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Conceptual Change in Psychology Students' Acceptance of the Scientific Foundation of the Discipline

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Two studies explored conceptual change in undergraduate psychology students' acceptance of the scientific foundations of the discipline. In Study 1, Introductory Psychology students completed the Psychology as Science questionnaire (PAS) at the beginning and end of the semester and did so from their own (Self Condition) and their instructors' (Professor Condition) perspectives. Study 2 replicated Study 1 with advanced students enrolled in research-oriented courses. In both studies, students had higher PAS scores in the Professor than the Self Condition and there was a modest change from the beginning to the end of the semester in Self PAS scores. The change in Self PAS scores was positively related to higher Professor PAS scores at the end of the semester, when controlling for initial Professor PAS scores and other variables. The discussion highlights pedagogical practices that promote students' representation of their professors' thinking about the discipline as distinct from and an alternative to their own misconceptions.

There is wide consensus that instruction in psychology should go beyond students acquiring knowledge of the discipline to educate them in the values and beliefs of the scientific approach to study mind and behavior (APA, 2013). As Charles Brewer and his colleagues noted, 'The fundamental goal of education in psychology, which all others follow, is to teach students to think as scientists about behavior' (Brewer et al., 1993, p. 163). At the very least, scientific psychology would require affirming the value of well-controlled research results and accepting their conclusions, despite such results not squaring with one's own experiences of the causes of the behavior.

Many people, including undergraduate students who enter Introductory Psychology classes, hold misconceptions about the discipline (Hughes, Lyddy, & Lambe, 2013, Lilienfeld, Lynn, Ruscio, & Beyerstein, 2009; Mercer, 2010), including doubts that the discipline is scientific (Benjamin, 1986; Friedrich, 1996; Stanovich, 2013). Accepting psychology as a science would seem necessary for people to debunk misconceptions. But between libraries and bookstores full of ineffective self-help books (Rosen, Glasgow, & Moore, 2003) and sham media psychologists practicing the discipline for entertainment rather than professional purposes, it is easy to see how people adopt the view of psychology as frivolous pseudoscience.

An unscientific image of the discipline is also the result of an everyday understanding of the mind and behavior, labeled as 'Folk Psychology' (D'Andrade, 1987; Premack & Woodruff, 1978; Wimmer & Perner, 1983). Folk Psychology is an account of behavior which appeals to individuals' subjective beliefs and desires as the basis for action, with explanations taking the form of individuals doing what they *believe* will get them what they *want* (Bennett, 1991). By assuming that individuals have privileged access to their own beliefs and desires which are the basis for explaining their behavior, Folk Psychology undermines the core values and beliefs necessary to scientifically

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study the mind and behavior (Dennett, 1971, Greenwood 1991; Stich, 1983; Stich & Ravenscroft, 1994).

Instructors of undergraduate psychology courses bear the challenge of helping psychology students overcome disciplinary misconceptions (Brewer et al., 1993; Friedrich, 1996; Kowalski, & Taylor, 2009). However, this 'mythbusting' has proven difficult to accomplish, particularly for the scientific foundation of the discipline. Undergraduate psychology students only slightly agree with the values and beliefs of scientific psychology as measured by Friedrich's (1996) Psychology as a Science (PAS) questionnaire (see Study 1 Methods section for reliability and validity details) (Amsel, Baird, & Ashley, 2011; Bartels, Hinds, Glass, & Ryan, 2009; Bartoszeck, Abramson, & Place, 2005; Friedrich, 1996; Gervasio, Wendorf, & Yoder, 2010; Holmes, 2014). Notably, higher PAS scores were only weakly related (Amsel et al., 2011; Bartels et al., 2009; Friedrich, 1996) to greater exposure to the discipline (i.e., major status, more advanced academic standing, or coursework in psychology), if they were related at all (Holmes & Beins, 2009).

