Perceived Control and Failure Preoccupation in Academic Computing: Effects on Cognitions, Emotions, and Achievement Outcomes

Maymon, R.,[a] Hall, N. C.,[a] Perry, R. P.,[b] & Hladkyj, S.[b]
[a]McGill University
[b]University of Manitoba

INTRODUCTION

The increasing use of computers in educational settings has prompted increasing research interest how students deal with technological problems, particularly in secondary education. More specifically, the impact of students' computer use and attitudes on learning and achievement has attracted the attention of many researchers over the past several years (Hannon, 2013; Littlejohn et al., 2012; Phelps et al., 2005). In particular, previous research on computer-based learning environments has demonstrated significant relationships between computer self-efficacy and learning processes and outcomes (Moos & Azevedo, 2009). With respect to instructional technology, Hove and Corcoran (2008) also highlight the importance of examining student emotions in technology-rich (web-based) educational settings. As educational institutions continue to utilize digital platforms in support of both logistics and learning, it is essential to examine the implications of students' perceptions of academic computing issues for motivation, learning, and achievement. Although perceptions of competence regarding computers have been previously addressed with respect to perceptions of ability, as has computer anxiety (Cooper, 2006; He & Freeman, 2010; Huang et al., 2013), how students interpret and respond to academic computing difficulties has been marginally explored. Thus, despite great interest in the field of computer use in education, there is currently a lack of research exploring motivation and emotions specific to technology-related challenges in educational settings, as well as their link to objective academic achievement outcomes.

Research in higher education consistently shows perceptions of control to predict increased achievement striving and performance (Perry, 1991; Perry et al., 2007). Further studies (Perry et al., 2001, 2005) show effects of perceived control to be moderated by other psychosocial factors, such as failure preoccupation (i.e., state orientation as outlined in action control theory and perseveration concerning academic failure events; Kuhl 1985, 1994, 1996). Perry et al. (2001; *Journal of Educational Psychology*) showed students with higher perceived control beliefs concerning the causes of their academic performance to report more adaptive cognitions (e.g., attributions to effort) and emotions (e.g., lower boredom, anxiety) compared to those with lower perceived control beliefs. Furthermore, a two-way interaction effects showed students with high levels of control as well as preoccupation with failure to receive higher final course grades than their peers. This two-way interaction was subsequently replicated in a three-year longitudinal study showing high-PC/high-FP students to obtain higher cumulative academic achievement (GPA) as well as lower voluntary course withdrawal levels (Perry et al., 2005). In an effort to extend research on students' motivation and emotions regarding academic computing difficulties in a manner consistent with research on perceived academic control, the present study aimed to examine the effects of perceived control and failure preoccupation regarding academic computing.

More specifically, the present longitudinal study examined the effects of college students' perceived control and preoccupation with failure, with respect to using computers to complete academic tasks, on students' cognitions and emotions concerning technological difficulties, as well as objective achievement outcomes. In accordance with Perry et al. (2001, 2005), the dependent variables assessed included computing-related versions of equivalent measures of emotions (boredom, anxiety; Pekrun et al., 2002) and causal attributions (effort, ability; Hall et al., 2007), and academic achievement (final course grades). Moreover, this study included additional self-report measures to better assess the generalizability of Perry et al.'s (2001, 2005) findings to students' computing-related emotions (enjoyment) and attributions (luck, strategy). The present study emphasis on causal attributions is consistent with research highlighting the importance of individuals' explanations for computing difficulties (Koch et al., 2008; Mansourian & Ford, 2007). The inclusion of academic achievement as a consequence of students' computing-related beliefs is also consistent with recent findings showing causal attributions for computing difficulties to predict students' grades, over and above the effects of attributions for academic challenges (Maymon et al., 2013).

It was expected that students' perceived control beliefs would positively predict academic achievement, as well as more adaptive levels of attributions and emotions related to academic computing. Similarly, we anticipated an interaction effect of computing-related perceived control and failure preoccupation on students' academic achievement. Consistent with Perry et al. (2001, 2005), we expected students with high levels of perceived control as well as failure preoccupation regarding computing difficulties to obtain higher course grades than their peers. This hypothesis is consistent with findings showing high levels of self-efficacy regarding academic computing to predict more adaptive outcomes (Moos & Azevedo, 2009), with self-efficacy in Bandura's model assumed to consist of personal ability beliefs combined with expectancies for success (i.e., perceived control). However, this hypothesis extends upon this research by examining the extent to which preoccupation with technological challenges (i.e., not prematurely disengaging from resolving computing difficulties) enhances the positive effects of perceived control regarding computer problems, as previously found for academic versions of these measures.

