because those with already high levels of a given approach are unlikely to further increase in that approach. Nevertheless, *Hypothesis 4b* proposed that primary and secondary control should also correspond positively with individuals' perceptions of their ability to switch between these approaches. That is, higher levels of endorsement for each type of control should correspond to a higher-order belief in one's ability to switch between them in a bidirectional manner in congruence with performance outcomes (see Hall, Perry, Ruthig, et al., 2006).

METHOD

PARTICIPANTS AND PROCEDURE

Three weeks into the academic year, 568 students were recruited from eight sections of a two-semester introductory psychology course at a Research-1 university for a five-phase, web-based study in exchange for experimental credit.[1] In the initial sample, 66% were female, 80% reported English as their first language, and 90% were 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 most were in their first year (69%) or second year of study (20%). The average self-reported grade for students' final year of high school was 81%. Although students at this institution are not registered in a specific faculty until their second year, the most common faculty affiliations reported by non-freshman students were the faculties of Science (40%), Arts (23%), Management (10%), Nursing (5%), and Human Ecology (5%).

Students' participation in this study involved the completion of a web-based questionnaire, including the self-report measures described below, at five points throughout the first and second semesters. The first questionnaire was completed during the third and fourth weeks of classes (Time 1) to ensure that students had not yet completed a course exam. The remaining four questionnaires were completed within 10 days after each of their next four test results were posted (Times 2-5). One exception was the Time 4 questionnaire that was completed during the first 10 days of the second semester due to the results of Test 3 being posted during the winter break. Web survey access was restricted to campus computing facilities to prevent distraction and allow for access to technical support staff, and was available only during the five time periods specified. In addition to experimental credit for all participants, vouchers for the campus bookstore were also awarded to randomly selected participants who completed all study phases. Study reminders were provided through in-class announcements, email updates, and printed notices displayed beside the posted course grades.

Participant Attrition and Exclusions. As expected, attrition did occur from one phase to the next because of students having already completed their experimental credit requirements, having withdrawn from the course, illness, etc. However, the extent of attrition observed 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 rate was 16%). These attrition rates show considerable engagement in the web-based study protocol, and are well below those observed in similar pencil-and-paper studies (e.g., 21%, Hall, Perry, Chipperfield, et al., 2006; 55%, Perry et al., 2001). However, approximately 5% of participants' elapsed times for completing the survey were very low, suggesting that not all survey items were read or responded to with due consideration. A two-part rationale involving estimated rates of responding and inter-item correlations provided further empirical support for the exclusion of these participants.[2]

1. Recruiting students from only introductory psychology was advantageous for multiple reasons. First, this course attracts students from various disciplines, with many enrolling to fulfill an ancillary course requirement. Second, by recruiting from multiple sections of a course consisting of over 3000 students taught by different instructors and varying in classroom size, the hypotheses are tested in a real-life academic context involving a greater range of classroom teaching and learning dynamics than in more specific courses (e.g., biochemistry). It should be noted, however, that recruiting from several sections prevents the atypical testing practices of a few professors from biassing the findings on performance. Finally, by recruiting from only this course, the curriculum as well as number, format, and timing of exams was relatively consistent across different course sections. This minimizes the influence of these and other confounding factors including test weighting and preparation time, as well as familiarity with course content.

2. In terms of response time, the fastest 5% took a maximum of 2.52 to 4.66 seconds to read and respond to each survey question, whereas the average participant spent between 6.41 and 9.03 seconds on each question (elapsed time divided by number of items, per phase). By dividing the elapsed completion time by the total number of words per phase, the fastest top 5% were also found to read *and* respond to survey items on average (*M*s: 330-713 words per minute) up to over twice as fast as the average reading rate for high-school graduates (300-350 wpm; Carver, 1990). With respect to inter-item correlations for the first scale of the questionnaire (primary control), overall correlations between items of the same valence were positive, all correlations between positively and negatively phrased items were negative, and no correlations exceeded .50. For the fastest 5% group, three positive correlations were found between positively and negatively phrased items, with two highly significant correlations found between adjacent scale items (*r*s = .81, .65). Analyses also showed the correlations to be significantly more variable for the fastest 5% (SD = .20) as compared to other participants (SD = .10; Levene test statistic = 13.20, $p < .001$).

STUDY MEASURES

Reliability levels, means, and standard deviations for all measures in each study phase are outlined in Table 1.

Academic Performance. Students' grade percentages on their first five tests in introductory psychology were obtained from course instructors throughout the academic year. Actual course performance represents an objective achievement outcome following which shifts in primary and secondary control should occur. Each course section administered a total of six course exams throughout the academic year. Each exam was of equal weight, noncumulative in content, and administered approximately one month apart in each semester.

Achievement Motivation. Two 4-item, 7-point scales adapted from Pintrich, Smith, and McKeachie (1989) were included at Time 1 to measure students' achievement motivation with respect to *performance orientation* (α range: .72-.83) and *mastery orientation* (α range: .70-.81). Both scales showed equivalent reliability that improved over time, and were included as covariates in all main analyses (see Rationale for Analyses). 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," and the mastery orientation scale included items such as "I prefer course material that really challenges me so I can learn new things" (1 = not at all true of me, 7 = very true of me).

Primary Control (PC). For the present study, both the primary and secondary control scales were prefaced by instructions to respond to survey items based on how the participant felt *at that moment*. It was anticipated that by encouraging more temporally-specific responses, these scales that are typically used to assess control-related dispositions (Perry et al., 2001) would be more sensitive to changes from one study phase to the next. To assess primary academic control beliefs, a 10-item measure based on Perry et al.'s (2001) Primary Academic Control (PAC) scale was administered 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

TABLE 1. Descriptive Statistics

Measures	Time 1	Time 2	Time 3	Time 4	Time 5
Test performance					
M	71.24	67.63	67.55	69.12	73.32
SD	18.97	19.06	18.61	19.68	13.99
Performance orientation					
α	.72	.73	.79	.79	.83
M	23.12	22.99	22.93	22.95	22.46
SD	3.89	4.00	4.29	4.27	4.63
Mastery orientation					
α	.70	.73	.79	.80	.81
M	20.49	19.82	19.65	19.54	18.63
SD	3.82	3.98	4.37	4.21	4.48
Primary control (PC)					
α	.80	.83	.84	.84	.87
M	58.42	57.55	56.74	56.38	56.31
SD	7.62	7.86	8.08	7.93	8.70
Secondary control (SC)					
α	.77	.77	.80	.83	.85
M	19.10	18.87	18.51	18.82	19.13
SD	4.49	4.30	4.48	4.44	4.53
Reported congruence					
SC to PC					
α	.73	.79	.78	.79	.83
M	20.98	20.47	20.16	20.26	19.92
SD	3.70	3.84	3.68	3.70	4.01
PC to SC					
α	.75	.84	.87	.88	.89
M	26.26	26.09	25.67	26.16	26.21
SD	5.35	5.67	6.02	6.13	6.13
Both					
α	.41	.51	.62	.65	.68
M	15.96	15.55	15.54	15.61	15.57
SD	2.70	2.74	2.78	2.76	2.86
Observed congruence					
SC to PC					
M	N/A	292.14	248.74	225.26	219.82
SD	N/A	25.09	22.77	23.63	21.67
PC to SC					
M	N/A	73.25	100.10	111.87	114.23
SD	N/A	162.42	204.14	176.05	212.70

"The more effort I put into my courses, the better I do in them" (1 = strongly disagree, 7 = strongly agree).

