



Multisource feedback for STEM students improves academic performance

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Abstract

Motivating students to productively engage course material and perform to their potential is among our most urgent challenges as STEM educators. Professional organizations commonly seek to motivate employees by providing performance feedback from multiple raters who may include supervisors, peers, subordinates, clients, and others. With support from National Science Foundation grant EEC #1158728, the present study used a newly developed online delivery system to provide personalized multisource feedback to a sample of 206 undergraduate STEM students in a science and technology problem-solving course. PersonalityPad.org is an automated multisource feedback platform that allows users to generate their own personalized multisource feedback. This process incorporates prevalent 360-degree feedback strategies and “best practices” for effective feedback administration. A longitudinal experiment within an interventional framework evaluated the hypothesis that *multisource conscientiousness feedback* would provoke goal-directedness and motivate adaptive action. Students who received conscientiousness feedback from multiple sources – including friends, parents, and teachers – participated more in class and submitted higher quality homework assignments afterward, leading to significantly higher final course grades ($M = 83.90$) compared to a control group in the same class ($M = 78.79$). A structural analysis of relationships among key variables indicated that post-intervention goal-directedness plays a key intermediary role between receiving personalized feedback and achieving subsequent self-development goals. Implications are discussed from academic and social perspectives.

Introduction

Getting to know thyself is a difficult task. If self-insight is the destination, the individual faces many obstacles along the way. Accurate self-knowledge is threatened by self-serving^{1,2} and confirmation^{3,4} biases, by dissociation between implicit and explicit cognitive processes,⁵ and by our tendency to misconstrue self-relevant information.⁶ Unfortunately for us, self-understanding may be more important than ever. The complexities of modern social life demand an accordingly complex sense of self,⁷ and there is evidence to suggest that such complexity is best complemented by emphasis on acquiring accurate self-knowledge.^{8,9} Self-reflection and introspection may provide added insight,^{10,11,12} but essential aspects of one’s own character are often inaccessible to introspection,^{13,14} or vulnerable to a host of interpretation biases.^{15,16,17}

The problems inherent to gaining true self-insight are formidable, but they are not unchallenged. In professional environments, where an accurate understanding of one’s own behavior may increase profit margins, the self-insight problem has been partially resolved using multisource (or *360-degree*) feedback interventions. The goal of this project is to adapt best practices and existing theoretical knowledge from the organizational literature to facilitate self-insight and adaptive self-development in a collegiate population of Science, Technology, Engineering, and Mathematics (STEM) students. These experimental strategies are *technologies of the self*,^{18,19} social psychological tools whose purpose is to help individuals chart new territory within their selves and use this discovery to propel intentional behavioral change.

The enduring problem of self-insight

Introspection has long served as standard practice for those pursuing self-discovery. Many famous thinkers (e.g. Socrates, Plato, Buddha) believed that to understand yourself, you must spend a lot of time thinking about yourself, and psychologists have traditionally agreed with this principle.^{20,21} Recent psychological evidence has exposed the limits of contemplation, suggesting that because of the pervasive influence of the adaptive unconscious, and because we are prone to so many errors, misattributions, and biases, introspection often leads to the generation of incorrect and incomplete self-narratives.²² Wilson²³ argues that the high functionality of the adaptive unconscious makes knowing who we are, and knowing why, information that may be inaccessible to our conscious awareness, eluding even our best introspective efforts. Another obstacle to accurate self-reflection is the disproportionate weight people place on their internal thoughts and feelings at the expense of observing their own behavior.²⁴ Self-verification theory^{25, 26} identifies an additional obstacle to accurate self-insight and intentional change - the pervasive human desire to maintain consistent, rather than accurate, self-perceptions.

It seems we have made little headway in resolving the problems inherent to self-insight, but psychologists have recently been offering new ideas in this domain. Wilson and Dunn²⁷ recommend: “Another approach is to try to see ourselves through the eyes of other people, and if their view differs from ours, consider the possibility that they are correct” (p. 513). Vazire and Mehl²⁸ similarly propose: “It may be useful to draw on close others’ impressions of us when trying to understand ourselves, when predicting our own future behavior, or even when making major life decisions” (p. 1214). Feedback strategies like these are mostly new to the contemporary domain of *personal* self-insight, but they have been utilized extensively to augment *professional* self-insight and -development practices. I will engage these organizational strategies following a brief review of relevant personality, social, and developmental perspectives.

Conscientiousness predicts professional and academic success

While psychologists have summarily rejected the idea of an ideal personality type, certain “Big Five” dimensions have been linked to indicators of professional and academic achievement. Conscientiousness and, to a lesser extent, emotional stability have been shown to positively predict numerous adaptive outcomes at work, including salary, number of promotions, occupational status, and job satisfaction.^{29, 30, 31} Conscientiousness also predicts collegiate success, as indicated by grade point average³² and quality of thesis research.³³ Inspired by these findings, the current study evaluates a conscientiousness feedback intervention aimed at enhancing academic performance.

Social psychological interventions for academic success

Under the right circumstances, relatively minimal interventions can precipitate remarkable academic outcomes. Wilson^{34, 35} reviewed a growing set of self-oriented social psychological interventions that have significantly improved academic performance in experimental studies. African-American seventh graders who completed a short writing

assignment about their most important values achieved significantly better semester grades compared to students in a control condition.³⁶ This effect was recently replicated in a college physics class.³⁷ Other small interventions that have enhanced academic success at the college level include telling students that grades tend to improve after the first year³⁸, that intelligence is malleable,³⁹ and that worries about social belonging decrease over time.⁴⁰ The conscientiousness feedback intervention employed in the current study is similar in scope. While relatively minimal, its potential effectiveness depends on its ability to alter self-perceptions and motivate behavior in adaptive directions.

Multisource (360-degree) feedback interventions for professional success

The first known systematic use of multisource feedback was by the German military during World War II.⁴¹ Supervisors, peers, and subordinates provided soldiers with feedback about their performance, and this information was also used to determine promotions. Several large companies (most notably General Electric) implemented multisource feedback in the 1960s and experienced subsequent success, inspiring others to follow suit. By the mid-1990s, it was estimated that ninety percent of Fortune 500 companies employed multisource feedback strategies.⁴² The effectiveness of multisource feedback – also called *360-degree feedback* – as a professional development tool has been debated since the early 1990s. Some researchers found that 360-degree feedback significantly improved performance,^{43,44} while others have concluded there is little evidence demonstrating that such feedback consistently results in behavior change or performance improvement.⁴⁵ Conway, Lombardo, and Sanders⁴⁶ conducted a meta-analysis of correlational effect sizes and found that reports from subordinates and peers accounted for significant variation in desired objective measures (e.g., production, profit) over and above other sources. In a large sample of store managers, Erickson and Allen⁴⁷ found that multisource feedback ratings were positively related to retail store outcomes, such as sales, revenue, and profit margins. Smither and Walker⁴⁸ found that banks providing branch managers with multisource feedback scored higher on measures of customer loyalty compared to banks that did not employ such strategies. Church⁴⁹ found that managers who received more multisource feedback had lower turnover and higher service quality in their workgroups.