METHOD

Participants

A web-based questionnaire concerning academic computing was completed by college students six months into the academic year at a mid-western, research-intensive Canadian university. Students were recruited from an Introductory Psychology course and participated in exchange for experimental credit ($N = 788$). The sample was comprised of 509 females and 271 males, with an average age of 19.91 ($SD = 3.92$) and course performance of 71.86% ($SD = 11.86$).

Independent Measures

Perceived control concerning experiences with computers. A 12-item scale comprised of 7-point Likert-style measures (1 = *strongly disagree*, 7 = *strongly agree*) derived from items of the Perceived Academic Control (PAC; Perry et al., 2001) assessed students' perceptions of academic control while using computers for school-related purposes. The scale consisted of items such as "I have a great deal of control over how well I can use a computer" and "With enough practice, anyone can improve their computer skills" ($M = 64.58$, $SD = 10.27$, $\alpha = .84$).

Failure preoccupation regarding computer problems. An 11-item, forced-choice scale adapted from the Action Control scale in Perry et al. (2001) measured students' tendency to ruminate (as opposed to disengage) when faced with computer problems (e.g., "When I have lost a file on the computer that is very valuable to me and I can't find it anywhere: (1) I have a hard time concentrating on something else; (2) I put it out of my mind for a little while" (*M* = 16.34, *SD* = 3.11, α = .81).

Dependent Measures

Grade percentage. Final grade percentages for students in Introductory Psychology courses were obtained from their professors at the end of the academic year.

Attributions for computer problems. Four 10-point items (1 = *not at all*, 10 = *very much so*) were used to assess attributions for computer problems while completing academic tasks to low ability (*M* = 4.43, *SD* = 2.52), insufficient effort (*M* = 5.14, *SD* = 2.71), poor strategy (*M* = 5.32, *SD* = 2.48), and luck (*M* = 4.17, *SD* = 2.59). The items are based on Weiner's attribution theory and adapted from parallel items concerning academic performance (Hall et al., 2007).

Computer-related emotions. Three 6-item scales comprised of 5-point Likert measures (1 = *not at all true*, 5 = *completely true*) assessed emotions of enjoyment, anxiety, and boredom specific to academic computing were evaluated using a modified version of the Achievement Emotions Questionnaire (AEQ; Pekrun et al., 2002). Computer-related *enjoyment* was assessed using items such as "I often find using computers for class to be enjoyable" (*M* = 17.44, *SD* = 5.56, α = .88). Computer-related *anxiety* was assessed using items such as "Before I have to work with a computer, I feel tense and anxious" (*M* = 9.19, *SD* = 4.50, α = .92). Computer-related *boredom* was assessed using items such as "Working with computers is dull and monotonous" (*M* = 10.80, *SD* = 5.35, α = .93).

ANALYSES

Linear regression analyses were conducted to assess the hypothesized main and interaction effects (mean centered) of computer-related perceived control (PC) and preoccupation with failure (PF) on computer-related attributions, emotions, and academic achievement. The covariates consisted of demographic variables (gender, English as a first language), academic background variables (self-reported high school grades, course load), and academic computing experience (number of courses taken with computer components).

RESULTS

Significant main effects showed perceived control regarding academic computing to predict more enjoyment [$\beta = .35$, $p < .001$], less anxiety [$\beta = -.57$, $p < .001$], less boredom [$\beta = -.64$, $p < .001$], and higher final grades [$\beta = .09$, $p < .05$]. Students high in perceived control also made more adaptive attributions for computer problems to ability [$\beta = -.24$, $p < .001$] and luck [$\beta = -.31$, $p < .001$], with a marginally significant effect on attributions to effort also observed [$\beta = -.07$, $p = .065$]. Significant main effects for failure preoccupation regarding technological difficulties were also found in which high failure preoccupation predicted better grades [$\beta = .10$, $p < .05$]. However, failure preoccupation was also found to predict more anxiety [$\beta = .17$, $p < .001$], more boredom [$\beta = .07$, $p < .05$], and more maladaptive attributions to luck concerning computer problems [$\beta = .09$, $p < .05$].