The primary academic control (PC) scale showed high internal reliability in each phase (α range: .80-.87), consistent with previous pencil-and-paper versions of this scale (e.g., α = .78, Hall, Perry, Ruthig, et al., 2006; α = .80, Perry et al., 2001). The present primary-control measure was also found to be negatively skewed (Skewness Time 1 = -1.13), with the majority of students scoring above the mid-point. 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, it should be noted that the degree of skewness decreased consistently with each phase (Skewness Times 2-5: -.82/-.72/-.56/-.54), with the distribution for this scale resembling a normal curve by the final study phase.

Secondary Control (SC). Secondary academic control was assessed using a measure based on the 4-item, 7-point Likert-style subscale of the Secondary Academic Control (SAC) Scale (see Hall, Chipperfield, et al., 2006; Hall, Perry, Ruthig, et al., 2006). The items concerned interpretive secondary-control strategies and 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 measure showed a respectable degree of internal consistency that improved over time (α range: .77-.85) and was notably higher than that found in recent pencil-and-paper administrations of this scale (α = .62, Hall, Perry, Ruthig, et al., 2006).

Reported Congruence (RC). A 7-point, 13-item measure assessing participants' self-reported ability to shift their emphasis between primary and secondary control following both positive and negative performance outcomes was developed for this study (see Appendix A; 1 = strongly disagree, 7 = strongly agree). The total RC scale showed acceptable reliability that improved over time (α range: .80-.89). Exploratory factor analyses (Varimax rotation, 3-factor restriction) also revealed an intended three-factor structure that became more evident over time.

For Time 1 RC, Factor 1 involved the perceived ability to make emphasis shifts from primary to secondary control with poor performance and included items like "I quickly realize when my effort is not paying off and am able to adjust my thinking accordingly" (item 7). Factor 2 reflected shifts from secondary to primary control with good performance and consisted of items such as "I am able to switch from adjusting to low grades to being more persistent if an opportunity for success arises" (item 6). Factor 3 included items concerning the perceived ability to shift back and forth (i.e., bidirectionally) such as "It is important to persist when success is possible and change my thinking about a class when it is not" (item 1).

Items expected to load on Factor 1 (items 2-4, 7, 9, 10), Factor 2 (items 6, 11-13), and Factor 3 (items 1, 5, 8) loaded at or over .30 on that factor. It should be noted that 6 of 13 items double-loaded on at least one other factor at Time 1, and that the lowest factor loadings were observed during this phase. In each of the subsequent phases, however, only three items were found to double load, all factor loadings exceeded .50, and all items loaded most highly on the expected factor. For example, whereas lower loadings were found for Factor 1 items at Time 1 (items 2/3/4/7/9/10 = .68/.79/.71/.32/.48/.54), Factor 1 loadings were noticeably higher by Time 5 (items 2/3/4/7/9/10 = .74/.85/.79/.65/.77/.76). It is also important to note that with the exception of one item (item 10, Time 1), all double-loading items were from the "Both" subscale, as would be expected considering the overarching nature of these RC items.

Reliability analyses for the three RC measures found the PC-to-SC subscale to be most reliable (α range: .75-.89), the SC-to-PC subscale to have slightly lower reliability (α range: .73-.83), and the bidirectional subscale, referred to as the "Both" subscale, to have the poorest, albeit most improved, reliability levels over time (α range: .41-.68). In fact, t-tests on observed improvements in reliability from the initial to final study phase found only the Both RC subscale to significantly increase in reliability throughout the study ($t = 4.58$, $p < .05$). Thus, although the directional RC subscales had acceptable reliability at the outset of the study, the bidirectional RC subscale had lower initial reliability levels that improved considerably over

TABLE 2. Construction of Observed Congruence (OC) Scores

1. SC scores are multiplied by 2.5 to equate with PC metric.
2. SC is subtracted from PC in each study phase, creating five relative emphasis scores.
3. Each score is subtracted from the next, creating four emphasis change scores.
4. Positive scores are recoded as a separate variable indicating an increased relative emphasis on PC (negative scores recoded as zeros), creating four SC to PC emphasis change scores.
Negative scores are reversed and recoded as a separate variable indicating an increased relative emphasis on SC (positive scores recoded as zeros), creating four PC to SC emphasis change scores.
5. SC to PC scores are multiplied by performance on the intermediate test, creating four SC to PC x success scores.
PC to SC scores are multiplied by the inverse of performance on the intermediate test, creating four PC to SC x failure scores.

time. Based on these factor analytic and reliability results, the three RC subscales were assessed separately in subsequent models.

Observed Congruence (OC). In order to examine actual behavior involving a shift in relative emphasis between primary and secondary control over time based on performance, scores reflecting observed congruent shifts were calculated based on the original control measures. As outlined in Table 2, the OC scores were calculated using a five-step process. First, because the primary- and secondary-control scales consisted of 10 and 4 items respectively, secondary-control scores were multiplied by 2.5 in order for both measures to have the same metric. In the second step, secondary control was subtracted from primary control in each study phase. This subtraction created a “PC minus SC” difference score for each phase, indicating participants' *relative emphasis* on primary control (positive scores) vs. secondary control (negative scores) at that time.

Following that, a third set of calculations was done to see if this relative emphasis changed over time. More specifically, to explore how much participants' relative emphasis on primary vs. secondary control changed from one phase to the next, the “PC minus SC” difference score from one phase was subtracted from the “PC minus SC” score from the next phase (e.g., Time 2 minus Time 1). For these new difference scores, positive values indicated a change in emphasis favoring primary control, whereas negative values indicated a change in emphasis favoring secondary control. To summarize, whereas the second calculation resulted in scores reflecting an emphasis on PC vs. SC in a given phase, the third calculation created scores indicating how that emphasis changed from one phase to the next.

However, one problem with the third calculation is that it results in scores that confound shifts toward primary control with shifts away from secondary control (positive scores), and shifts toward secondary control with shifts away from primary control (negative scores). This assumption that shifting toward one control process necessarily requires a shift away from the other is not consistent with the nonsignificant correlation between primary and secondary control found for college students (Hall, Perry, Ruthig, et al., 2006). Because of this, a fourth set of calculations was conducted to separate these positive and negative scores into two separate variables. The first variable retained the positive scores (and recoded the negative scores to zero), and as such, represented emphasis shifts toward primary control (SC to PC). The second variable retained the negative values (and recoded the positive values to zero), which were then reverse-coded in order for higher scores to represent greater emphasis shifts toward secondary control (PC to SC). Taken together, the fourth series of calculations resulted in two sets of variables indicating the *direction* of emphasis shift from one phase to the next (i.e., toward primary or secondary control; see Hypothesis 1).