A theoretical model of self-development following multisource feedback

An influential meta-analysis of longitudinal studies published by Smither, London, and Reilly⁵⁰ examined the amount of performance improvement that occurs following multisource feedback and the factors that predict such improvement. The authors, who are among the most prolific and highly-regarded scholars in the field of organizational psychology, reviewed evidence from 24 longitudinal studies and formulated a theoretical model for understanding factors predicting self-development following the receipt of multisource feedback (see Figure 1). The design of the current project is derived in part from this model, so I have included the passage below, which summarizes key findings and implications.

The accumulated evidence points to eight broad factors that play a role in determining the extent of behavior change and performance improvement following multisource feedback: characteristics of the feedback, initial reactions to feedback, personality, feedback orientation, perceived need for change, beliefs about change, goal setting, and taking action.

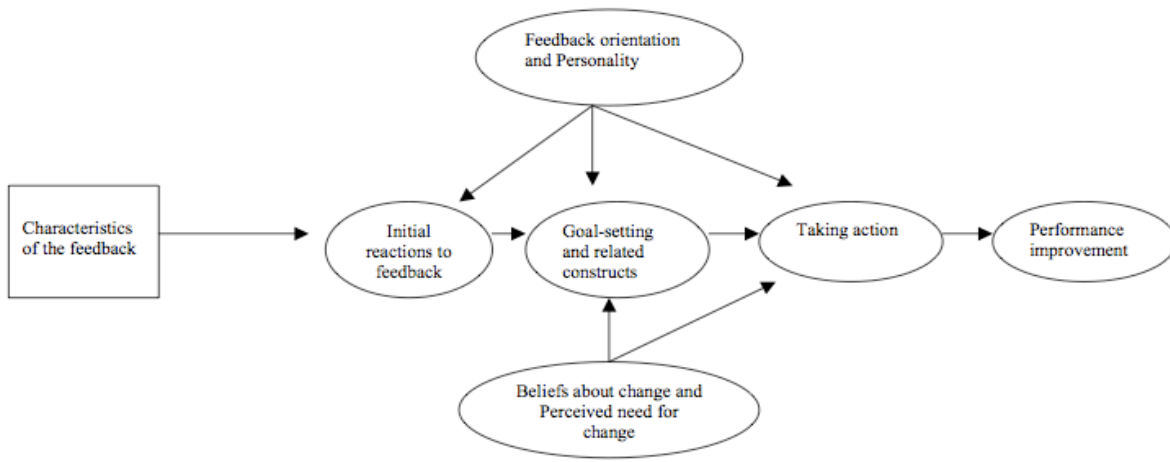
The model begins with the characteristics of the feedback itself. These characteristics influence recipients' initial reactions, which in turn affect goal setting. Goal setting influences taking action, which in turn determines performance improvement. Personality and feedback orientation influence reactions to feedback, goal setting, and taking action. Beliefs about change influence initial reactions and goal setting, and perceived need for change influences goal setting and taking action.⁵¹

The authors go on to say that most of the studies reviewed for the meta-analysis indicated that feedback recipients were encouraged to set goals, but there were no measures of the extent to which feedback recipients actually set goals or of the quality or commitment to any goals that might have been set. They conclude that future research should collect data concerning the extent to which feedback recipients set goals after receiving multisource feedback. The research design and empirical model I employ in the current study are based largely on the preceding theoretical model and research recommendations. For instance, I assess participants' reactions to receiving conscientiousness feedback as well as the extent to which they are subsequently motivated to set and pursue self-development goals. Using structural equation modeling (SEM) techniques, I examine direct and indirect effects among these and other key variables in the multisource feedback process.

Summary

The unique human capacity for self-understanding, while extraordinary, is also limited and biased. Gaining accurate self-insight is difficult and potentially distressing, so it can be tempting to adopt a *laissez-faire* attitude toward self-discovery. But accurate self-knowledge is valuable and people have the capacity to change themselves, so it may be worth working to overcome inherent challenges. This goal is endorsed by many organizations, and professional tools for acquiring and interpreting self-oriented feedback from multiple sources are now widespread. The organizational literature provides a theoretical basis for generating personal feedback interventions aimed at facilitating self-insight and motivating intentional self-development. Students, like professionals, may benefit from gaining a clearer understanding of their own characteristic behavior and how it compares to established standards or ideals. A simple but impactful feedback intervention targeting behavior that predicts academic success could lead to better performance. The effectiveness of these experimental strategies will depend on their ability to penetrate defense mechanisms, influence self-perceptions, and precipitate observable downstream effects. As reviewed above, trait-level conscientiousness consistently predicts academic success.^{52, 53} The primary goal of the present study was to motivate students to take action and improve their conscientiousness to a degree that could be observed in objective evaluations of their academic performance.

Figure 1. Smither, London, & Reilly’s theoretical model for understanding performance improvement following multisource feedback



Method

Participants

Participants were 206 undergraduate STEM students enrolled in a class entitled *Problem Solving Approaches in Science and Technology* at a mid-size public university in the mid-Atlantic United States. Eighty-four were men, 122 were women, and the mean age at the end of the project was 18.84. Participants received ungraded course credit in return for their participation, which was optional. Data from four participants were excluded from all analyses because they failed to complete the follow-up self-development survey and from two others who had a large amount of missing data.

Design

To enhance interactivity and efficiency, professional multisource feedback is now often electronically administered. With colleagues, I developed an automated, interactive web platform that allows users to facilitate their own multisource personality feedback. This process incorporates prevalent 360-degree feedback strategies and “best practices” for effective feedback administration⁵⁴ as listed above. At PersonalityPad.org, users register their own “Personality Pad,” a dedicated WordPress dashboard that displays dimension- and item-level feedback generated by the user and by user-selected informants, as well as normative information for comparison, interpretation tools, and detailed instructions. Users are also provided space to take process notes and set personal development goals if they so choose. Feedback results and notes are automatically saved and available upon login. The platform integrates multisource feedback tools into a WordPress website using the advanced functionality of Qualtrics, an online survey generation, delivery, and analysis tool. Qualtrics offers an advanced programming interface that enables a relatively sophisticated level of automaticity, including automatic survey scoring and message distribution. Figure 2 shows a screenshot of a participant’s Personality Pad results for

one of fifteen items used in the present study. Data were collected through the Personality Pad website over the course of two successive academic semesters. Data analyses for each study were conducted in two stages. The first stage entailed between-groups analyses of the three experimental groups that received different types of personality feedback. The second stage entailed predictive modeling of the impact of individual difference factors such as individual experiences and the content of feedback.