Significant PC x FP interaction effects on academic achievement (Figure 1) and strategy attributions (Figure 2) were also observed. Computer-related failure preoccupation was found to predict better grades only when perceived control was low, $\beta = -.08$, $p < .05$. A similar effect was found for strategy attributions, $\beta = -.08$, $p < .05$, with computer-related failure preoccupation predicting more adaptive strategy attributions for computer problems only when perceived control was low. A similar interaction effect on effort attributions approached significance, β = -.07, p = .059.

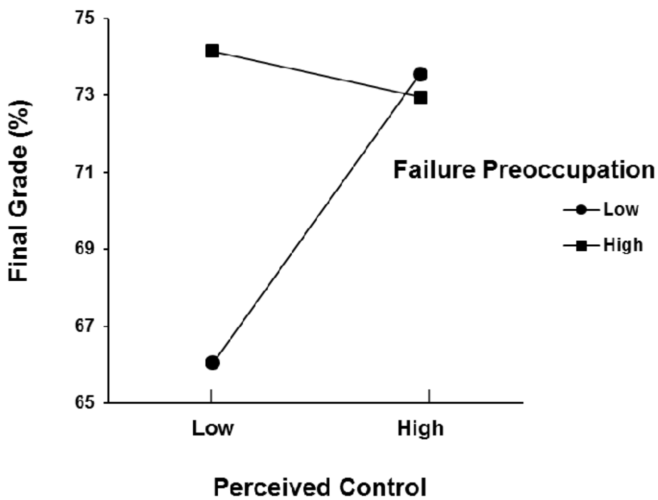

Figure 1. Effects of perceived control by preoccupation with failure for final course grade percentage.

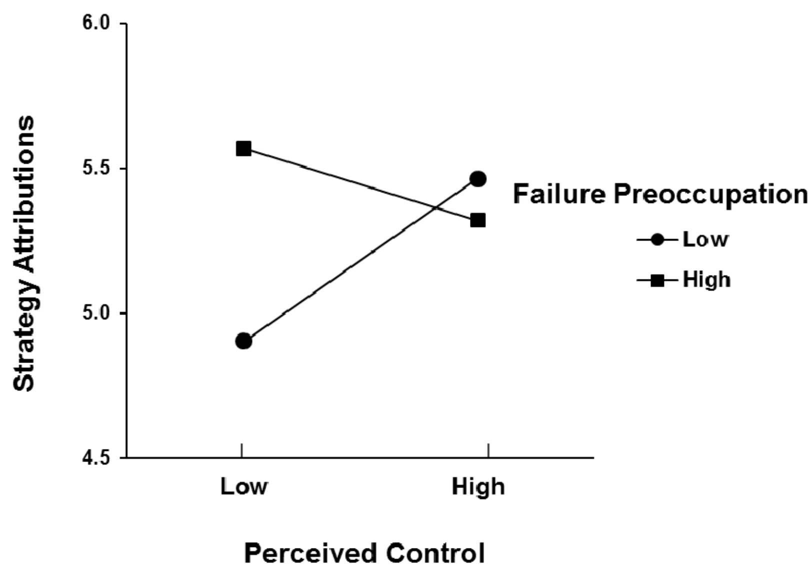

Figure 2. Effects of perceived control by preoccupation with failure for strategy attributions.

DISCUSSION

Consistent with Perry et al. (2001, 2005), the present findings revealed high perceived control beliefs regarding academic computing to positively predict computing-related attributions and emotions, as well as academic achievement. Similarly, high failure preoccupation regarding computing challenges was found to positively predict achievement outcomes, depending on students' level of perceived control regarding computing. Interaction effects for the computer-related control and preoccupation measures, however, did not exactly replicate previous findings. Rather than a type of "bolstering" effect being observed, with failure preoccupation showing a positive effect on grades only when combined with high perceived control, these results clearly demonstrated a type of "buffering" effect with failure preoccupation predicting better grades only when perceived control was low. With respect to academic computing, results showed failure preoccupation to compensate for a lack of perceived control in helping students to maintain their performance, and lack of failure preoccupation to predict lower grades if perceived control was low. In addition to replicating findings from Perry et al., the present study found a similar interaction effect for strategy attributions, suggesting that failure preoccupation may help students maintain a sense of controllability (regarding their strategy use) even when overall low levels of perceived control are observed (operationalized, in part, as effort attributions combined with low ability attributions). In sum, failure preoccupation made a difference only when perceived control was low (not high; Perry et al., 2001, 2005); or conversely, high levels of computer-related perceived control eliminated the negative effects of low computer-related failure preoccupation.