Students' resistance to adopting core values and beliefs of scientific psychology may be due to them holding alternative Folk Psychological understanding of mind and behavior. Science educators suggest that holding an alternative conceptual understanding of a discipline is an impediment to learning unless and until students critically reflect on and revise their values, beliefs and concepts, aligning them to those of the discipline (Carey, 2000; Posner, Strike, Hewson, & Gertzog, 1982; Strike & Posner, 1992). This process requires that students not only overcome their allegiance to an alternative conceptual understanding of a discipline, but also accept a disciplinary-appropriate understanding of which they are ignorant. However, Amsel et al. (2009) challenged the view that psychology students are ignorant of the values and beliefs of the discipline and undergo a radical restructuring. Introductory Psychology students completed the PAS questionnaire from their own (Self Condition) perspective or from their instructors' (Professor Condition) perspectives. PAS scores were higher in the Professor than the Self Condition independently of demographic and academic variables. The findings suggest that Introductory Psychology students *understand* the values and beliefs associated with a scientific psychology, as represented by their ascription to their professors of higher PAS scores than they ascribe to themselves, but are just skeptical about *accepting* them. A similar conclusion was reached by Holmes and Beins (2009), who found that undergraduate students' scientific literacy increased with advanced coursework in psychology. However, students' knowledge about science from studying psychology was unrelated to their accepting psychology as a science, as measured by the PAS.

The present research includes two studies which further assesses if, when, and how students overcome their skepticism and begin to accept the core values and beliefs of scientific psychology. The research had three goals. The first goal was to more carefully document whether there is an increase in students' acceptance of core disciplinary beliefs with exposure to the discipline. The inconsistency of findings of the effect of exposure to the discipline on PAS scores may be due to the potential extraneous variables that exist between students' background, interests, and career motivations early on in their undergraduate career when they have less exposure to the discipline and those later on in their undergraduate careers when they have more exposure. Although attempts to control such variables by using exclusively psychology majors (Bartels et al., 2009; Holmes, 2014; Holmes & Beins, 2009), or by grouping students according to their interest in the discipline as majors, minors, or neither majors nor minors (Amsel et al., 2011; Holmes, 2014) go only so far. As a means to control extraneous variability, we used a within-subjects design to assess semester-long changes in PAS scores within the same students. Students enrolled in Introductory Psychology (Study 1) and research-oriented (Study 2) classes completed the PAS at the beginning and end of the semester to assess the impact of these courses on changes in their acceptance of core values and beliefs of scientific psychology.

Additionally, to further test the claim that students are skeptical rather than ignorant of the discipline's core values and beliefs, participants completed the PAS questionnaire in both the Self and Professor conditions. Amsel et al.'s (2009) finding of the between-subjects difference between students' own PAS scores and the scores they ascribe to their instructors is not a direct test of whether they are aware of the substantial differences that have been shown to exist between their own and their instructors' PAS performance. Holmes (2014) reports psychology instructors score a point higher on the 7-point PAS scale than students in psychology classes. In the present study, students completed the PAS questionnaire from their own and their professors' perspectives at the

same time to ensure that participants were cognizant of the differences between their judgments in each condition.

Finally, a third goal of the research was to examine the significance and consequences of students' ascriptions to their instructor of their acceptance of core disciplinary values and beliefs. Of particular interest was whether students' attribution of higher PAS scores to professors is related to higher *actual* not just self-reported *anticipated* (Amsel et al., 2009) final grades (Study 1) and reflective of them adopting a serious, deep approach to learning the conceptual foundation of discipline (Study 2). We expected a general relation between changes in students' own acceptance of core disciplinary values and beliefs over a semester and their ascription of those values and beliefs to their professors.