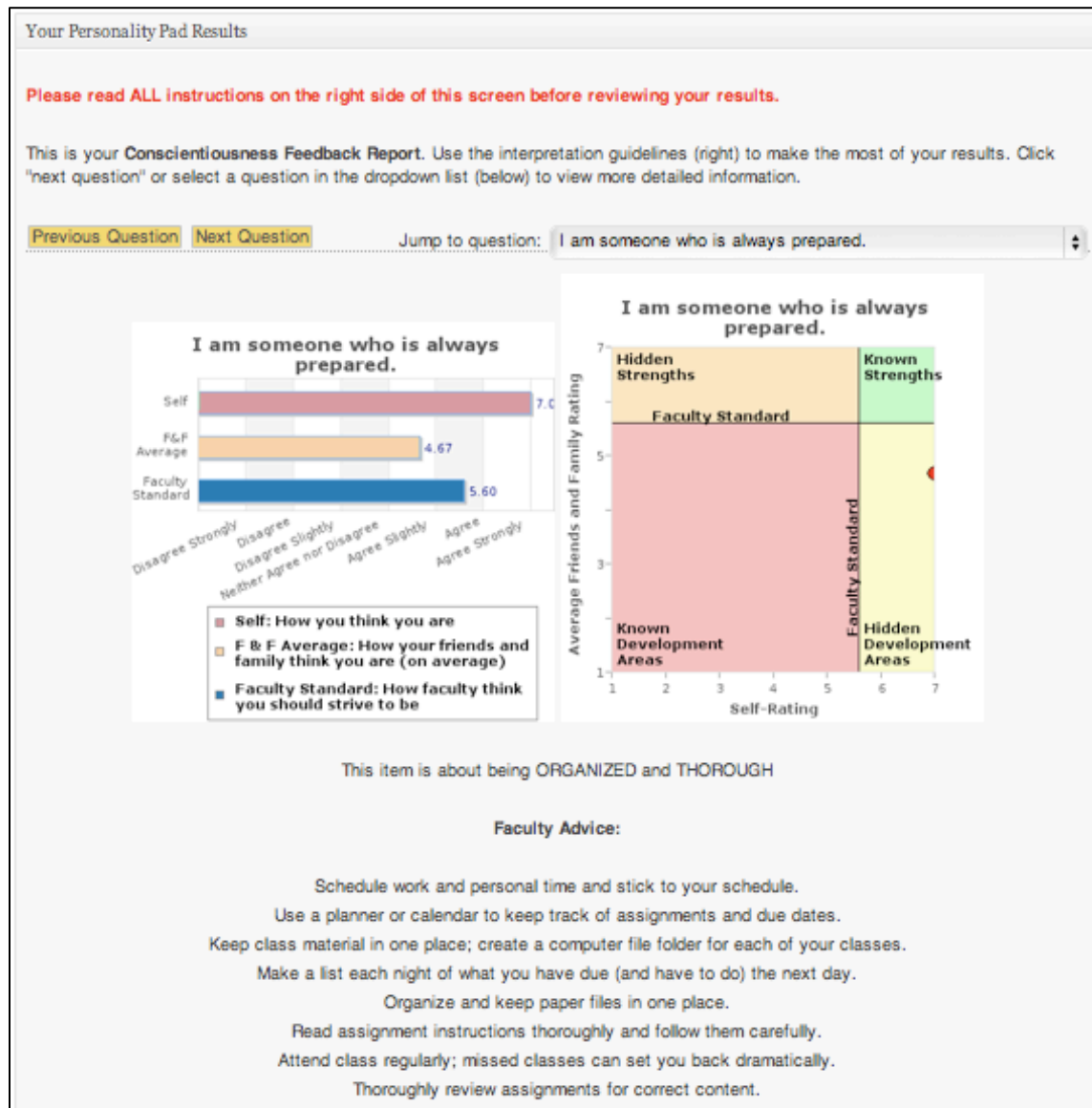
Participants were randomly assigned to one of three groups. Those in the *control* condition (n = 45) were enrolled in the same course as active participants, but they did not know about the study or participate in any study-related activities. Participants in *normative* feedback condition (n = 82) used PersonalityPad.org to generate “real self” (but not “ideal self”) conscientiousness feedback using a 15-item survey.⁵⁵ They received normative feedback in the form of faculty conscientiousness standards and behavioral advice provided by professors at their university. Those in the *360-degree* feedback condition (n = 79) received the same sources of feedback as those in the *normative* condition, and they also received informant ratings of their conscientiousness from self-selected friends and family members. All active participants completed a survey assessing individual differences before the intervention, the survey assessing individual experiences immediately afterwards, and a survey assessing perceived self-development six weeks later.

Prior to the study, a group of 32 faculty advisors at the same university rated each item using the stem “A successful student is someone who...”. They also listed specific behaviors that they believe promote or indicate conscientiousness. These suggestions were compiled, edited, and a unique set of faculty advice was displayed with feedback for each of 15 items on the conscientiousness scale⁵⁶ on the Personality Pad dashboard. In addition to the bar chart display and faculty advice, each item-level screen also displayed a Johari window plotting participants’ self-rating against their informant rating in one of the following four quadrants, determined by the faculty standard for that item: 1) Known Strength – The self-rating and the informant rating are both above the faculty standard; 2) Known Development Area – The self-rating and the informant rating are both below the faculty standard; 3) Hidden Strength – The self-rating is below the faculty standard, but the informant rating is above the faculty standard; and 4) Hidden Development Area – The self-rating is above the faculty standard, but the informant rating is below the faculty standard. Figure 2 shows a screenshot of the item-level feedback display for The Conscientiousness Project.

Building from Smither, London, and Reilly’s⁵⁷ theoretical structural model of performance improvement following multisource feedback (Figure 1), measured variables included *pre-feedback conscientiousness*, *self-satisfaction*, *need for self-development*, *personality change-efficacy*, *feedback content*, *reaction to feedback*, and *goal-directedness*. Objective indicators of academic performance were also measured, including class *attendance* (out of 28), in-class *participation* (total number of comments made), *homework grades* (both pre-feedback and post-feedback totals), *final paper grade*, *final course grade*, and overall *semester GPA*. I also assessed the Big Five personality dimensions before the conscientiousness intervention, and again six weeks afterward, using BFI-10 both times.⁵⁸ The control group was surreptitiously administered the BFI-10 at similar times as part of another class assignment. The professor,

teaching assistants, and graders were aware of the research project, but they were blind to condition and to the specifics of the feedback process.

Figure 2. Sample screenshot of a participant’s Personality Pad results for one of the fifteen items used in the present study (conscientiousness feedback intervention)



Procedure

Halfway through the academic semester, participants assigned to the *360-degree* feedback condition were sent a link to PersonalityPad.org and instructed to register an account. All subsequent elements of the feedback generation and interpretation process were fully automated through the Personality Pad website, although participants were encouraged to contact the experimenter with questions or problems. Upon logging in, participants were presented with

a link to take the pre-feedback survey and a 15-item measure of conscientiousness⁵⁹. Participants were asked to provide names and email addresses for three or more well-known friends and/or family members to provide informant ratings. These individuals received an email from the participant describing the project and requesting their help. They followed a link to the conscientiousness scale and responded *about the person who had sent them the survey*. Once at least three informants had responded, participants were able to view their feedback on their personal Personality Pad dashboard.

The main dashboard screen displayed multisource feedback for the overall domain of conscientiousness. Dashboard instructions guided participants through the process of scrolling through their item-level feedback and interpreting results. Participants in the *normative* condition followed the same procedure as those in the *360-degree* group, except they did not request, receive, or interpret informant feedback. An untreated control group in the same class provided a basis for academic comparison with the two treatment groups.