Overall, these findings demonstrate important effects of perceived control and failure preoccupation related to computing on academic achievement, as well as cognitions and emotions concerning the difficulties encountered during academic computing. As the effects observed are specific to academic computing and not directly related to course content, it can be assumed that the present findings should generalize to performance in other courses, thus warranting efforts to replicate these results on cumulative achievement outcomes in other academic domains (e.g., natural sciences). Finally, our findings suggest that developing technology support programs for college students that improve perceived control beliefs regarding academic computing should contribute to increased academic motivation and performance. Moreover, given the conceptual overlap between the constructs of perceived control and controllable attributions as outlined in Weiner's Attribution Theory (1985), as well as high perceived control regarding computing being found to predict more adaptive attributions for computer-based problems, programs in which controllable attributions are explicitly encouraged (e.g., Attributional Retraining, Hall et al., 2007, 2011) may be effective for improving students' academic computing experiences, and more generally, contribute to improved achievement outcomes.

REFERENCES

Astleitner, H., & Leutner, D. (2000). Designing instructional technology from an emotional perspective. *Journal of Research on Computing in Education, 32,* 497-510.

Barbeite, F. G., & Weiss, E. M. (2004). Computer self-efficacy and anxiety scales for an Internet sample: Testing measurement equivalence of existing measures and development of new scales. *Computers in Human Behavior, 20,* 1–15.

Chou, H.-W. (2001). Effects of training method and computer anxiety on learning performance and

self-efficacy. *Computers in Human Behavior, 17,* 51-69.
Cooper, J. (2006). The digital divide: The special case of gender. *Journal of Computer Assisted Learning, 22,* 320–334.
DeBerard, M. S., Spielmans, G. I., & Julka, D. L. (2004). Predictors of academic achievement and retention among college freshman: A longitudinal study. *College Student Journal, 38,* 66-80.
Durndella, A., & Haag, Z. (2002). Computer self efficacy, computer anxiety, attitudes towards the Internet and reported experience with the Internet, by gender, in an East European sample. *Computers in Human Behavior, 18,* 521–535.
Hannon, J. (2013). Incommensurate practices: Sociomaterial entanglements of learning technology implementation. *Journal of Computer Assisted Learning, 29,* 168–178.
Hall, N. C., Jackson, S. E., Goetz, T., & Musu-Gillette, L. E. (2011). Attributional retraining, self-esteem, and the job interview: Benefits and risks for college student employment. *Journal of Experimental Education, 79,* 318-339.
Hall, N. C., Perry, R. P., Goetz, T., Ruthig, J. C., Stupnisky, R. H., & Newall, N. E. (2007). Attributional retraining and elaborative learning: Improving academic development through writing-based interventions. *Learning and Individual Differences, 17,* 280-290.
Hall, N. C., Perry, R. P, Ruthig, J. C., Haynes, T. L., & Stupnisky, R. H. (2005, April). *Internet-based attributional retraining: Longitudinal effects on academic achievement in college students.* American Educational Research Association, Montreal, QC.
He, J., & Freeman, L. A. (2010). Are men more technology-oriented than women? The role of gender on the development of general computer self-efficacy of college students. *Journal of Information Systems Education, 21,* 203-212.
Hove, M., & Corcoran, K. J. (2008). Educational technologies: Impact on learning and frustration. *Teaching Of Psychology*, *35*, 121-125.
Huang, D. W. -H., Hood, D. W., & Yoo, S. J., (2013). Gender divide and acceptance of collaborative Web 2.0 applications for learning in higher education. *Internet and Higher Education, 16,* 57-65.
Jones, S. (2002). The internet goes to college: How students are living in the future with today's technology. *Pew Internet & American Life Project.* Washington, DC.
Koch, S. C., Müller, S. M., & Sieverding, M. (2008). Women and computers. Effects of stereotype threat on attribution of failure. *Computers & Education, 51,* 1795-1803.
Kuhl, J. (1985). Volitional mediators of cognition-behavior consistency: Self-regulatory processes and action versus state orientation. In J. Kuhl & J. Beckmann (Eds.), *Action control: From cognition to behavior* (pp. 101-128). Berlin, Germany: Springer-Verlag.
Kuhl, J. (1994). A theory of action and state orientation. In J. Kuhl & J. Beckmann (Eds.), *Volition and personality: Action versus state orientation* (pp. 9-46). Seattle, WA: Hogfre & Huber.
Kuhl, J. (1996). Who controls whom when "I control myself"? *Psychological Inquiry, 7*, 61-68.
Linnenbrink, E., & Pintrich, P. (2002). Motivation as an enabler for academic success. *School Psychology Review, 31,* 313-327.
Littlejohn, A., Beetham, H., & McGill, L. (2012). Learning at the digital frontier: A review of digital literacies in theory and practice. *Journal of Computer Assisted Learning, 28,* 547–556.
Mansourian, Y., & Ford, N. (2007). Web searchers' attributions of success and failure: An empirical study. *Journal of Documentation, 63,* 659-679.
Maymon, R., Rahimi, S., Hubbard, K., & Hall, N. C. (2013, June). *Technology attributions and achievement: Effects of computer and performance attributions on academic achievement*. Poster presented at the Canadian Psychological Association Conference, Quebec City, QC.
Moos, D., & Azevedo, R. (2009). Learning with computer-based learning environments: A literature review of computer self-efficacy. *Review of Educational Research, 79,* 576-600.
Pekrun, R. (2006). The control-value theory of achievement emotions: Assumptions, corollaries, and implications for educational research and practice. *Educational Psychology Review, 18,* 315-341.