Nevertheless, in order to address the present research questions concerning directional emphasis shifts in congruence with performance outcomes (Hypotheses 2-4), a fifth and final set of calculations was required. To create scores representing emphasis shifts toward primary control after success, each SC-to-PC score from Step 4 was multiplied by the percentage grade on the course test completed between the two phases involved. This resulted in four variables reflecting SC-to-PC shifts from one phase to the next (e.g., Time 1 to 2) in congruence with higher grades (e.g., on Test 1). In a similar manner, to create scores reflecting emphasis shifts toward secondary control after failure, each PC-to-SC score was multiplied by the inverse of the intermediate test score. Test scores were inverted before being multiplied in order for higher scores on these four variables to represent PC-to-SC shifts in congruence with lower grades. To sum up, as a result of this five-step process, two sets of variables representing observed congruence (OC) were created that allowed for an examination of how individuals shift toward primary control in response to success, and toward secondary control in response to failure.[3]

RESULTS

PRELIMINARY ANALYSES

Means Analyses. Repeated-measures ANOVAs were conducted on all study variables for participants who completed all study phases in order to assess mean level changes throughout the academic year. Means for study variables in each phase are provided in Table 1. Of the moderate to large effects observed ($\eta_p^2 > .04$; Huberty, 2002), significant linear effects were found for primary control, $F(303) = 39.19$, $p < .001$, $\eta_p^2 = .12$, and SC-to-PC reported congruence, $F(306) = 16.75$, $p < .001$, $\eta_p^2 = .05$, showing mean levels on these measures to steadily decline. Two variables were also found to have a significant *quadratic* or U-shaped trend over time, namely test performance, $F(487) = 124.93$, $p < .001$, $\eta_p^2 = .20$, and secondary control, $F(304) = 13.74$, $p < .001$, $\eta_p^2 = .04$. For test performance, the means for Tests 1 and 5 were over 73%, whereas the average for Tests 2 to 4 were approximately 4% lower. The quadratic effect for secondary control showed a steady decrease in mean levels from Time 1 to Time 3, and an increase of the same magnitude from Time 3 to Time 5.

Correlational Analyses. Correlations between performance and the self-report study variables within each phase are presented in Table 3. Of the sets of correlations not addressed in the main analyses, one showed a particularly interesting pattern. Although no significant correlation was found between primary and secondary control at Time 1, this relationship was increasingly positive and significant over time. This suggests that primary and secondary control were no longer orthogonal constructs by the end of the academic year; a finding consistent with the premise that secondary control becomes an increasingly complimentary back-up strategy when primary-control efforts become less effective (e.g., performance declines; Heckhausen & Schulz, 1995, 1998).

RATIONALE FOR ANALYSES

Analytical Models. Hypothesis 1 was evaluated in Model 1, which used regression-based path analyses to assess the causal relationship between test performance and emphasis shifts toward primary control, and toward secondary control. This analysis included actual performance measures predicting two types of difference scores reflecting changes in emphasis toward primary vs. secondary control (i.e., scores from Step 4, Table 2). The next three analyses evaluated Hypotheses 2 and 3 using cross-lagged structural equation models (SEM).[4] In the cross-lagged analyses, the cross-path coefficients were expected to be small in magnitude for two reasons. First, cross-lagged models typically include (a) highly significant auto-regressive paths, and (b) multiple cross-sectional correlations, leaving little remaining variance to be explained (cf., self-esteem research; Baumeister, Campbell, Krueger, & Vohs, 2003; Guay, Marsh, & Boivin, 2003). Second, study measures were operationalized in a way that restricted potential variance with respect to (a) a negatively skewed PC measure, (b) several manifest variables, and (c) OC variables that required PC and SC as covariates (ceiling effects). As a result of these statistical and methodological restrictions, the present causal analyses are highly conservative (see Appendix B)

3. It is important to note that the OC scores reflect a change in relative emphasis between PC and SC over time, not necessarily an overemphasis on one relative to the other. As the control processes assessed are assumed to be relatively stable, a large emphasis shift where one control process subsequently exceeds the other (e.g., from PC > SC to PC < SC) is less likely than a more subtle shift towards one control process (e.g., PC > SC to PC = SC). The OC scores are also not a zero-sum calculation where an increase in one control process entails a decrease in the other. OC scores simply indicate that one control process increased in emphasis *relative* to the other and not necessarily at the expense of the other. OC scores reflect any change in PC and SC that results in one control process having a greater emphasis over time relative to other, whether due to an increase or decrease in one or both types of control.

4. Structural equation models were assessed using AMOS 5.0 (Arbuckle, 2003). Steiger and Lind's (1980) root mean square error of approximation (RMSEA) was considered to be the most reliable fit index, as it is least affected by sample size, accounts for model complexity, and is sensitive to model misspecification (for model complexity, see Appendix B). RMSEA is also better suited to confirmatory hypothesis testing than incremental fit indices that function best in exploratory research with smaller samples (e.g., CFI, TLI; see Rigdon, 1996). 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 (Hu & Bentler, 1999; MacCallum, Browne, & Sugawara, 1996).

TABLE 3. Correlational Analyses

	1	2	3	4	5	6
1. Test performance	—					
2. Primary control	.33/.34/.31/.32/.36	—				
3. Secondary control	-.17/-.06/-.02/.07/.05	.06/.09/.20/.18/.23	—			
Reported congruence						
4. SC to PC	.09/.12/.10/.16/.23	.22/.43/.42/.40/.44	.27/.33/.40/.38/.37	—		
5. PC to SC	-.12/-.08/-.14/-.11/-.08	.00/.08/.04/.02/.07	.38/.38/.42/.43/.48	.44/.37/.40/.44/.41	—	
6. Both	.07/.09/.10/.11/.11	.24/.25/.31/.33/.30	.41/.39/.42/.47/.45	.33/.40/.42/.48/.40	.39/.46/.50/.57/.56	—
Covariates (Time 1)						
7. Performance orientation	.05/.07/.09/.12/.04	.14/.13/.08/.18/.15	.02/.00/-.02/.03/.00	.32/.21/.14/.23/.11	.03/-.03/-.03/-.06/-.09	.08/.04/.14/.11/.12
8. Mastery orientation	.02/.07/.04/.07/.06	.27/.16/.20/.20/.18	.36/.33/.36/.31/.36	.32/.32/.29/.28/.22	.20/.18/.24/.19/.21	.25/.22/.24/.21/.25

Note. $p < .05$ for $|r| > .10$ (Time 1), $|r| > .08$ (Times 2-4), $|r| > .09$ (Time 5). Correlation between performance and mastery orientation at Time 1: $r(402) = .27$, $p < .001$.

and minimize Type I error, and require that modest cross-path coefficients be given considerable weight (see Prentice & Miller, 1992). To assess the predictive validity of the direction-specific reported congruence measures (Hypothesis 2), Model 2 tested whether these two measures predicted the observed congruence variables (i.e., Step 5, Table 2) to which they corresponded. The causal paths between the reported and observed shifts toward primary control with better grades was assessed in Model 2a, and paths involving shifts toward secondary control with poorer grades were assessed in Model 2b.