Predictions

Group differences. I expected the 360-degree group to report being more *conscientious* than the normative group six weeks after the feedback intervention when controlling for the influence of pre-feedback *conscientiousness* scores. As indicated earlier, organizational evidence has illustrated performance-related benefits of effectively administered multisource performance feedback.^{60, 61, 62} In addition, conscientiousness is a robust positive predictor of academic performance.⁶³ I predicted that, compared to participants in the control condition, those who received multisource conscientiousness feedback in the normative and 360-degree feedback conditions would perform significantly better across the set of objective academic outcomes. Because of the added influence of informant feedback, participants in the 360-degree condition were expected to demonstrate relatively larger gains in academic performance compared to those in the normative condition. I expected the intervention to have the largest influence on the conscientiousness-oriented outcomes of class attendance and in-class participation. I expected the intervention to have a lesser impact on homework and final paper grades, which may reflect variation in factors like intelligence and prior knowledge.

Individual experiences. I predicted that *reaction to feedback* would positively predict *goal-directedness*, but would not directly predict the self-reported or objective academic outcomes. I predicted that *goal-directedness* would again emerge as the more robust predictor of self-reported feedback outcomes, and that this influence would extend to observed academic outcomes.

Feedback content. *Feedback balance* was computed by subtracting informant-reported conscientiousness scores from self-reported conscientiousness scores. I expected *feedback balance* scores for conscientiousness would negatively predict *goal-directedness* and *reported self-development*, and I expected this inverse relationship to extend to academic performance.

Results

Group differences

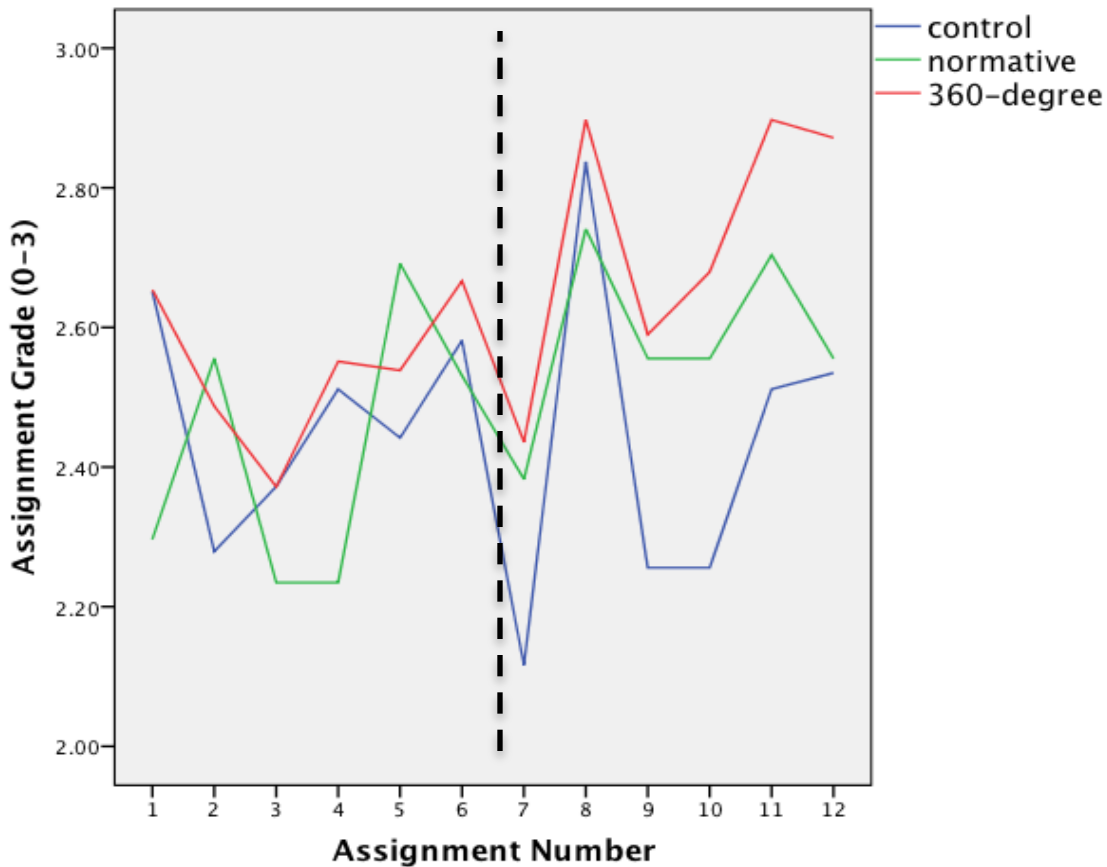
A series of one-way, between-groups ANOVA tests were computed to assess potentially significant differences among the three experimental groups on the academic and self-reported outcome measures. To determine the particular location of significant effects, omnibus tests were followed up with Tukey's HSD post hoc analyses. A subsequent series of ANCOVA tests compared outcomes reported by the two multisource feedback groups while controlling for the influence of individual differences.

Academic Performance. A one-way, between subjects ANOVA was conducted to compare the effect of conscientiousness feedback on academic performance in the 360-degree feedback, normative feedback, and control conditions. The dependent measure was attendance, as indicated by the total number of classes missed. The omnibus test was not significant, $F(2,197) = 1.94, p = ns$. Another one-way, between subjects ANOVA was conducted to compare the effect of conscientiousness feedback on the three groups. The dependent measure was in-class *participation* as indicated by the total number of comments made during the semester. The omnibus test was significant, $F(2, 199) = 4.51, p < 0.05, \eta^2 = 0.04$. Tukey's HSD post hoc analysis revealed those in 360-degree feedback group ($M = 17.18, SD = 2.71$) and the normative feedback group ($M = 16.89, SD = 3.16$) participated in class more than those in the control group ($M = 15.13, SD = 2.21$). Participation rates for the 360-degree feedback group and the normative feedback group were not significantly different.

A one-way ANOVA compared the three experimental groups on the dependent measure *post-feedback homework grade*. The omnibus test was significant, $F(2, 198) = 4.89, p < 0.01, \eta^2 = 0.05$. Tukey's HSD post hoc analysis indicated that participants in 360-degree group ($M = 16.37, SD = 2.29$) achieved significantly higher homework grades after the conscientiousness intervention compared to those in the control group ($M = 14.67, SD = 3.56$). The normative feedback group ($M = 15.49, SD = 3.10$) did not differ significantly from the 360-degree feedback group or the control group. Another ANOVA was conducted on *pre-feedback homework grades*. The omnibus test was not significant, $F(2, 199) = 1.49, p = ns$. Figure 3 displays mean level homework grades by feedback condition across the semester (before and after the conscientiousness intervention).

Potentially significant group differences on final paper grades were assessed with another one-way, between groups ANOVA test, which was not significant, $F(2, 197) = 0.55, p = ns$. Group differences on *final course grade* were computed using the same type of ANOVA test, and this time the omnibus test was significant, $F(2, 199) = 5.66, p = 0.004$. Tukey's HSD post hoc analysis indicated that participants in 360-degree feedback group ($M = 83.90, SD = 7.42$) had significantly higher final course grades compared to those in the control group ($M = 78.79, SD = 7.97$). The normative feedback group ($M = 81.67, SD = 8.63$) trended as predicted, but did not differ significantly from the 360-degree feedback group or the control group.

