What do students think when asked about psychology as a science?

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Abstract

Research has shown that undergraduate courses in psychology often fail to make students accept the discipline as a science (Sizemore & Lewandowski, 2009). It may be that explicit instruction is not sufficient to modify students' conceptualization of psychology as something other than *science*. The goal of this study was to examine introductory psychology students' conceptualizations of psychology and science. 570 participants completed a free association task (Nelson et al., 1998) for disciplines that included psychology and other sciences. They also provided ratings for these disciplines on relevant dimensions (e.g., important and scientific) and were asked "Is psychology a science?" Students tended to agree that psychology was a science, but rated it to be less scientific than the natural sciences. Moreover, the free association results suggested that psychology was semantically distant from the other sciences. Thus, successful pedagogy will need to focus on conceptual change if students are to accept psychology as a science.

Keywords: psychology, education, science, perception

What do students have in mind when they are asked to think about psychology as a science?

There is no doubt that popular psychological phenomena seem to fascinate the general public. Unfortunately, people tend to hold many misconceptions tied to the pseudoscientific and commonsense explanations of psychological phenomena that appear in the media (Stanovich, 2019). Lilienfeld (2012) argued that psychologists encounter people's disconcerting misperceptions as soon as they enter the "real world". However, research has demonstrated that the misconceptions about psychology are not only held by the lay public, but by undergraduate psychology students and non-psychology college faculty as well (Janda, England, Lovejoy, & Drury, 1998; Lassonde, Kolquist, & Vergin, 2017). Alas, this includes the thousands of first year psychology students that enter introductory psychology classes each year (Toomey, Richardson, & Hammock, 2017). In fact, their misconceptions appear to be particularly robust considering that they are not diminished by an introductory course (Kowalski & Taylor, 2009). Still, one of the main goals of teaching introductory psychology classes is to debunk misconceptions about psychology (Rosell et al., 2005). This goal is made particularly difficult to reach when students initially believe that psychology is not a science (Thieman, Clary, Olson, Dauner, & Risng, 2009). So, researchers and educators must attempt to overcome this pedagogical challenge by somehow convincing their students that their field of study is scientific. As such, the goal of this study was to examine how psychology and science are conceptualized by students in order to understand how introductory psychology courses can help improve the perception of psychology as a science.

How are Disciplines Determined to be Sciences?

The question of what makes a given discipline a science is complex (see Chalmers, 2013 for an excellent discussion). Nonetheless, while it is possible to establish a list of reasonable criteria that define science (e.g., Coyne, 2015), it is highly unlikely that people do so in order to determine whether or not psychology is a science. Considering that people typically act like "cognitive misers" (Fiske & Taylor, 2013; Stanovich, 2009), it is much more probable that they use a heuristic to make this judgment. These heuristics allow one to find quick, but sometimes incorrect, solutions to given problems (Roberts, 2004). Hence, when faced with the question "Is psychology a science?", participants may cursorily assess psychology's stereotypical features and decide that it is not a science because its features do not seem to overlap with those of science.

A variety of studies offer support for this idea. For instance, researchers have examined the possibility that psychology's perceived lack of utility (i.e., uselessness) or importance might influence the likelihood that it is seen as unscientific (e.g., Janda et al., 1998; Sizemore & Lewandowski, 2009). Others have argued that its status as an easy to understand discipline might lead to the same result (e.g., Keil, Lockhart, & Schlegel, 2010; Miller & Gentile, 1998). It has also been suggested that psychology does not appear to be as concrete as other scientific disciplines like neuroscience, which relies on brain imagery (Hopkins, Weisberg, & Taylor, 2016; See also Bechlivanidis, Lagnado, Zemla, & Sloman, 2017). In fact, it has been found that the mere inclusion of neuroscientific terminology, specifically references to the brain, makes the description of psychological phenomena more satisfying (Rhodes, Rodriguez, & Shah, 2014; Weisberg et al., 2008; Weisberg, Taylor, & Hopkin, 2015). Schwartz, Lillienfeld, Meca, and Sauvingé (2016) attributed findings such as these to the contemporary division between psychology and neuroscience. Finally, people rate the topics studied and equipment used by the natural sciences (e.g., cancer and microscopes) as more scientific than those used by psychology (e.g., personality and questionnaires) (Krull & Silvera, 2013). Thus, a number of stereotypical features may be informing people's judgments about psychology's scientific status.