To assess the predictive validity of the bidirectional reported congruence measure (Hypothesis 3a), a more complex cross-lagged analysis shown in Model 3 evaluated the causal relations between the bidirectional reported congruence measure and both types of observed congruence variables simultaneously. The final SEM analysis (Model 4) evaluated a cumulative, mediational model based on the preceding analyses, and also evaluated Hypotheses 3b and 4. In this model, the original primary- and secondary-control scales predicted the bidirectional reported congruence measure (Hypothesis 4b), which in turn predicted the two directional RC measures (Hypothesis 3b). Each directional RC measure, in turn, predicted its respective observed congruence variable (Hypotheses 2). Causal paths between the original control scales and the two OC variables were also included (Hypothesis 4a), and the entire model was assessed four times (Time 1-4 self-report measures predicting subsequent OC scores) to evaluate replicability and changes in relations over time.

Covariate Information. Test performance was controlled for in all SEM analyses to ensure that the OC scores did not mainly represent performance but rather the extent to which control approaches changed in congruence with performance. The original primary- and secondary-control measures were also included as covariates in the cross-lagged analyses to control for potential ceiling effects. To control for the highly common and effective nature of increased primary control following failure events (see Perry, 1991, 2003 for reviews; cf. reactance, Wortman & Brehm, 1975), and provide a clearer analysis of the motivating influence of success, performance orientation (see Study Measures) was included as a covariate in all main analyses. Further, despite the apparent similarity between mastery orientation and secondary control (e.g., learning from failure; see Table 3), mastery orientation was also controlled for in subsequent analyses. As mastery-oriented individuals are also characterized by a tendency to select domains with a greater likelihood of failure, controlling for this variable allowed for a clearer analysis of how people respond to poor performance regardless of how expected or desirable it was. Supplemental information on covariates, correlations, and parcelling is provided in Appendix B, with information on the interpretation of figures provided in footnote 5.

MODEL 1: OBSERVED CONGRUENCE

Model 1 evaluated the first hypothesis that people generally shift toward PC following success and toward SC after performing poorly. Because all of the main variables were manifest in nature, a path analytic model based on regression analyses was assessed in which test performance predicted both SC-to-PC and PC-to-SC emphasis changes, controlling for auto-regressive paths. These emphasis change scores are not the final OC scores, but instead indicate emphasis shifts toward PC or toward SC irrespective of their congruence with performance outcomes (Table 2, Step 4).

As shown in Figure 1, strong auto-regressive paths were found between the test performance measures (βs = .59-.72, $p < .001$), showing future grades to be positively predicted by previous performance. Significant auto-regressive paths were also found between the emphasis change variables, indicating that if participants made multiple emphasis shifts, they tended to differ in magnitude from one phase to the next (e.g., large shift followed by a smaller shift). This finding was observed for shifts toward PC relative to SC (Time 3-4 to 4-5: β = -.15, $p < .05$) and shifts toward SC relative to PC (Time 2-3 to 3-4, Time 3-4 to 4-5: β = -.16, $p < .01$). These paths suggest that

5. 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. Error terms, correlations, and covariates are not presented to allow the hypothesized relationships to be more clearly depicted. In the figures for phase-specific SEM analyses, Beta values for each phase are separated by a forward slash (Times 1/2/3/4), and the OC variables represent the four phase-to-phase calculations (Times 1-2/2-3/3-4/4-5).

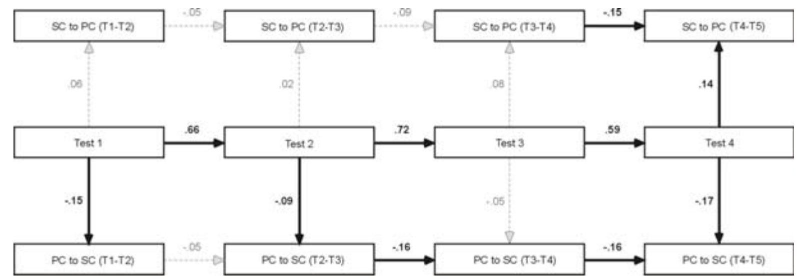

FIGURE 1. Model 1: Path Analysis of Performance and Observed Emphasis Shifts.

participants were not inclined to make repeated emphasis shifts of similar magnitude toward a specific control approach (e.g., two equally large shifts toward PC in a row), but instead tended to make repeated emphasis changes that differed in magnitude (e.g., a larger shift toward PC followed by a smaller shift toward PC).

Concerning the causal paths of interest (see Figure 1), this model provides support for the first part of Hypothesis 1 in showing success to significantly predict emphasis shifts toward PC. Higher grades on Test 4 predicted increased subsequent emphasis on PC relative to SC (β = .14, $p < .01$), with a similar, nonsignificant trend found following Test 3 (β = .08, $p < .10$). These results are also consistent with the second part of Hypothesis 1, in showing poorer grades to significantly predict shifts toward SC. Increased emphasis on SC relative to PC was significantly predicted by lower grades on Test 1 (β = -.15, $p < .01$) and Test 2 in the first semester (β = -.09, $p < .05$), as well as on Test 4 in the second semester (β = -.18, $p = .001$). In providing empirical support for Hypothesis 1, these findings also support the subsequent use of the final OC scores in which emphasis shifts are multiplied by performance outcomes (Table 2, Step 5).

MODEL 2: REPORTED AND OBSERVED CONGRUENCE, DIRECTIONAL MEASURES

Two cross-lagged SEM analyses were used to evaluate Hypothesis 2 concerning the predictive validity of two self-report measures involving the perceived ability to shift toward PC with success (Model

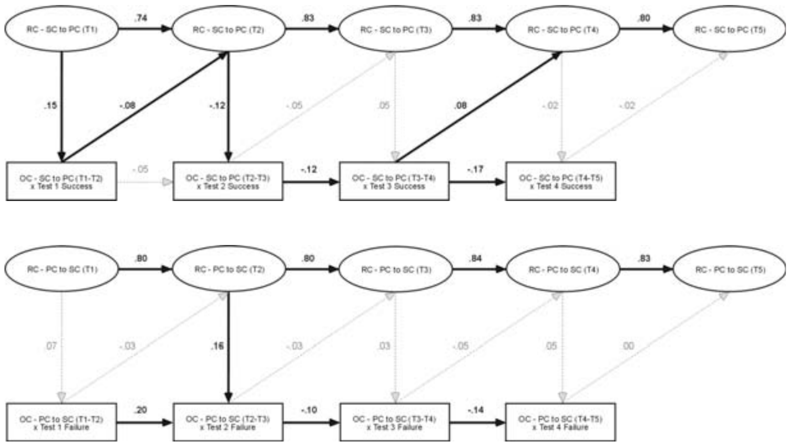

FIGURE 2. Model 2a: Cross-lagged Analysis of Reported vs. Observed SC-to-PC Emphasis Shifts in Congruence with Better Performance (Success). Model 2b: Cross-lagged Analysis of Reported vs. Observed PC-to-SC Emphasis Shifts in Congruence with Poorer Performance (Failure).