Study 1

Study 1 was designed to explore the origin of the disparity between students' thinking about their own and their psychology professors' acceptance of disciplinary values and beliefs and the changes in both over the course of a one-semester (14 weeks) Introductory Psychology course. Students from Introductory Psychology classes were given the PAS questionnaire to complete in both the Self and Professor Conditions during the first week and again between the tenth and twelfth weeks of classes. It was hypothesized that participants' PAS scores would be initially higher in the Professor than the Self Condition and scores in each condition would increase as students are exposed to the discipline. Of interest was whether there was a relation between the increases in Self scores as students better represent their professors' beliefs.

Method

Participants

Students ($N = 100$) from three traditionally taught Introductory Psychology classes who completed the PAS questionnaire twice were the participants in the study. The instructors (2 male and 1 female) were full time and experienced and taught the course similarly and in standard ways. They followed traditional textbook organization with a focus on research early in the semester and attention to such topics as psychopathology and therapy later in the semester. Two of the instructors taught the class on the main campus and one taught the class at a satellite campus. A total of 198 students completed the questionnaire at Time 1 and 135 students completed it at Time 2. The average age of the 100 participants who completed the questionnaire at both testing occasions (completers) was 22.37 years ($SD = 5.72$ years) which was no different from non-completers 21.48, ($N = 96$, $SD = 4.93$), $F(1, 194) = 1.36$, $p = .25$, $\eta p^2 = .007$. Most of the completers were female (56%) which was similar for the non-completers (54%), χ^2 (1, $N = 198$) = .07, $p = .89$, $d = .04$ and most completers (90%) and non-completers (95%) were freshmen or sophomores, χ^2 (1, $N = 198$) = 1.7, $p = .28$, $d = .19$.

Non-completers came from each of the three Introductory Psychology classes at equal rates, χ^2 (2, $N = 198$) = .58, $p = .75$, $d = .11$. They did not complete the study for a variety of reasons: some dropped the course without receiving a grade ($N = 52$), some had completed the course and received a grade but just missed a testing session ($N = 30$), and some did not complete all the PAS items on each occasion so their scores could not be used ($N = 16$). Participants gave their consent not only for the research but also for researchers to access from institutional records their ACT scores and final letter grade in the class. The average ACT Composite score ($M = 21.6$, $N = 80$, $SD = 3.51$) was no different from the university average ($M = 21.4$), $t(80) = .51$, $p = .61$, $d = .05$ (one-sample *t*-test) and from non-completers ($M = 21.62$, $SD = 4.84$), $F(1, 117) = 0.00$, $p = .98$, $d = 0.0$.

Task and Procedure

Participants completed Friedrich's (1996) PAS questionnaire in their classroom at the beginning (first week) and end (tenth–twelfth weeks) of the semester and received research participation credit for it. Prior to completing the questionnaire at each session, participants answered questions regarding their demographic (age, sex, year in college) and academic background (the number of

previous psychology courses, their academic major and minor, and the likelihood [from 1 = 'not at all likely' to 4 = 'very likely'] that they would major in the discipline). As most participants had not declared a major or minor, their likelihood of majoring was used to index their interest in psychology.

The instructions to complete the PAS scale directed participants to read each of 20 (15 experimental and 5 filler) statements. The experimental items included statements which address core disciplinary values of the importance of research (affirming that 'Research conducted in controlled laboratory settings is essential for understanding everyday behavior', and denying that 'Psychological advice given in popular books and magazines is often as useful as more research-based claims'); and beliefs in its effectiveness (affirming that 'Psychological research can enable us to anticipate people's behavior with a high degree of accuracy', and denying that 'Our ability as humans to behave in any way we choose makes our attempts to predict behavior ineffective'). Participants responded to each statement by selecting a number from 1 (strongly disagree) to 7 (strongly agree) that accurately described the extent of their own and their professors' agreement or disagreement with the statement. The questionnaire used the same statements and presented them in the same order as Friedrich (1996). The 15 experimental statements included 7 negatively keyed (reverse scored) and 8 positively keyed items. The instructions were taken from Friedrich (1996), but edited to direct participants to answer each item at the same time from their own (Self Condition) and their professors' (Professor Condition) perspectives (see Appendix). For half the participants at each assessment, the Self Condition scores were entered on the left-hand side and for the other half, Self Condition scores were to be entered on the right.