Conceptualizing Science and Psychology

Like other schemas, it may be assumed that the one for science develops tacitly via education and the media. One method of exploring individuals' preconceived schemata for science and psychology is by examining their semantic associative networks. For instance, psychology might be perceived as unscientific because the natural sciences (e.g., biology, chemistry, and physics) are highly associated with the concept *science* while psychology is not. Consequently, this might lead individuals to believe psychology is unrelated to science.

Free association. One paradigm that can be used to study semantic networks is the free association task (e.g., Nelson & McEvoy, 2000). It allows researchers to explore the underlying semantic strength between words by evaluating single-response words (i.e., associates) specified for a particular term of interest (i.e., a cue). In such tasks, participants are asked to list the first word that comes to mind that is meaningfully related to the cue word. Semantic association is calculated by analyzing the frequency of words produced by each cue. Subsequently, an index of the relative accessibility of related words in memory can be created. Nelson, McEvoy, and Schreiber (2004) have generated a public database containing more than 72,000 word pairs along with a number of related data. It offers word norms and semantic strength association, but data collection initially started in 1973. The semantics associated with terminology tend to evolve over time, either by semantic change or transfer of meaning (Lehrer, 1978). Thus, although Nelson et al.'s word norms may continue to be useful for some experimental work in psychology (e.g., semantic priming), it seems unreasonable to expect them to measure a contemporary perception of psychology. Nonetheless, free association provides a means to empirically analyze the semantic strength between psychology, science, and the natural sciences.

Goals of This Present Study

The goal of this study was to investigate students' conceptualizations of psychology and science. To achieve this goal, a discrete free association paradigm (Nelson, McEvoy & Schreiber, 1998) was used whereby participants listed the first word that came to mind when shown 30 terms that comprised common academic disciplines. These disciplines were also rated by participants on six different dimensions: specificity, concreteness, difficulty, imageability, importance, and the extent to which each discipline was thought to be scientific (i.e., "scientificity"). Finally, participants were asked explicitly "Is psychology a science?" Groups were compared based on scientific expertise and current level of education in psychology. Therefore, a Science Literacy questionnaire (SLQ), comprising questions on the knowledge of topics and methodologies and attitude toward science was also administered. Moreover, participants were asked to provide their program and current year of study.

Three hypotheses were formulated. First, it was expected that students with more psychology-specific education and higher science literacy scores would perceive psychology as more scientific than other students. Second, it was expected that psychology would be rated as less scientific, less important, and less difficult than science and the natural sciences. Moreover, participants' ratings of science and the natural sciences were expected to be similar to each other and different from psychology for all six dimensions. Finally, it was expected that the terminology to come to participants' minds when they were shown the terms science, biology, chemistry, and physics would be similar to each other and different from those listed for psychology.

Method

Participants

A total of 570 participants were recruited from both Carleton University and the general public. Due to a programming error, participants could start the experiment without explicitly giving informed consent. Consequently, those who did not were removed from the dataset (n = 17). Additionally, two participants declined informed consent and were therefore removed from further analyses as well. Thus, the analyses focused on the remaining 551 participants.

The SONA system provided by Carleton University was used to recruit 510 university undergraduates. These participants received 1% bonus credit in their respective psychology courses as compensation. The Social Psychology Network (SPN) was used to recruit 19 persons from the general public[1]. The SPN is a website that specializes in assisting researchers with the recruitment of participants for online experiments in the area of social and personality psychology. A brief advertisement was placed on the SPN website to invite volunteers to take part in the study. These participants received no compensation for their participation. The online software Qualtrics (Qualtrics, Provo, UT) did not code the recruitment source for participants who did not click on the “submit” button upon completion of the online survey. Thus, it is impossible to know whether the remaining 22 participants were recruited from SONA or SPN.

Materials

The stimuli that were used in this study consisted of 30 cues, which comprised a list of academic disciplines (as shown in the left-hand column of Table 1) selected to represent a variety of common North American university programs. The cues of interest for this present study were *psychology*, *science*, *chemistry*, *biology*, *physics*, and *neuroscience*.