2a) or toward SC with failure (Model 2b; see Figure 2). In addressing shifts toward PC with success, Model 2a showed adequate model fit (RMSEA = .06, CFI = .80, TLI = .78). Strong positive auto-regressive paths between the RC measures, as well as increasingly negative auto-regressive paths between the OC scores were also observed. These paths indicate that although participants' perceived ability to shift from SC to PC with success was highly stable, actual repeated shifts of similar magnitude from SC to PC following success were less common. Instead, if multiple shifts toward PC after success were observed, they tended to differ in magnitude from one phase to the next (e.g., notably smaller shifts toward PC after repeated success experiences).

Concerning the cross-paths of interest, results showed the SC-to-PC RC measure to more strongly predict the corresponding OC scores than vice versa. As anticipated, the strongest causal path showed the first RC scale (Time 1) to positively predict subsequent OC scores (Time 1-2; $\beta = .15$, $p < .05$). However, the remaining results from Model 2a were mixed. In contrast to the initial positive path

from RC to OC measures, the next path from RC (Time 2) to OC (Time 2-3) was negative ($\beta = .12$, $p = .05$). Although OC scores were also found to significantly predict RC measures, the first path from OC (Time 1-2) to RC (Time 2) was negative ($\beta = -.08$, $p = .05$), whereas the second path from OC (Time 3-4) to RC (Time 4) was positive ($\beta = .08$, $p < .05$). It should be noted that the negative paths achieved only marginal significance ($p = .05$), and that the path showing RC to positively predict OC scores was nearly twice as strong as those showing OC to predict RC measures. Thus, despite mixed results, the strongest findings from Model 2a suggest that the SC-to-PC RC measures more strongly predict OC scores than vice versa.

The second cross-lagged analysis presented in Model 2b examined the proposed causal relationship between the RC and OC variables involving a shift toward SC with failure (see Figure 2). This model fit the data well (RMSEA = .05, CFI = .84, TLI = .82) and showed strong auto-regressive paths for the RC scale. An interesting series of auto-regressive paths between OC scores was also found, with the first being positive, and the latter two negative. This suggests that participants tended to make shifts of similar magnitude toward SC after repeated poor performance in the first semester, yet were later inclined to change how much they shifted toward SC if they continued to do poorly in the second semester (e.g., made increasingly smaller shifts toward SC after repeated poor performance). Concerning the cross-paths of interest, Model 2b showed the PC-to-SC RC scale to significantly predict the corresponding OC scores. As outlined in Figure 2, the only significant causal path showed the second RC scale (Time 2) to positively predict OC scores (Time 2-3; $\beta = .16$, $p < .01$). Taken together, the results from Model 2 provide empirical support for Hypothesis 2 in showing the self-report RC measures involving directional emphasis shifts to positively predict the corresponding OC scores.

MODEL 3: REPORTED AND OBSERVED CONGRUENCE, BIDIRECTIONAL MEASURES

A more complex cross-lagged SEM model (Figure 3) was used to evaluate Hypothesis 3a concerning the causal relationships be-

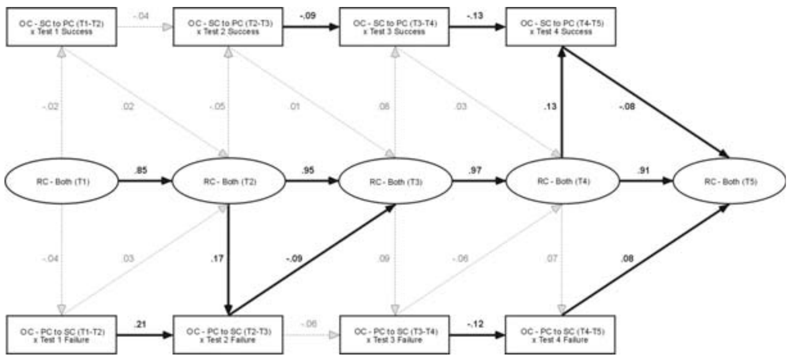

FIGURE 3. Model 3: Cross-lagged Analysis of Reported vs. Observed Bidirectional Emphasis Shifts in Congruence with Performance.

tween the RC scale involving bidirectional emphasis shifts and both OC variables indicating shifts toward PC with better grades, and toward SC with poorer grades. This model provided an adequate fit to the data (RMSEA = .08, CFI = .70, TLI = .66). Fit indices were notably lower than for Models 2a and 2b likely due to considerably greater model complexity and the inclusion of several manifest variables (see Appendix B; Footnote 4). Strong auto-regressive paths for the RC variables were observed, and auto-regressive paths for both OC variables were similar to those found in Models 2a and 2b.

With respect to the cross-paths of interest, the bidirectional RC scale positively predicted both emphasis shifts toward PC with success (RC Time 4 to OC Time 4-5; $\beta = .13$, $p < .05$) and toward SC with poor performance (RC Time 2 to OC Time 2-3; $\beta = .17$, $p = .01$). Significant OC to RC paths were also observed, with SC-to-PC OC scores negatively predicting later RC levels (OC Time 4-5 to RC Time 5; $\beta = -.08$, $p < .05$), and PC-to-SC OC scores both negatively and positively predicting later RC measures (OC Time 2-3 to RC Time 3; $\beta = -.08$, $p < .05$; OC Time 4-5 to RC Time 5; $\beta = .08$, $p < .05$). Concerning the negative OC to RC paths, these paths were found to immediately follow, and be weaker than, the positive RC to OC paths. As such, this model provides empirical support primarily for the predictive validity of the bidirectional RC measure.[6]

MODEL 4: MEDIATIONAL PROCESS MODEL

Following from the preceding causal analyses, the interrelationships between all study variables were assessed as part of a cumulative, mediational process model (Figure 4). PC and SC predicted the bidirectional RC scale (Hypothesis 4b) as well as both types of OC scores (Hypothesis 4a). Paths from PC and SC to the directional RC measures were also included to provide a more conservative analysis. The three RC scales were organized in a hierarchical manner, with the bidirectional RC scale predicting the two directional RC scales. Each directional RC scale, in turn, predicted both types of OC scores (cf., Model 2) to assess the predictive and discriminant validity of these measures. According to Hypothesis 3b, the bidirectional RC scale should indirectly predict OC scores through a hierarchical relationship with the directional RC scales. This mediational model was evaluated four times, with the self-report measures (Times 1-4) predicting subsequent OC scores. Test performance (as included in the OC scores) as well as performance and mastery orientation were included as covariates. Correlations between PC and SC, between the two directional RC scales, and between the two OC scores were also included.