Figure 3. Mean-level assignment scores across the semester by feedback condition (conscientiousness intervention was administered between assignment 6 and 7)



Survey Measures. An ANCOVA test was conducted to compare the 360-degree, normative, and control groups on *follow-up conscientiousness* while controlling for the influence of *pre-feedback conscientiousness*. Unequal sample sizes among the groups caused Levene's Test for Equality of Error Variance's to achieve significance, $F(2, 195) = 4.23, p < 0.05$. Three-group ANCOVA analyses were once again abandoned. Instead, paired-samples t-tests were computed for each group to assess mean-level differences in pre-feedback and follow-up BFI-10 conscientiousness scores. The 360-degree group reported significantly more conscientiousness six weeks after the intervention ($M = 5.54, SD = 0.97$) than they reported before it ($M = 4.98, SD = 1.04$), $t(76) = 4.73, p < 0.001$. The normative group also reported significantly more conscientiousness six weeks after the intervention ($M = 5.51, SD = 0.95$) than they reported before it ($M = 5.10, SD = 1.01$), $t(75) = 3.57, p < 0.001$. The BFI-10 was administered to the control group under the guise of another, unrelated class project. Conscientiousness scores assessed half way through the semester ($M = 5.05, SD = 1.07$) were not significantly different from conscientiousness scores assessed again six-weeks later ($M = 5.30, SD = 1.02$), $t(39) = 1.52, p = ns$.

A series of ANCOVA tests was conducted to compare the two multisource feedback groups on *reaction to feedback*, *goal-directedness*, and *reported self-development* while

controlling for individual differences in *self-satisfaction*, *need for self-development*, and *personality change efficacy*. The control group was excluded from these analyses because it did not complete the survey measures. After controlling for individual differences, the two multisource feedback groups did not differ in terms of *reaction to feedback* or *reported self-development*.

Predictive models

The analysis of the structure of the relationships among the principle survey measures used maximum likelihood estimation within AMOS 5.0.1. I also tested a second model comprised of the same exogenous and intermediate endogenous variables, but using objective academic outcomes in place of self-reported outcomes.

Survey model. Predictive analyses were based on an empirical model of survey measures presented in Figure 4. Successive trimming of nonsignificant paths yielded the parsimonious model shown in Figure 5. The model demonstrated good fit ($\chi^2 = 6.96$, $df = 5$, $p = 0.224$), GFI = 0.98, CFI = 0.97, TLI = 0.94, RMSEA = 0.05. The combined effect of the two remaining exogenous variables, *feedback type* and *need for self-development*, accounted for 15% of the total variance in *goal-directedness* ($R^2 = 0.15$). *Need for self-development* and *goal-directedness* accounted for just 12% of the variance in *reported self-development* ($R^2 = 0.12$), and *reported self-development* accounted for 15% of the variance in *reported conscientiousness change* ($R^2 = 0.15$).

Good model fit justified the interpretation of causal effects. The independent variable *Feedback type* (360-degree vs. normative) had a direct positive effect on the intermediate variable *goal-directedness* ($\beta = 0.25$, $p < 0.001$). *Need for self-development* exhibited direct positive effects on *goal-directedness* ($\beta = 0.29$, $p < 0.001$) and on the *reported self-development* ($\beta = 0.22$, $p < 0.01$). *Goal-directedness* had a direct positive effect on *reported self-development* ($\beta = 0.21$, $p < 0.01$), which, in turn, had a positive effect on *reported conscientiousness change* ($\beta = 0.39$, $p < 0.001$). *Feedback type* and *need for self-development* predicted *reported self-development* indirectly through *goal-directedness*, and *reported conscientiousness change* indirectly through *goal-directedness* and *reported self-development*.

Figure 4. Fully saturated empirical path model of survey measures

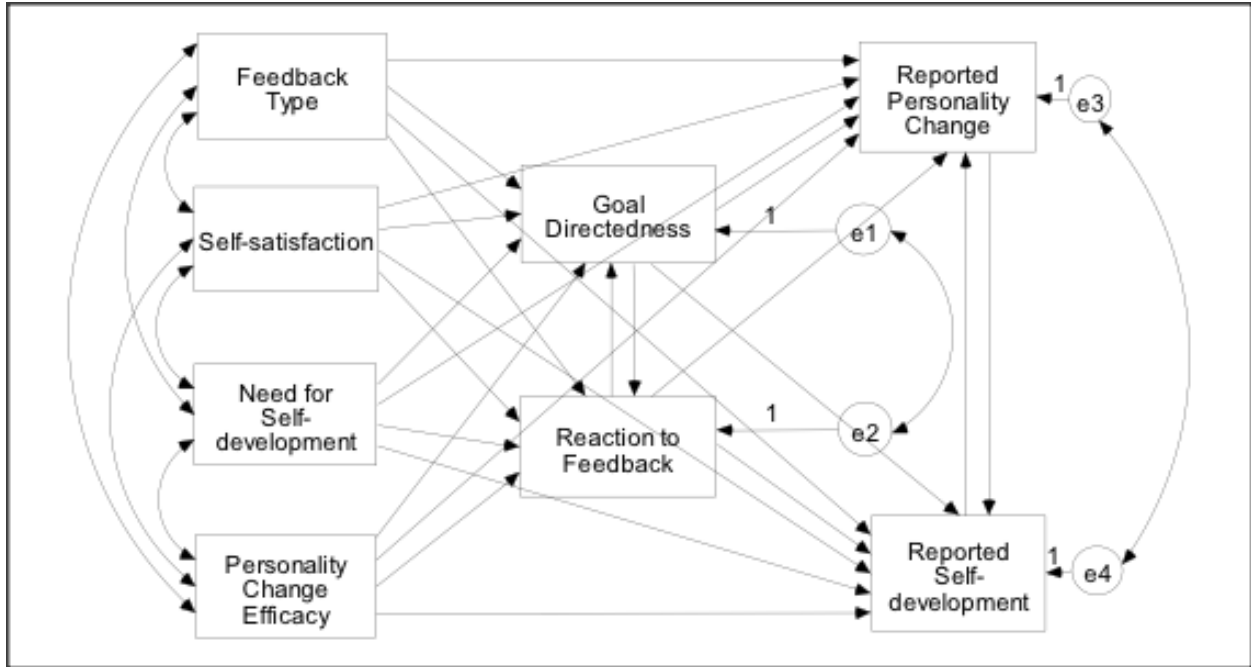
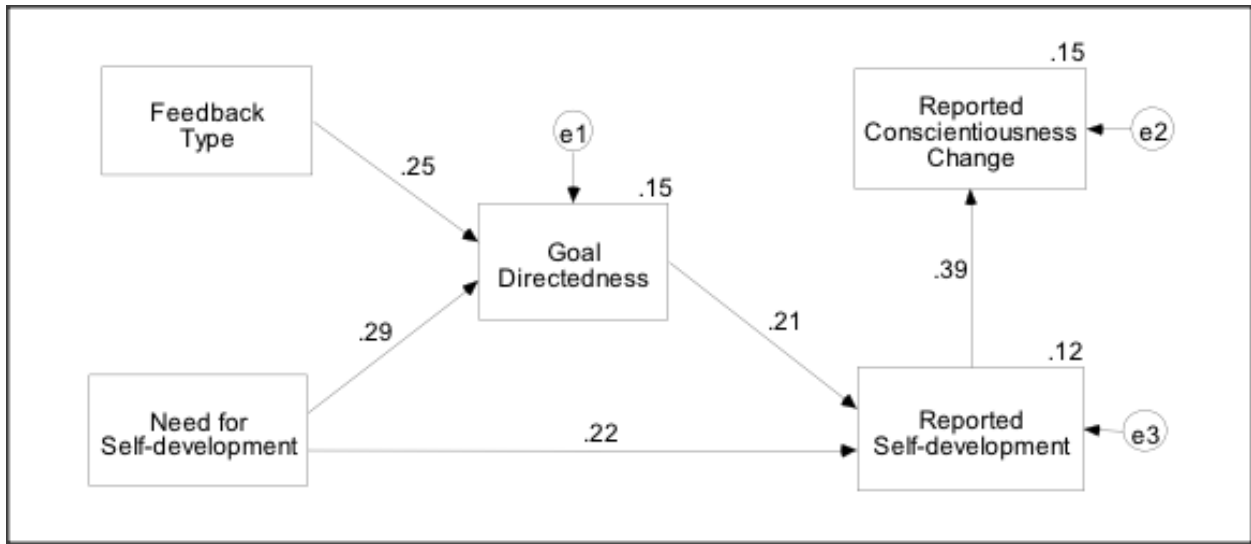