The PAS is a reliable and valid measure of the core values and beliefs of scientific psychology. Friedrich (1996) reported a reliability (coefficient alpha) of .77 with 239 students at a small select liberal arts college, and test-retest reliability of .76. Holmes and Beins (2009) found a coefficient alpha of .73 with 201 students also at a selective liberal arts college and Amsel et al. (2011) found a coefficient alpha of .83 with 448 students at an open enrollment regional university. Validity data described in Friedrich (1996) and elsewhere (Gervasio et al., 2010; Holmes & Beins, 2009) show that PAS predicts students' interest and engagement in psychological research. Holmes (2014) confirmed that psychology instructors had substantially higher PAS scores than did their students, and Amsel et al. (2009) found that Introductory Psychology students' PAS scores were positively correlated with their self-reported sixth-week grade, independently of demographic and academic variables.

Results and Discussion

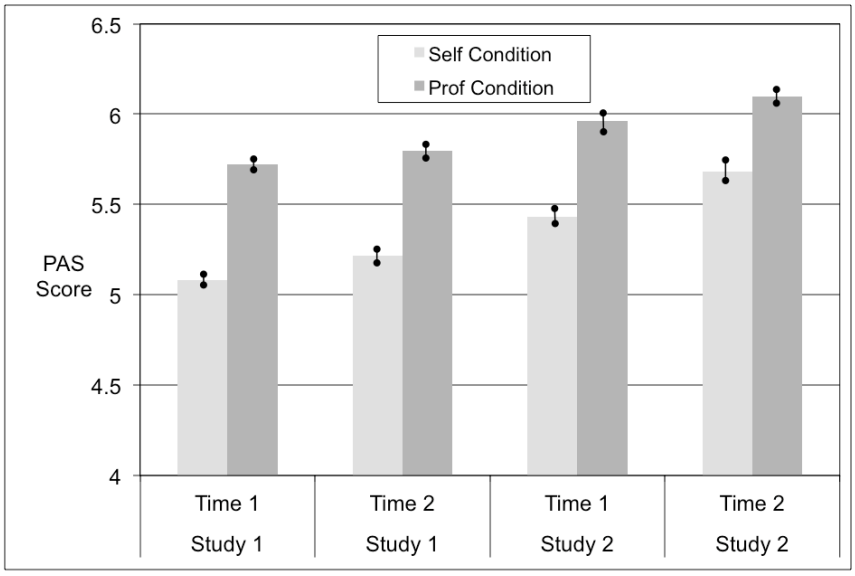
Average PAS scores for each participant in each perspective at each time of testing were computed so that higher PAS scores reflected greater acceptance of the values and beliefs of scientific psychology. PAS scores ranged from a low of 3.87 in the Self Condition at Time 1 to a high of 7.00 in the Professor Condition at Time 2. The data were subjected to a 2 (Time) by 2 (Perspective) ANCOVA controlling for demographic characteristics (age, sex, year in college), academic variables (likelihood to be a psychology major, previous psychology courses, psychology professor, final class grade), and task variables (order of presentation of Self and Professor Conditions at each assessment). The results revealed a main effect of Time, $F(1, 90) = 6.20$, $p = .015$, $\eta p2 = .06$ and Perspective, $F(1, 90) = 15.68$, $p < .001$, $\eta p^2 = .15$. The Time by Perspective interaction effect $F(1, 90) = 2.79$, $p = .10$, $\eta p^2 = .03$ did not reach statistical significance (see Figure 1).

The findings suggest that upon entering into an Introductory Psychology class, college students only moderately accept values and beliefs associated with Psychology as Science, but recognize their professors as accepting those values and beliefs more strongly. The extent that students perceive the difference in PAS scores between themselves and their instructors ($M = .64$, $N = 100$, $SD = .52$) underestimates Holmes' (2014) report of the actual difference ($M = .97$), $t(99) = 6.30$, $p < .001$, $d = .63$ (single-sample t-test).