Model 4 fit the data well in each replication (Times 1-4: RMSEA = .05; CFI = .83/.88/.88/.87; TLI = .80/.86/.85/.84). As shown in

6. Although these paths could suggest that acting on one's congruence-related beliefs leads to less confidence in one's ability to make congruent emphasis shifts, a more likely explanation involves the specific wording these RC scale items. Whereas the two directional RC scales asked participants to directly evaluate their ability to make emphasis changes, the bidirectional RC items instead referred to the perceived importance of shifting back and forth based on one's grades. Thus, just as greater emphasis shifts toward PC or SC were generally followed by smaller shifts in that direction (auto-regressive paths, OC scores), this finding may be due to this self-report measure capturing, to some extent, the perceived importance of making bidirectional shifts at a given time, with subsequent behaviors serving to satiate this need and reducing perceived importance levels.

Figure 4, significant positive paths were found from PC and SC to the bidirectional RC scale throughout the academic year. Although significant paths were also found from PC to the SC-to-PC RC scale (Times 2-4), and from SC to the PC-to-SC RC scale (Time 3), the paths from PC and SC to the bidirectional RC scale were much stronger. Thus, these paths provide support for Hypothesis 4b in showing higher levels of PC and SC to contribute to a greater perceived ability to alternate between them based on performance.

A consistently negative path from PC to the PC-to-SC RC scale was also observed in Model 4. Although PC predicted higher levels on this directional RC scale indirectly through a positive relationship with the bidirectional RC scale, it was also found to directly predict lower levels on this directional scale. Significant ceiling effects were observed for both PC and SC with respect to the corresponding OC scores. Consistent with Hypothesis 4a, participants with higher PC levels were significantly less likely to keep switching toward PC after success, and those with higher SC levels were less likely to continue shifting toward SC after poor performance. Concerning the paths from PC and SC to the noncorresponding OC scores, a consistently significant path also showed SC to positively predict subsequent emphasis shifts toward PC with higher grades throughout the academic year.

With respect to predictive validity of the directional RC measures, the SC-to-PC RC scale positively predicted SC-to-PC OC scores (Times 1 and 4), and the PC-to-SC RC scale positively predicted PC-to-SC OC scores (Times 1, 2, and 4; Time 3 p = .10). In contrast to Model 2, in which multiple significant RC to OC paths were unlikely (due to earlier paths being controlled for), this phase-specific approach showed both directional RC measures to significantly predict the corresponding OC scores throughout the academic year. In terms of discriminant validity, the SC-to-PC RC scale negatively predicted PC-to-SC OC scores (Time 4; Time 1 at p < .10), and the PC-to-SC RC scale negatively predicted SC-to-PC OC scores (Times 1 and 4). As such, the directional RC measures not only positively predicted the OC scores to which they corresponded (Hypothesis 2), but also negatively predicted OC scores involving shifts in the other direction.

The results from Model 4 also provide empirical support for Hypothesis 3b in showing the bidirectional RC measure to positively predict actual emphasis shifts via an indirect, hierarchical relation-

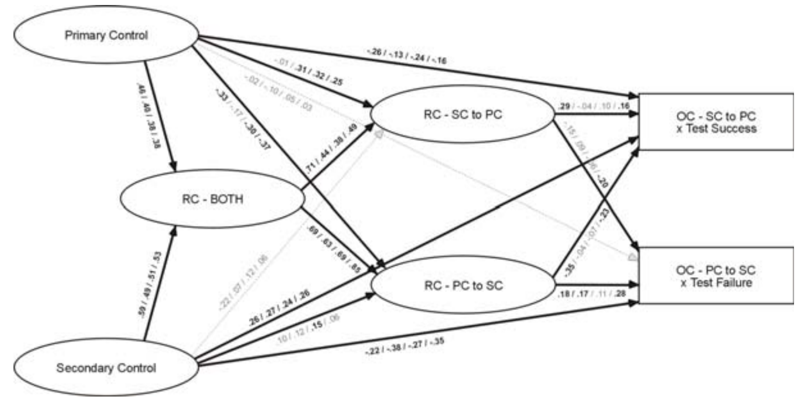

FIGURE 4. Model 4: Mediational Process Model at Times 1-4.

ship with the more specific RC scales. Controlling for significant paths from the original PC and SC measures, the strongest paths in Model 4 showed the Both RC scale to positively predict both directional RC scales in each study phase. These two RC scales, in turn, predicted the corresponding OC scores in multiple study phases, thus showing the bidirectional RC scale to indirectly predict observed emphasis changes through the proposed hierarchical relationship with the directional RC measures.

DISCUSSION

Existing research consistently demonstrates the importance of primary and secondary control from childhood (Band & Weisz, 1990; Langrock, Compas, Keller, Merehaht, & Copeland, 2002; Thurber & Weisz, 1997; Weisz et al., 1994) and young adulthood (Heckhausen & Tomasik, 2002; Petito & Cummins, 2000; Wadsworth & Compas, 2002) to old age (Chipperfield & Perry, 2006; Lang & Heckhausen, 2001; Wrosch et al., 2000), with the dual-process model proposed by Rothbaum et al. (1982), and extended by Heckhausen and Schulz (1995), having contributed significantly to our understanding of how people adjust to developmental challenges across the life span. The present study underscores the significance of primary and secondary control in an achievement setting in exploring individuals' self-regulatory capacity to alternate between them over time in congruence with actual performance outcomes. Following from recent research on the implications of primary and secondary control in academic achievement settings (e.g., Hall, Chipperfield, et al., 2006; Hall, Perry, Ruthig, et al., 2006), this study provides empirical support for the premise that people do change their relative emphasis on these control approaches based on performance feedback, and further, highlights the predictive validity of self-report measures to assess individuals' perceived ability to do so.

HYPOTHESIS 1: OBSERVED CONGRUENCE

Hypothesis 1 suggested that a shift toward primary relative to secondary control should be observed after success, whereas a shift toward secondary relative to primary control should be found following poor performance. The results from Model 1 support this hypothesis in showing higher test scores to correspond with subsequent emphasis shifts toward primary control (after Test 4; Test 3, $p < .10$), and poorer grades to predict emphasis shifts in favor of secondary control (after Tests 1, 2, and 4). In other words, when an individual performed well, any subsequent change in these control process was more likely to involve an increased relative emphasis on primary as opposed to secondary control, with the opposite emphasis shift being more likely after one performed poorly. Following from these results, these emphasis change scores were then multiplied by performance to create the final Observed Congruence (OC) scores that were then used to evaluate the extent to which these congruent emphasis shifts could be predicted by the self-report measures (see Table 2, Step 5).

Findings from Model 1 further suggested that emphasis shifts toward secondary control may occur more frequently than shifts toward primary control. It is important to note, however, that this finding may be due to the primary control scale having a strong negative skew that steadily improved over time. In other words, although emphasis changes toward primary relative to secondary control did occur after later success experiences, an initial tendency to overemphasize primary control regardless of performance was found at the start of the academic year (a typical overemphasis among young adults at the outset of transition phases; Heckhausen & Schulz, 1995, 1998). In contrast, a more normal distribution and greater variability was found for the secondary control measure making it more likely that emphasis shifts toward this control process would be observed.