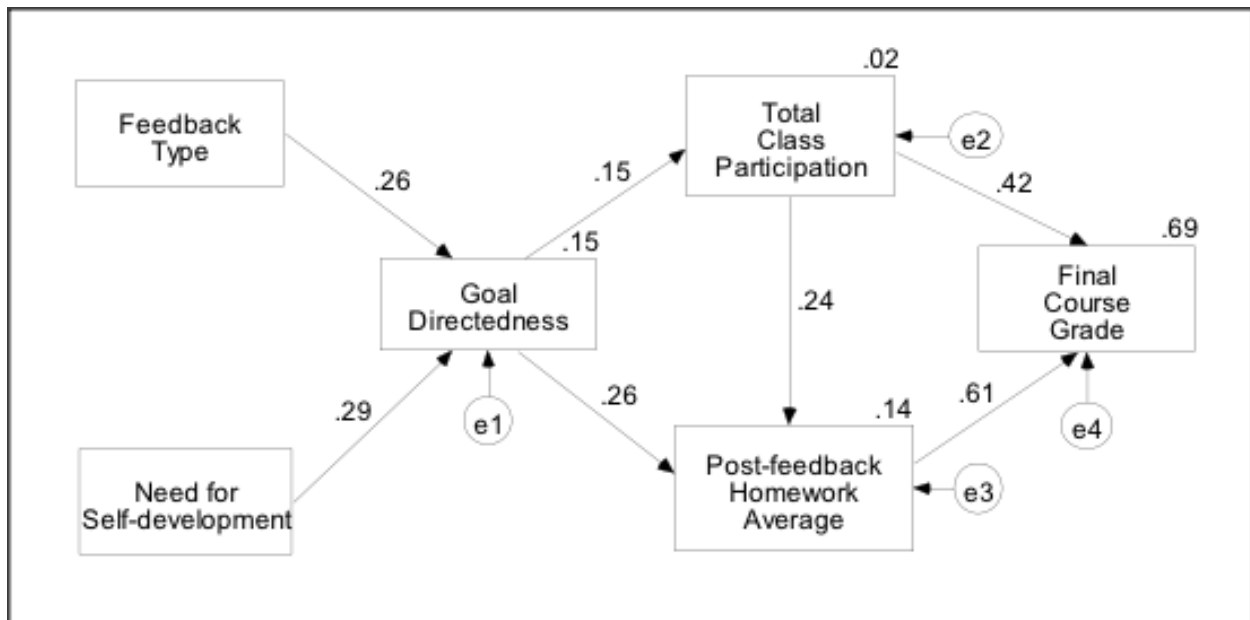
Figure 5. Parsimonious path model of survey measures



Academic model. I tested another empirical model using objective indicators of academic performance (rather than self-reported survey measures) as predicted outcomes. Measures of academic performance included (1) total number of classes missed (*attendance*), (2) total number of in-class comments (*participation*), (3) post-feedback *homework average*, (4) *final paper grade*, and (5) *final course grade*. The exogenous and intermediate variables were modeled identically to those in the empirical survey model. Model modification using the same path trimming

technique as above led to the parsimonious model displayed in Figure 6. This model fit the data very well ($\chi^2 = 4.67$, $df = 8$, $p = 0.793$), GFI = 0.99, CFI = 1.00, TLI = 1.00, RMSEA = 0.00. The two remaining exogenous predictors and one remaining intermediate variable were identical to those in the parsimonious survey model. The relationships among these three variables were also essentially unchanged, as *goal-directedness* was positively predicted by *feedback type* ($\beta = 0.26$, $p < 0.001$) and *need for self-development* ($\beta = 0.29$, $p < 0.001$). *Goal-directedness* was a weak-but-significant predictor of *participation* ($\beta = 0.15$, $p < 0.05$), and a slightly stronger predictor of *homework average* ($\beta = 0.25$, $p < 0.001$). *Participation* was a positive predictor of *homework average* ($\beta = 0.24$, $p < 0.01$). *Final course grade* was strongly predicted by both *participation* ($\beta = 0.15$, $p < 0.05$) and *homework average* ($\beta = 0.24$, $p < 0.01$). No direct causal relationships were observed among the exogenous predictors and the academic outcomes. Both *feedback type* and *need for self-development* related to *participation*, *homework average*, and *final course grade* only through the mediating effect of *goal-directedness*, which explained 2% of the variance in *participation* ($R^2 = 0.02$) and 14% of the variance in *homework average* ($R^2 = 0.14$). The variable *final course grade* is a composite of the other academic outcomes, so it is not surprising that *participation* and *homework average* explain 69% of its variance ($R^2 = 0.69$).

Figure 6. Parsimonious path model of survey measures predicting academic outcomes



Moderation by feedback type. Multigroup moderation analyses were applied to both empirical models above using *feedback type* as a grouping variable rather than as a predictor. No significant interactions by feedback group were observed with the survey model. There were, however, two unexpected moderating effects within the academic model. *Goal-directedness* was a significantly stronger predictor of *participation* ($z = -2.18$, $p < 0.05$) in the 360-degree feedback condition ($\beta = 0.30$, $p < 0.01$) than in the normative feedback condition ($\beta = -0.03$, $p = ns$). *Goal-directedness* was a significantly stronger predictor of *homework average* ($z = 2.03$, $p < 0.05$) in the normative condition ($\beta = 0.36$, $p < 0.001$) than in the 360-degree condition ($\beta = 0.07$, $p = ns$).

Feedback content. Within the 360-degree group, *feedback balance* scores were computed by subtracting informant-reported conscientiousness scores from self-reported conscientiousness scores. *Feedback balance* in this domain was a significant negative predictor of *goal-directedness* ($\beta = -0.31, p < 0.01$), indicating that negative informant feedback was more likely to motivate goal-directed behavior than positive informant feedback. A similar effect also applied to one of the academic performance measures; *feedback balance* was a significant negative predictor of *participation* in class ($\beta = -0.22, p < 0.05$).