Pekrun, R., Goetz, T., Titz, W., & Perry, R. P. (2002). Academic emotions in students' self-regulated learning and achievement: A program of qualitative and quantitative research. *Educational Psychologist, 37,* 91-106.
Perry, R. P. (1991). Perceived control in college students: Implications for instruction in higher education. In J. Smart (Ed.), *Higher education: Handbook of theory and research* (Vol. 7, pp. 1-56). New York: Agathon.
Perry, R. P., Hall, N. C., & Ruthig, J. C. (2007). Perceived (academic) control and scholastic attainment in college students. In R. Perry & J. Smart (Eds.), *The scholarship of teaching and learning in higher education: An evidence-based perspective* (pp. 477-551). New York: Springer.
Perry, R. P., Hladkyj, S., Pekrun, R. H., Clifton, R. A., & Chipperfield, J. G. (2005). Perceived academic control and failure in college students: A three-year study in scholastic attainment. *Research in Higher Education, 46,* 535-569.
Perry, R. P., Hladkyj, S., Pekrun, R. H., & Pelletier, S. T. (2001). Academic control and action control in the achievement of college students: A longitudinal field study. *Journal of Educational Psychology, 93,* 776-789.
Perry, R. P., & Magnusson, J. -L. (1989). Causal attributions and perceived performance: Consequences for college students' achievement and perceived control in different instructional conditions. *Journal of Educational Psychology, 81,* 164-172.
Phelps, R., Hase, S., & Ellis, A. (2005). Competency, capability, complexity and computers: Exploring a new model for conceptualizing end-user computer education. *British Journal of Educational Technology, 36,* 67-84.
Weiner, B. (1985). An attributional theory of achievement motivation and emotion. *Psychological Review, 92,* 548-573.
Weiner, B. (1994). Ability versus effort revisited: The moral determinants of achievement evaluation and achievement as a moral system. *Educational Psychologist, 29,* 163-172.
Weiner, B. (2000). Intrapersonal and interpersonal theories of motivation from an attributional perspective. *Educational Psychology Review, 12,* 1-14.
Weiner, B. (2010). The development of an attribution-based theory of motivation: A history of ideas. *Educational Psychologist, 45,* 28-36.