HYPOTHESES 2 AND 3A: REPORTED AND OBSERVED CONGRUENCE

The present findings also provide empirical support for the utility of self-report measures to assess one's ability to alternate between primary and secondary control in congruence with performance. Initial factor analyses revealed a clear three-factor structure for the Reported Congruence (RC) items, supporting the use of three increasingly reliable measures involving shifts toward primary control with success (SC-to-PC RC), toward secondary control with failure (PC-to-SC RC), and back and forth in congruence with both performance outcomes (Both RC). Following from these analyses, cross-lagged analytical models provided empirical support for the predictive validity of the directional as well as bidirectional self-report measures.

Directional Congruence Measures (Hypothesis 2). Both self-report measures involving emphasis shifts toward a specific control approach were found to significantly predict actual, corresponding emphasis changes in congruence with performance. In Model 2a, results showed the SC-to-PC RC scale (Time 1) to more strongly predict emphasis shifts toward primary control after success (Time 1-2) than vice-versa. In a similar manner, Model 2b produced only a single significant causal path showing the PC-to-SC RC scale (Time 2) to positively predict subsequent emphasis shifts toward secondary control after poor performance (Time 2-3). Taken together, these findings suggest that perceptions predict behavior with respect to directional, performance-based shifts between control approaches, and thus support Hypothesis 2 concerning the predictive utility of the directional self-report measures developed for this study.

The results from Models 2a and 2b also revealed a series of significant auto-regressive paths indicating continued calibration of emphasis shifts made in congruence with performance. In terms of congruent shifts later in the year, these paths suggest that if people did make repeated emphasis shifts based on their grades, they did not shift the same way each time but instead followed up one emphasis change (e.g., a large shift toward PC after success) with another that differed in magnitude (e.g., a smaller or no shift toward PC after success). Considered in combination with the declining (SC-to-PC) or plateauing (PC-to-SC) OC scores shown in Table 1, the most plausible interpretation is that these changes in magnitude is that they involved increasingly smaller shifts in emphasis toward a specific control process. Together, these auto-regressive paths and mean OC scores suggest that the calibration of control-related emphasis changes does occur, and further, is more likely to happen later in the academic year and involve increasingly smaller, performance-congruent shifts toward a specific control approach.

One notable exception to this overall finding, however, is the initially positive auto-regressive path found between the OC scores indicating shifts toward secondary control after poorer performance. Whereas the general tendency later on was for repeated emphasis changes to become increasingly smaller, this result suggests that if repeated emphasis shifts toward SC happened early on, these changes were made to consistently increase one's reliance on SC relative to PC after repeated poor performance. This interpretation is consistent with the PC-to-SC OC means in Table 1 showing a substantial increase in shifts toward SC after poor performance on Test 2 as compared to Test 1, followed by consistently large emphasis shifts toward SC after later tests. In summary, in addition to providing empirical support for Hypothesis 2, Models 2a and 2b showed significant auto-regressive paths between OC scores. These auto-regressive paths highlight the potentially adaptive nature of continued emphasis shifts toward secondary control after repeated poor performance early on, combined with increasingly smaller, performance-congruent shifts toward either control approach later in the year.

Bidirectional Congruence Measure (Hypothesis 3a). Consistent with Hypothesis 3a, Model 3 found higher scores on the bidirectional RC scale to predict shifts toward primary control after higher grades, as well as shifts toward secondary control after poor grades. Unlike the direction-specific RC scales that negatively predicted OC scores indicating a shift in the other direction (see Model 4), the bidirectional RC scale, involving the perceived ability to shift back and forth based on performance, positively predicted both types of emphasis shifts. These results underscore the unique predictive validity of this third, higher-order self-report measure, and provide empirical support for the hierarchical organization of these constructs as investigated in later analyses (Hypothesis 3b, Model 4).

The results from Model 3 also revealed an interesting causal ordering of emphasis shifts toward primary vs. secondary control based on Both RC levels. More specifically, multiple significant paths indicated that those with a greater perceived ability to shift bidirectionally tended to focus first on shifting toward secondary control if they performed poorly (RC Time 2 –> PC-to-SC OC Time 2-3), and then on shifting toward primary control if they performed well later on (RC Time 4 –> OC Time 2-3). These results suggest although individuals in general tend to shift toward SC after lower grades sooner and more frequently than toward PC after better grades (Models 1, 2b), those who perceive themselves as better able to make congruent emphasis shifts are even more likely to show this sequence of emphasis changes. To summarize, the findings from Model 3 are consistent with Hypothesis 3b in supporting the predictive validity of the bidirectional RC measure, and further, suggest those who perceive themselves as better able to make emphasis shifts focus first on protecting their motivation through SC after initial failure experiences, and then shift toward PC later on if opportunities for success arise.

HYPOTHESES 2-4: MEDIATIONAL PROCESS MODEL

Following from the preceding causal analyses, an elaborated mediational model was evaluated in order to assess the remaining hypotheses and provide a process-oriented, conceptual heuristic showing how primary and secondary control contribute to the perceived and demonstrated capacity to alternate between them. As outlined in Hypothesis 4b, primary and secondary control positively predicted the bidirectional RC scale, consistent with premise that greater familiarity with both control approaches contributes to an overarching perceived ability to alternate between them based on performance. This finding is consistent with recent research showing high levels of both primary and secondary control to promote optimal adjustment for initially unsuccessful students (Hall, Perry, Ruthig et al., 2006), and further, suggests that the observed benefits of this combination may be due to this higher-order, self-regulatory capacity to shift between them based on performance.

Consistent with Hypothesis 3b, this bidirectional RC measure was, in turn, found to predict observed emphasis changes via a hierarchical relationship with the direction-specific RC scales. In other words, although the perceived ability to alternate between primary and secondary control was initially found to directly predict observed emphasis changes (Model 3), these beliefs also indirectly predicted observed emphasis shifts through a top-down relationship with more specific beliefs involving shifts toward primary control after success, or toward secondary control after failure (Model 4). Furthermore, not only did the directional RC scales positively predict the OC scores to which they corresponded (Hypothesis 2), they were also found to negatively predict subsequent emphasis shifts toward the alternative control approach, thus highlighting both the predictive and discriminant validity of these measures. In sum, this process model represents a fully mediated conceptual heuristic showing how primary and secondary control contribute to perceptions and behavior involving a higher-order ability to alternate between them in congruence with performance outcomes. As such, this model provides empirical support for Hypotheses 2 through 4, and further, allows for considerable confidence in the findings observed because it followed from highly conservative cross-lagged analyses, was replicated in multiple study phases, and fit the data well in each replication.