Summary of findings

Two experimental groups that received multisource conscientiousness feedback interventions participated more in class and had better homework grades compared to an untreated control group in the same class. Although the two multisource feedback groups were not significantly different in terms of academic performance, students in the 360-degree group tended to perform best. This trend led the 360-degree group, but not the normative group, to achieve significantly higher final course grades than the control group. Based on the results of a very brief personality test administered before the intervention and again six weeks afterward, both multisource feedback groups reported significant gains in conscientious while the scores of the control group did not change. Compared to the students in the normative group, those in the 360-degree group demonstrated more goal-directedness after reviewing their feedback. Path modeling results indicate that goal-directedness played a key role in motivating self-developmental action following the multisource personality feedback intervention. In both parsimonious models, the type of feedback administered and the need for self-development were both causally linked to academic performance and reported self-development *only* through the intermediary influence of goal-directedness. Interestingly, goal-directedness predicted in-class participation only in the 360-degree condition and predicted homework grades only in the normative condition. Students who received 360-degree feedback tended to be more goal-directed and participate more in class when informant ratings of their conscientiousness were lower than their self-ratings. Self-satisfaction, personality change efficacy, and evaluative reactions to feedback did not influence the academic or self-reported developmental outcomes.

Discussion

A major limitation of the Smither, London, and Reilly⁶⁴ model, as identified by the authors, is a lack of existing knowledge about the hypothesized causal (i.e. direct and indirect) relationships among variables in the model. The predictive modeling techniques employed in the current studies were able to generate this type of evidence. I will discuss the implications of my findings before addressing potential limitations and considering future directions.

Group differences

Students who got multisource conscientiousness feedback participated more in class and submitted higher quality homework assignments afterward, leading to significantly higher final course grades in the 360-degree group ($M = 83.90$) compared to a control group in the same class ($M = 78.79$). It may seem unremarkable that multisource feedback consistently generated

stronger effects than self-generated feedback or no feedback, as participants in the multisource conditions received more self-relevant information and participated in a more elaborate, interactive experience. This situation could lead to a Hawthorne effect in which observed group differences stem from general study characteristics rather than specific features of the experimental manipulation. I will address this important issue, and why I consider it to be a source of strength rather than weakness, in my discussion of potential limitations.

The predicted differences in developmental outcomes between the two multisource feedback groups were largely unsupported by the data. Although the addition of informant feedback led to more goal-directedness, the normative and 360-degree strategies precipitated generally similar outcomes. This general equivalence suggests that the potentially stressful and time consuming process of soliciting and reviewing informant feedback is not always advisable. In some situations, normative feedback may be sufficient to motivate positive changes in behavior.⁶⁵ Adaptive changes are more likely to be inspired by examining specific elements of one's own personality in comparison to self-relevant norms and ideals.

Individual experiences

The intermediary factors reaction to feedback and goal-directedness were assessed immediately following the feedback intervention and reflected the experience and the frame of mind of participants at that time. I focused on these two variables in particular because they were both assigned key mediating roles in Smither, London and Reilly's⁶⁶ theoretical model of performance improvement following multisource feedback (Figure 1). In this model, characteristics of multisource feedback predict reactions to the feedback, which predict subsequent goal-directed behaviors, which predict taking action, which, finally, predicts performance improvement. While the authors readily admit to suffering from a lack of evidence on the causal relationships among the variables, the model is derived from a well-conducted review of longitudinal studies and a lot of combined experience in the field. My data suggest that they were somewhat cavalier in predicting a linear series of successive effects with no feedback or simultaneous elements. This finding does not necessarily threaten the validity of the proposed organizational model; however, reactions to personality feedback may systematically impact subsequent goal setting and motivation differently than similar reactions to job performance feedback. This could be due to the nature of rater-ratee relationships. While a negative reaction to feedback from professional acquaintances tends to demotivate subsequent improvement,⁶⁷ a similar reaction to feedback from close friends and family may be harder to dismiss, cause more dissonance, and lead to compensatory action.

Goal-directedness, on the other hand, emerged playing a critical mediating role in the relationship between multisource personality feedback and adaptive behavior change. This indirect effect was observed in both studies and for both self-reported and objective behavioral outcomes. The parsimonious model from the present study indicates that the independent variable feedback type and the influential individual difference variable need for self-development are related to academic performance *only* through the influence of goal-directedness. Is demonstrating goal-directed behavior and attitudes immediately after reviewing personality feedback really that important? The modest regression weights and relatively small amounts of variance explained by goal-directedness suggest that other important variables are at

play. However, these variables are likely to reflect idiosyncratic variation among individuals, and they are unlikely to be as malleable and broadly applicable as goal-directedness. Furthermore, goal-directed behavior may be a linchpin in these and other interventional scenarios because of its temporal importance. What recipients do immediately after reviewing their feedback, while its effects are still at their most potent, may be the best predictor of downstream developmental outcomes. Those who are inspired or strategically prompted to set achievable goals and declare the intent to pursue these goals may fare especially well. An interesting possibility which has not been evaluated in a feedback context is that generating specific implementation intentions (i.e. when and how a goal will be pursued) during this time would further enhance developmental outcomes.⁶⁸

Feedback content

The characteristics of informant feedback, as broadly indicated by *feedback balance* score, were not indirectly predictive of goal-directedness by way of initial reactions to feedback as predicted by Smither, London and Reilly's⁶⁹ model, but instead directly predicted goal-directedness. More specifically, students whose informant feedback in the domain of conscientiousness was more negative (revealed more "hidden weakness") were more likely to set goals and be motivated to pursue these goals compared to those who received more positive feedback (revealing more "hidden strength"). This finding supports my predictions and existing evidence in the organizational literature.^{70,71} It also represents an important step in demonstrating the utility of informant feedback for developmental purposes. Within the bias-centric models of self-perception that continue to dominate social psychology, however, this effect may be counterintuitive. Self-verification theory,⁷² self-discrepancy theory,^{73,74} self-perception theory,⁷⁵ and the many self-serving biases detailed by Dunning⁷⁶ would likely predict that receiving feedback from close others that poses a direct threat to the integrity of cherished self-views while also exposing previously unknown self-discrepancies would trigger all manner of bias-inducing defense mechanisms as well as a predictably negative emotional reaction. The results of both current studies support my hypothesis that when potentially threatening discrepancy feedback is authorized by the recipient and framed as an opportunity for self-insight and -improvement, its negative impact may be attenuated or even reversed. Implied in this hypothesis is the importance of effective feedback administration. It is important that recipients are not overwhelmed with negative information.⁷⁷ Bollich, Johannet, and Vazire⁷⁸ agree that individuals receiving negative feedback should be allowed time to process it effectively and on their own terms.