Procedure

Free association task. For the free association task (Nelson et al., 1998), participants were asked to provide the first word that came to mind that was meaningfully related to the cue expression (i.e., the stimuli terms). To avoid chaining effects, a single-response paradigm was used, where participants were asked to only list one associate per cue (Nelson et al., 2004). For example, given the cue *medicine*, participants might respond "doctor" or "nurse", but not both. Each cue was displayed individually and the order was randomly generated for each participant. However, since the cue *neuroscience* contains the word *science*, it always appeared last. This was done to avoid priming the concept of science while participants were responding to the other cues in the list. Participants typed all of their responses.

Rating task. Participants were presented with the 30 cue words and were asked to rate them on six different dimensions: concreteness, difficulty, imageability, importance, specificity, and the extent to which it was scientific. All dimensions were explicitly defined on the instructions page (e.g., "Imageability refers to how well you are able to picture something in your mind. For instance, while it may be simple to imagine the term table, it may be much more difficult to picture the term better"). Participants were asked to provide their rating using a 5-point Likert scale that comprised clickable stars, where one star indicated a low rating and five stars indicated a high rating. Participants were told to provide ratings based solely on their opinions and that there were no right or wrong answers. The dimensions were displayed one at a time and randomized (although the science dimension was always displayed last). Likewise, the order of the 30 cues was randomly generated for each dimension and each participant (with *neuroscience* always appearing last).

Science Literacy Questionnaire. The SLQ used in this present study was adapted from Impey, Buxner, Antonellis, Johnson, and King's (2011) questionnaire. The format of some questions was changed to true or false statements to maintain consistency throughout the questionnaire. It comprised the three following parts.

Knowledge of topics. Participants were shown the 17 scientific statements (e.g., "the oxygen that we breathe comes from plants") and asked to say whether they were true, probably true, probably false, or false. Of these 17 statements, 7 of them were added for the purposes of this study and 10 of them were from Impey et al.'s (2011) questionnaire. All statements were simultaneously displayed on the screen in a list, where participants clicked on the associated bubble to make their choice. However, the order of the statements was randomized for each participant.

Knowledge of methodology. This second section was devised for the purposes of this study and assessed participants' knowledge of scientific methodology. Participants were given 11 short scientific scenarios and asked to identify the conclusion that follows from a selection of possible answers. The following is an example of one of the scenarios and possible conclusions that was used:

> "Suppose a drug used to treat high blood pressure is suspected of not working well. The following is a list of three different ways scientists might use to investigate the problem. Which one do you think scientists would be most likely to use?
> (a) Talk to patients to get their opinions.
> (b) Use their knowledge of medicine to decide how good the drug is.
> (c) Give the drug to some patients but not to others. Then compare what happens to each group."

Each scenario was displayed one at a time and the order of the statements was displayed at random for each participant. Likewise, the possible conclusions for each statement were randomized.

Attitude toward science. Once more, the items from Impey et al. (2011) were used and three statements were added for the purposes of this study (e.g., "Theories founded in psychology can be attributed to common sense"). Participants were asked to tell us how strongly they agreed with each of the 20 statements, using a 5-point Likert scale. They were asked to think about their answers carefully and told that they would not be given the chance to go back to change their answers. Furthermore, they were encouraged to answer the questions to the best of their ability and to not look up the answers elsewhere. The statements were displayed individually and randomized for each participant.

General procedure. The Qualtrics software was used to administer the study and record the responses. Participants were told that the goal of the study was to examine people's perception of academic disciplines. The participants first gave their informed consent and then proceeded to the free association task. Subsequently, they took part in the rating task, after which the following demographic information was collected: age, gender, country of residence, level of education, type of education (i.e., program), and current year of study (if still in school). The participants were also asked whether they considered their field to be scientific and whether they identified as scientists. Finally, they rated the extent of their scientific training and their fluency in English. To obtain a more in-depth understanding of their native fluency in English, they were also asked to provide a list of any other languages they spoke fluently. The demographic questions appeared after the free association task and rating task to avoid priming the idea of science before the study.

In the last part of the study, participants completed the SLQ. Subsequently, to ensure participants were still naïve to the hypotheses of the study, they were asked to describe what the study was testing and how they came to such a conclusion. Next, they were asked explicitly "Is psychology a science?" and also "Why (not)?" Afterwards, they were asked if they would like to change their answer. Then, they were asked to define the term *science* before finally being allowed to alter their answer one last time. In total, the study lasted approximately 45 minutes.