Although there was not a significant Perspective by Time interaction effect in PAS scores, analyses point to differences by condition in PAS change scores over time. By the end of the semester, there was a slight but significant increase in students' own acceptance of the values and beliefs of scientific psychology (M Time 2 Self PAS – Time 1 Self PAS = .14, $SD = .68$, $t(99) = 2.01$, p

= .047, d = .40) but not in their ascriptions of such beliefs and values to their professors (M Time 2 Prof PAS – Time 1 Prof PAS = .07, SD = .76, $t(99)$ = .93, p = .35, d = .19).

Figure 1. PAS scores by Perspective Condition and Time for Study 1 (students in Introductory Psychology classes) and Study 2 (students in research-oriented classes), error bars are standard error of the means.



The analyses of PAS change scores by condition were augmented by sign tests that assessed whether an equal number of individuals had higher PAS scores at the second than at the first testing session, independently of ties. Significantly more participants than expected by chance had higher (N = 59) than lower (N = 37), Self PAS scores at the second testing session (Sign test, Z = 2.14, p = .03, two-tailed). In contrast, the number of participants who had higher (N = 55) than lower (N = 42) Prof PAS scores at the second testing session was no different than chance (Sign test, Z = 1.22, p = .22, *ns*, two-tailed). These analyses converge on finding significant increases over time only in Self PAS scores.

There were class-level differences in performance. Only a minority (30%) of students enrolled at the satellite campus class had higher Time 2 than Time 1 Self scores compared to the majority of students attending the two main campus classes (75% and 67%), $F(2, 97) = 8.82$, $p < .001$, $\eta p^2 = .15$ (LSD *post hoc* test). A smaller percentage of students increased in Prof scores in the satellite (37%) than one (68%) but not the other (58%) of the main campus classes, $F(2, 97) = 3.45$, $p = .036$, $\eta p^2 = .07$ (LSD *post hoc* test). Although it is difficult to know whether the class differences are due to characteristics of the students (their background or motivation), the instructors (their pedagogical practices), or an interaction between the two, the results suggest caution in generalizing the results across classes.

The relation between students' own acceptance of the values and beliefs of scientific psychology was analyzed in light of their ascription of such beliefs to their professors. A partial correlation was computed to predict the relation between Time 2 Prof PAS scores and increases in Self PAS scores from Time 1 to Time 2, removing Time 1 Prof PAS scores and the previously described demographic, academic, and task variables. The correlation was positive, $r(88) = .56$, $p < .001$, suggesting that irrespective of their background and initial assessment of their professors' acceptance of core disciplinary values and beliefs, the more students recognize their professors accepted such values and beliefs by the end of the semester (Time 2 Prof PAS scores), the more they accepted them too (change in Self PAS scores from Time 1 to Time 2).

We conducted further analysis to explore the relation between PAS scores and final course grades. A partial correlation was run predicting students' final course grades in Introductory Psychology from their PAS scores, independently of the same demographic, academic, and task variables. Only Time 1 Prof PAS scores, $r(90) = .31$, $p = .003$, predicted students' final grade,

underscoring the academic consequences of students' ability to entertain their professors' disciplinary values and beliefs, irrespective of their own acceptance of them.

Study 2

The goal of Study 2 was to replicate the findings of Study 1 with advanced psychology students in research-oriented psychology courses. Given that values and beliefs of scientific psychology are explicitly presented in such courses, it was expected that students in these courses would continue to demonstrate as much if not more change in Self PAS scores than students in Introductory Psychology. It was also predicted that changes in Self PAS scores would be related to higher Time 2 Prof PAS scores, independently of their Time 1 Prof PAS scores and other factors.