Self-reported self-development

Among the more intriguing challenges inherent to the current project is choosing a responsible strategy for interpreting reported self-development. Undoubtedly, demand characteristics and self-serving biases may lead participants to intentionally or unintentionally exaggerate the magnitude of intentional behavioral changes. In the absence of complementary objective measures, relying on highly subjective self-report data is a risky strategy. That being said, self-report data should not be discounted. Using these data to inform predictive models may be a more productive strategy than assessing absolute effect sizes or group differences. The magnitude of reported effects is probably unreliable, but the validity of emergent relationships

among variables is less likely to suffer from some amount of exaggeration, particularly if the bias is relatively evenly distributed throughout the data.

Self-reported developmental gains may have intrinsic value for an entirely different reason as well. In recent work on the revision of self-narratives in the interest of adaptive self-development, Wilson⁷⁹ recommends a *do good, be good* strategy, in which changes in behavior precede changes in self-perception. Upon observing our own good behavior, we may be compelled to revise our personal narratives accordingly. Walton and Banaji⁸⁰ found a similar effect inherent to verbal behavior. How people described their attitudes affected the strength, quality, and stability of those attitudes. In an interview, Walton reported, "Our research suggests that people come to be who they say they are." If this is the case, then claims of self-development may precipitate actual self-development. When participants observe themselves making claims about changes in their own character, they may be compelled to revise their self-narratives and behavior accordingly. From this perspective, more initial exaggeration of self-development may be expected to precipitate more real self-development afterward. I might like to advocate a *say so, be so* strategy.

Potential limitations

The Hawthorne Effect is the tendency for some people to work harder or perform better simply because they are participants in an experiment. This can present serious problems for researchers whose goal is to draw meaningful conclusions about the particular effects of specific manipulations. In the case of interventional strategies, however, the primary goal is usually to motivate changes in behavior, and the implications of a Hawthorne Effect in such situations may be strikingly different. Even if the outcomes of the current project are the result of such an effect, which to some extent I expect they are, this doesn't necessarily render the interventions less meaningful or useful. Because the primary purpose of these interventions is to focus attention on the self, motivate action, and change behavior (rather than simply to observe a systematic effect), the extent that people are motivated by the study process and/or the attention is likely to be an essential component of self-development. I think this is how interventions typically work. One could imagine that 360-degree feedback in organizational settings would have very little effect if employees did not know they were being tested and were not expected to change. A remaining concern is the durability of observed effects. One would expect Hawthorne Effects to disappear when the study ends, while more impactful effects should remain.

Self-reports. Can we assume, or even hope, that the self-reported behavioral changes (*reported self-development* and *reported personality change*) are a reliable indicator of the true magnitude of changes in behavior? No, the biases exposed in the self-insight literature almost certainly are at play. Self-reflection and self-report remain as important parts of the multisource process, and introspection may work better when people pay attention to subtle cues,⁸¹ or are educated about the common pitfalls and biases.⁸² The self-report data, while subject to error and bias, provide a suitable complement to the objective measures of academic performance. In addition, my proposal of a *say so, be so* effect (see above) could be empirically evaluated. Do people feel compelled to match subsequent behaviors to previous self-developmental claims, and does such behavior matching tend to justify the original claim?

Informant ratings. Funder's Realistic Accuracy Model (RAM) suggests that accurate personality judgment is a complicated process in which many steps must be achieved.^{83, 84} Collectively, the research suggests that close others, such as friends, family members, and coworkers, are often able to navigate this process and, as a result, possess knowledge about a person's personality that she herself lacks.⁸⁵ Close others often have positive biases about each other and may not be objective in their perceptions, especially for evaluative traits. Thus, well-acquainted informants who are not particularly attached to the target may be less biased in their ratings than those who are more connected.⁸⁶

Future directions

I have argued that the Hawthorne Effect should not always be feared in interventional studies, especially when the goal is performance improvement. However, one feature of Hawthorne Effects is that they tend to be short lived, disappearing when the study is over. Longitudinal studies are needed to determine if personality feedback effects are long-lived or short-lived for most, and under what conditions they are likely to endure.

Being specific about when and how one's goals will be pursued can dramatically increase the chances of goal attainment by delegating control of goal-directed responses to anticipated situational cue. An expanded goal setting process that includes the generation of implementation intentions is likely to enhance the effectiveness of multisource feedback interventions. This enticing possibility has not been studied in the organizational literature, probably due to a lack of communication between social and organizational psychologists. Other tools could be added to the interventional processes as well. The functionality of PersonalityPad.org is currently being updated, and will include several new feedback and development features, such as more detailed informant feedback, more interactivity among site users (a support blog), and more development projects from which to choose.

To achieve an experimental design and imply causality, I randomly assigned students to one of three conditions. However, these interventions were initially designed to facilitate self-insight and behavioral changes in intrinsically motivated populations. The broad facilitative effect of need for self-development suggests that a study of individuals who are specifically interested in self-development, and eager to engage the personality feedback process, may experience larger and more consistent effects.

Another future goal is to enhance the quality and usefulness of the feedback widget. We would like to be able to display as much feedback as possible without overwhelming the participant. New features based on inter-rater reliability, personalized efficacy statements, and automatic weekly reminders, are currently being developed.

The current studies demand more investigation to identify potential inconsistencies between the two feedback administrations. The content and scope of personality feedback may have important motivational and behavioral consequences. Are there different implications of receiving relatively broad, versus relatively specific, personality feedback? One might suspect that participants may have benefitted the most from a targeted intervention that was able to precipitate observable improvements in academic performance.

Conclusions

The multisource conscientiousness feedback intervention appears to be generally effective, and the addition of informant feedback led to more desirable outcomes in some cases. Other contexts in which informant feedback may prove to be particularly valuable include interpersonal relationships and individual well-being. Even under the best circumstances, however, some people will be resistant to feedback. As with other routes to self-knowledge, the effectiveness of feedback will depend in part on a person's goals and motives.⁸⁷ Does she want to improve the accuracy of his self-views? Is she defensive and interested in protecting or affirming her existing, biased self-views?

As reviewed earlier, Bollich, Johannet, and Vazire⁸⁸ recently published a unique hypothesis, that explicit personality feedback from close others could serve as a valuable self-development tool. Smither, London, and Reilly⁸⁹ published a theoretical model of improvement following multisource feedback. The current study provided some evidence for both these propositions; for instance, final course grades were significantly higher in the 360-degree feedback condition than in the control condition. One uniquely promising aspect of feedback as a route to self-knowledge is that, unlike the intrapersonal routes to self-knowledge, feedback actually gives the person new information to consider. Even if the person does not accept this new information right away, she may store it in memory and come back to it later, perhaps when more evidence presents itself that confirms the original feedback. If a person is confronted with repeated feedback from trusted sources, and if the recipient is appropriately prepared for the information, knowledge may be gained that would have otherwise never been possible through self-guided efforts. In short, the search for self-knowledge likely requires the active involvement of close others to help fill in our blind spots.

A final essential element of self-development is the formation of an intentional developmental relationship with one's self. One must practice self-control through benevolent self-governance stemming from a meta-cognitive awareness one's multiple identities, inner voices, social dynamics, and competing priorities. Successful self-governance is not so much about self-discovery as it is about facilitating inner dialogue and relationships among identities. "People think that what we have to do is disclose, or liberate, the hidden reality of the self. The problem is not to free the self, but to consider how it could be possible to elaborate new types of relationships with ourselves."⁹⁰

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