In addition to these main results, an intriguing set of results was observed in which secondary control was found to positively predict emphasis shifts toward primary control following a success experience. Taken together with findings from preceding analyses, these paths once again suggest that SC acts as a back-up to failed PC efforts in an academic achievement setting by buffering against early failure experiences and promoting later control-striving. This idea was first suggested by preliminary analyses showing increasingly positive correlations between PC and SC, and mean SC levels to increase while PC and performance levels declined. Subsequent analytical models further showed that shifts toward SC after poor performance tend to precede shifts toward PC after success (Models 1, 3), suggesting that early shifts toward SC after failure serve to preserve one's motivation and allow for later shifts toward PC if opportunities for success arise. As such, the significant paths from SC to shifts toward PC after success in Model 4 are consistent with primary/secondary theory and contribute to the cumulative empirical evidence in this study that "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" (Heckhausen & Schulz, 1998, p. 57).[7]

STRENGTHS AND LIMITATIONS

Inherent in this study are two critical strengths that contribute to the internal and external validity of findings described above. The first strength is the study sample, which was sufficiently large so as to not compromise the power of SEM analyses, and showed demographic characteristics consistent with those of similar pencil-and-paper studies. The sample was also recruited from a single multisection course which allowed for the number, weight, and content of course exams to be equivalent across participants. However, the sample was notably heterogenous in terms of students' faculty affiliations, allowing the findings to generalize to individuals enrolled in various academic programs (Footnote 1). Furthermore, preliminary analyses indicated considerable student engagement as demonstrated by low study attrition despite multiple study phases. Finally, based on a two-part empirical rationale involving rate of responding and inter-item correlations, participants who were not engaged in the web-based experimental protocol were excluded to minimize unwanted error variance.

The second strength of this research is that in addition to providing a comprehensive, domain-specific examination of a relatively unexplored self-regulatory facet of primary/secondary control theory, this longitudinal study was conducted in a field setting and

7. A second unanticipated finding showed higher primary control to directly predict lower perceived confidence in one's ability to shift toward secondary control after performing poorly. Although disconcerting, this finding is consistent with recent research highlighting the academic and health risks of relying on primary at the expense of secondary control in achievement settings (Hall, Chipperfield, et al., 2006; Hall, Perry, Ruthig, et al., 2006). It should be noted, however, that primary control was unrelated to actual emphasis shifts toward secondary control following poor performance.

explored how individuals respond to actual performance feedback. In contrast to simulation or cross-sectional studies, actual shifts between primary and secondary control over time were assessed with respect to real success and failure experiences. This study was also conducted over the course of an academic year, allowing for a comprehensive series of cross-lagged analyses and model replications to be conducted. As such, the present research offers an ecologically valid perspective on congruence processes in exploring how individuals shift their emphasis between primary and secondary control in a real-life achievement setting.

In addition to these strengths, two important limitations should be considered when interpreting these results. First, the initially poor reliability levels for the bidirectional reported congruence measure may have contributed to a lack of significant findings for this measure early in the first semester. This lower reliability may have been due to this measure having the fewest number of items or perhaps because students' higher-order thinking about congruence is less developed at the start of the academic year. It should be noted, however, that this measure showed a statistically significant improvement in reliability over time, and that the effects of initially lower reliability were minimized by the use of latent variables in the SEM analyses. Nonetheless, future research examining this self-regulation process utilizing an elaborated self-report measure is warranted.

Second, whereas the secondary-control measure used in this study addressed students' use of a specific secondary-control strategy involving the 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. As such, the use of a primary-control measure based on perceived control research in combination with a secondary-control scale based on Heckhausen's strategy-oriented model may have contributed to fewer significant findings for these variables as well as the observed congruence measures (for more on primary/secondary control beliefs vs. strategies, see Skinner, 1996; Morling & Evered, 2006). Future studies utilizing both belief- and strategy-oriented measures are encouraged in order to disentangle the potentially differential implications of regulating control beliefs vs. strategies in achievement settings.

CONCLUSION

The results of the present study provide empirical support for the previously unexplored self-regulatory implications of primary/secondary control theories in showing emphasis shifts favoring primary control to occur after success, and shifts toward secondary control to occur following a failure experience. This study also provides a cumulative, replicated, and effective process model for understanding how primary and secondary control contribute to perceptions and behavior involving shifts between control approaches based on performance. Thus, whereas previous research has found higher levels of primary and secondary control to contribute to better health, motivation, and performance in achievement settings, this study highlights the potential added benefit of a higher-order ability to alternate between these control processes in congruence with performance. To summarize this research in the words of the Prayer of Serenity, whereas primary control gives individuals the courage to change what they can, and secondary control allows them to accept what they cannot change, these findings illustrate the importance of "the wisdom to know the difference," namely the ability to regulate one's control beliefs and strategies based on the opportunities and challenges in real-life achievement settings.

APPENDIX A

REPORTED CONGRUENCE MEASURES

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 accord-

ingly.

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.

Note. PC to SC: items 2-4, 7, 9, 10; SC to PC: items 6, 11-13; Both: items 1, 5, 8. Response scale – Likert-style: 1 (strongly disagree) to 7 (strongly agree).

APPENDIX B

Supplemental Rationale for SEM Analyses

As recommended by Marsh and Hau (1996), all cross-lagged SEM models were first evaluated including all correlations between error terms for the same scale items in different phases to control for systematic measurement error. However, because many correlations were not significant, all nonsignificant ($p > .10$) correlations involving item residuals were removed and the model reassessed in an iterative manner until no nonsignificant correlations remained. The residuals for the manifest test performance were not intercorrelated in cross-lagged analyses. Error terms for the emphasis change variables were also not intercorrelated as the unexplained variance in observed emphasis shifts was not assumed to be systematic. With respect to covariates, test performance was controlled for in all SEM analyses to ensure that the OC scores did not primarily represent performance but rather the extent of observed congruence with performance outcomes. Performance and mastery orientation (Time 1) were also included as covariates in all causal models, with each latent SEM variables predicting four scale items.

Latent PC and SC variables were included as covariates in the cross-lagged analyses (unless otherwise indicated). When included as covariates for observed emphasis shifts, directional paths from PC and SC to the emphasis change scores were modelled to reflect their temporal sequence. As a covariate, the latent PC variable predicted two PC parcels based on factor analyses distinguishing between positively (items 1, 2, 5, and 9) and negatively-worded items (items 3, 4, 6-8, 10). In addition to making large-scale models more parsimonious, parcels have also been shown to have a stronger relationships with latent variables, be 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). The latent SC variable, both as a covariate and main variable, predicted all SC items. As suggested by Finkel (1995), covariates in cross-lagged models included the covariate variable from each study phase as well as auto-regressive paths between adjacent assessments of that covariate.

To summarize, although not presented in the figures, each cross-lagged model included test performance, PC, and SC as covariates, and all path/SEM analyses controlled for baseline measures of performance and mastery orientation. More specifically, cross-lagged models included (a) the auto-regressive 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 emphasis change score (e.g., Time 1 PC to Time 1-2 OC), (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 RC). An exception to this last set of correlations was test performance (Tests 1-4) which although was correlated with the appropriate OC variable in each phase (e.g., Test 1 with Time 1-2 OC), was correlated with the latent main and covariate variables from the subsequent phase (e.g., Test 1 with Time 2 PC). Test performance was also correlated with the latent covariates from the subsequent phase when examined as a main variable. Finally, because only Tests 1 through 4 were included as covariates, the Test 1 covariate was correlated not only with latent main and covariate variables from Time 2 but also with those from Time 1 to ensure that Time 1 variables were also evaluated with performance controlled for.

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