Additionally, to better understand the kind of learning involved in students' own and recognition of their professors' acceptance of core disciplinary values and beliefs, participants in Study 2 completed a learning style assessment. The assessment explores students' surface and deep learning styles by measuring their motivational and strategic approaches to knowledge acquisition in academic settings (Biggs, Kember, & Leung, 2001; Marton & Saljö, 1976). The surface learning approach involves strategies and motivations to process information at a minimal level, necessary to achieve acceptable grade performance in classes and avoid academic failure. The deep learning approach involves strategies and motivations to process information at the most meaningful level, necessary to achieve a conceptual understanding and satisfy intrinsic interests. It was predicted that higher Self and Prof PAS scores after a research-oriented class would be negatively related to a surface learning and positively related to deep learning scores.

Method

Participants

Participants were 57 students (47% female, 72% juniors and seniors, 88% major or minor in psychology) from the same university as Study 1 who completed the PAS questionnaire on two testing occasions. Participants were from three sections of an upper-division Research Methods in Psychology and one section of a lower-division Psychology as Science and Profession class.[1] Both classes are dedicated to explaining the foundation and significance of scientific research to students, albeit at different levels of detail. Again, participants gave their consent for the research and for researchers to access their overall university GPA ($N = 57$, $M = 3.10$, $SD = .53$), psychology GPA ($N = 48$, $M = 3.30$, $SD = .43$) and final class letter grade, expressed as a GPA score ($N = 56$, $M = 3.09$, $SD = .95$).

Task and Procedure

Participants in Study 2 completed the same demographics and PAS questionnaire used in Study 1 and did so during the first week of classes and again during the ninth or tenth week of the 14-week semester. At the second assessment, all participants also completed the Revised Two-Factor Study Process Questionnaire (R-SPQ-2F) developed by Biggs et al. (2001) to assesses strategies and motivation associated with deep and surface learning. The 20-item questionnaire generates 4 sub-scores based on 5 items each, including deep learning strategies ('I find most new topics interesting and often spend extra time trying to obtain more information about them'), deep learning motivation ('I come to most classes with questions in mind that I want answered'), surface learning strategies ('I only study seriously what's given out in class or in the course outlines'), and surface learning motivation ('My aim is to pass the course while doing as little work as possible'). Students evaluated the statements relative to a given course on a 5-point scale from 1 ('This is never or only rarely true of me') to 5 ('This is always or almost always true of me'). Scores were totaled and combined into two general 10-item scales of surface and deep learning approach as recommended by Justicia, Pichardo, Cano, Berben, and De la Fuente (2008), although see Immekus and Imbrie (2010). Cronbach's alpha for each scale based on a sample of 90 participants (the 57 students in the present sample and 33 additional students collected for another study) was .77, which is higher than

alphas for the two scales reported by Biggs et al. (2001) but on par with other findings (Justicia et al., 2008).

Results and Discussion

Average PAS scores for each participant in each perspective at each time of testing were computed. PAS scores ranged from a low of 3.67 in the Self Condition at Time 2 to a high of 6.93 in the Professor and Self Conditions at Time 2. The data were subjected to a 2 (Time) by 2 (Perspective) ANCOVA controlling for demographic characteristics (age, sex, year in college), academic variables (psychology status, previous psychology courses, research class type, and final class grade), and task variables (order of presentation of Self and Professor Conditions at each assessment). The results revealed no significant main effects but a Time by Perspective interaction effect $F(1, 43) = 5.82$, $p = .02$, $\eta p^2 = .12$, which was due to a change over time in PAS scores in the Self, $F(1, 43) = 5.86$, $p = .02$, $\eta p^2 = .12$ but not the Professor Condition, $F(1, 43) = .09$, $p = .76$, $\eta p^2 = .002$. Again, the analyses of PAS change scores converged with the results of sign tests. Significantly more participants had higher ($N = 38$) than lower ($N = 18$) Self PAS scores at the second than the first testing session (Sign test, $Z = 3.02$, $p = .003$, two-tailed) although the number of participants with higher ($N = 33$) than lower ($N = 20$) Prof PAS scores at Time 2 than Time 1 was no different (Sign test, $Z = 1.65$, $p = .10$, two-tailed).

The change in Self PAS scores among Study 2 students in research-oriented psychology courses ($M = .26$, $N = 55$, $SD = .50$) was not significantly different than Self PAS change scores of Study 1 students in Introductory Psychology ($M = .14$, $N = 100$, $SD = .68$), $t(153) = 1.16$, $p = .25$, $d = .17$. Moreover, the number of students whose Self PAS scores increased in study 1 ($N = 59$ out of 100) and Study 2 ($N = 33$ out of 55) was no different, $\chi^2 (1) = 1.54$, $N = 155$, $p = .21$, $d = .20$.

The partial correlation predicting change in Self PAS scores from Time 2 Prof PAS scores, removing Time 1 Prof PAS scores and the previously identified demographic, academic, and task variables was positive, $r(40) = .36$, $p = .021$, replicating the results from Study 1. Surface learning scores were negatively correlated with Time 2 Self PAS scores, $r(39) = -.42$, $p < .006$, and Prof PAS scores, $r(39) = -.34$, $p = .031$, independently of the same demographic, academic, and task variables. However, deep learning scores were unrelated to Self PAS scores, $r(39) = .10$, *ns*, and Prof PAS scores, $r(39) = -.07$, *ns*. Students who critically consider their own and their professors' thinking about the discipline tend not to adopt a surface learning orientation. But students who are inclined to reflect on the discipline may also not adopt more traditional deep learning strategies or motivations assessed by the questionnaire, such as posing questions in class or performing additional research.

General Discussion

Two studies assessed how undergraduate students come to accept the core values and beliefs of scientific psychology. The first goal of the study was to test in a within-subjects design whether exposure to the discipline is related to changes in students' adoption of core disciplinary beliefs, as reflected by their PAS scores. The results from each study support the claim: students in Introductory Psychology increase in Self PAS scores over a semester as do those who advance in the discipline and take research-oriented courses. The results may reflect the impact of repeated assessments resulting in an overestimation of the increase in students' PAS scores. But the present within-subjects data converge with those from between-subjects studies. If we consider the change scores in the Self PAS Condition in Study 1 and Study 2 as independent and additive, then the total change in the average students' Self PAS score is .40 (Study 1 = .14 + Study 2 = .26). This sum is consistent with Friedrich's (1996) report of a .44 difference in PAS scores between students in Introductory Psychology and Research Methods classes and Amsel et al.'s (2011) account of a .38 difference in PAS scores of between freshmen and seniors.

The class-level variability in Self PAS change scores suggests limits in the generalization of the findings. However, such variability is also of theoretical interest. Hughes et al. (2013) reviews research on the impact of instructor and student factors on overcoming psychological misconceptions. Future research could inventory these instructor and student factors in addition to

background variables (e.g., class size) across a variety of different psychology classes to predict and explain the class-level variability in conceptual change.

The second goal of the research was to test the claim that students were skeptical rather than ignorant of the discipline's core values and beliefs. In Study 1, students were shown to enter Introductory Psychology classes fully aware that their values and beliefs about the discipline are at odds with their professor. Although underestimating the actual difference that exists between instructors' and students' PAS scores (Holmes, 2014), the data suggest that students are aware that a significant gulf exists. Faculty members who assume that students are ignorant rather than skeptical of the discipline's scientific nature may not appreciate that to achieve desired learning outcomes, students may need more than just foundational information about the science of the discipline (e.g., understanding the design of experiments). Instruction must provide sufficient reasons for students to accept the discipline as a science in order to believe information from experiments (e.g., valuing experiments as a basis to understand human nature). Over fifty years of persuasion research suggests that changing values and attitudes involves more than just offering information but actively promoting the adoption of targeted beliefs and attitudes (see Friedrich & Douglass [1998] for an extended discussion on persuasion in teaching of psychology). Similarly, work on cognitive apprenticeships and situated learning suggests that only by engaging students in authentic practices in the discipline will they be socialized with the values and skills from the discipline (Brown, Collins, & Duguid, 1989). So rather than just reporting theories and findings, faculty must promote a disciplinary understanding in students about how psychologists use scientific information to explain human nature.

Finally, a third goal of the research was to examine the significance and consequences of students' ascriptions of core disciplinary values and beliefs to their professor. Higher Prof PAS scores, reflecting more accurate recognition of their instructors' beliefs, were positively related to grades (Study 1) and negatively related to surface learning strategies and motivations (Study 2). But most notably, there was evidence from both studies that higher Prof PAS scores at the end of the semester predicted an increase in students' Self PAS scores, independently of the initial PAS score they ascribed to the instructor. The results suggest that one way to promote students adopting disciplinary values and beliefs is to induce them to think like their psychology professor.

We propose that the reason for the relation between changes in students' Self PAS scores and Time 2 Prof PAS scores lies in the students representing disciplinary information as *distinct from* and as *alternative to* their own misconceptions and misgivings about discipline. Classroom practices which afford opportunities for students to represent scientific information about a topic independently from their own misconceptions, allowing a comparison between the two, have been linked to conceptual change in students' beliefs (Hughes et al., 2013). For example, Miller, Wozniak, Rust, Miller, and Slezak (1996) demonstrated the value of students writing counter arguments to their own misconceptions as a way for them to revise those misconceptions. Such *counterattitudinal advocacy* is a social psychology persuasion technique which requires students to represent scientific information independently from misconceptions they harbor about the topic. Similarly, Kowalski and Taylor (2009) employed a science education tactic, called *refutation teaching* in which students' misconceptions and the correct scientific information about a topic are presented simultaneously to enable students to represent the latter independently from the former and compare the two. They found refutation teaching was effective in students overcoming psychological misconceptions.

Although these techniques can be used effectively in the classroom, we also propose that merely instructing students to represent professors' beliefs creates the conditions for conceptual change. Recent experimental work from our lab has found that inviting students to think like a psychology professor about scientific information presented in a video was more effective in promoting conceptual change than asking them to think about what they learned or what they believe (Russell, Voigt, & Amsel, 2014), an effect that sustained after a month-long follow-up (Amsel, Bessire, Daniels, & Soelberg, 2014). We found the same effect for thinking like a physicist in promoting physics students to overcome misconceptions about electromagnetism (Johnston & Amsel, 2014). Future research testing hypotheses about ways to best induce students' representation of scientific information independently of their misconceptions could provide insight into how to promote psychology students' acceptance of its scientific foundation.

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Notes

[1] Research Methods is a required class for psychology majors in which students write up a study that they design, collect, and analyze over the semester. Psychology as a Science and Profession (Amsel & Kay, 2008) is an elective class which introduces students to the discipline by emphasizing the importance of the scientific foundation of clinical practice. Students complete a study during the semester to introduce them to statistical and research issues.

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APPENDIX

Listed on the next page are a number of statements. Each statement represents an opinion regarding some aspect of psychology. Evaluate each statement from your own perspective and your psychology professor's perspective. You and your psychology professor may disagree with each other on some of these statements and agree on others. There are no correct or incorrect answers. Read each statement carefully using the following scale, write a number on the space provided to indicate your own (Self) and your psychology professor's (Psych Prof) opinion:

1	2	3	4	5	6	7
Strongly disagree			Neither agree nor disagree			Strongly agree

For example consider the following statement:

Psych Professor		Self
_____	Psychology should be a required course for all students	_____

If YOU disagree slightly with the statement write the number 3 underneath Self. If your PSYCHOLOGY PROFESSOR strongly agrees with the above statement you write the number 7 on the line underneath Psych Prof. Be sure to give a response for each perspective on every statement.

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