Results

Demographics

Nine percent of the participants were removed from the dataset: 43 because they completed less than 10% of the study and 7 because they discovered the hypothesis of the study (or some version of it). Thus, 501 remained for the analyses. Demographic information was obtained for 481 participants. It is given in Table 2. Also included in Table 2 is the information regarding participants' education (i.e., program and year of study).

Science Literacy

The SLQ was completed by 477 participants. The internal consistency of the Knowledge of Topics and Knowledge of Methodologies sections was measured using Cronbach's alpha. These sections of the questionnaire were found to be adequately reliable (28 items, α = .74). Participants' overall Science Literacy Scores comprised their average of scores from the Topics and Methods sub-sections (M = .70, SD = .15). They scored higher on the topics (M = .73, SD = .16) portion of the questionnaire than on the methods (M = .67, SD = .19) section (M_D = 0.05, SD_D = 0.16, 95% CI [0.01, 0.04]), $t(476)$ = 7.09, p < .001; d = 0.31. The lack of definitive answers to most questions made the Attitude Toward Science section of the questionnaire difficult to interpret in relation to the other aspects of the present study. Therefore, this portion of the questionnaire was not analyzed further.

Is Psychology a Science?

Because research has demonstrated that people do not generally believe psychology to be a science, it was anticipated that the participants of this study would be unlikely to agree that psychology is a science. Of those who responded to the three re-iterations of the explicit question "Is psychology a science?" (*n* = 482), 8% of participants changed their answer at any given interval. Because of this lack of change in responding, the participants' final decisions were used as their responses. The data are shown in Table 3. Contrary to expectations, a vast majority of participants said "yes" psychology is a science. Thus, participants in our sample agreed with the idea that psychology was a science to a much larger degree than shown in previous research (e.g., Janda et al., 1998).

Hypothesis #1: Psychology-Specific Education and Science Literacy

It was first hypothesized that students with more psychology-specific education would perceive psychology as more scientific than other students. A chi-square test of independence determined that the relation between these variables was significant, X^2 (2, N = 411) = 6.93, p = .03. Relatedly, it was also expected that students with higher scientific literacy scores would perceive psychology to be more scientific as well. This hypothesis was not supported, as binomial logistic regression analyses determined that participants' scores on the SLQ did not affect their likelihood to agree that "yes" psychology is a science, X^2 (1, N = 395) = 1.212, p = .27. So, while individuals' psychology-specific education affected their willingness to agree that psychology is a science, their knowledge of topics and methods commonly used in science did not.

Hypothesis #2: Dimension Ratings

The second hypothesis stated that psychology would be rated as less scientific, less important, and less difficult than the natural sciences. It was also expected that participants would rate science and the natural sciences similarly. The mean score for each dimension was calculated for each cue word. The descriptive statistics are shown in Table 1. Psychology was ranked below the mean on all dimensions excluding scientific and important. However, for the scientificity dimension, the five other science cues (i.e., science, chemistry, biology, neuroscience, and physics) ranked within the first five positions, whereas psychology was 10th. Similar results were found for the importance dimension. As expected, the five other science cues were rated as more important than psychology. Hence, this second hypothesis was supported.

The correlations among the dimensions were generally strong. As shown in Table 4, they displayed medium to strong effect sizes with the exception of those involving imageability. To ascertain which dimensions best predicted the perception of any discipline as scientific, we conducted a stepwise regression. The criterion variable was the mean participant ratings for the dimension scientific per discipline. The predictor variables were importance, concreteness, specificity, difficulty, and imageability. Only two predictors explained a significant amount of variance: Difficulty (R^2 change = .67, $F(1, 28) = 56.60$, $p < .001$) and Concreteness (R^2 change = .05, $F(2, 27) = 34.94$, $p < .001$).

Hypothesis #3: Free Association

Even though participants typically agreed that psychology is a science, psychology was rated to be less scientific than the natural sciences and neuroscience. The final hypothesis predicted that students' semantic associative networks surrounding science and the natural sciences would be similar, but different from psychology. In order to examine the students' semantic networks involving psychology in relation to the other sciences, their free association data were analyzed.

Data cleaning and screening. Free Association responses were screened following Nelson et al.'s (2004) methodology. Before cleaning, the total number of associates was 14,819.

All obvious typos (e.g., "sychology") and abbreviations (e.g., "neur") were corrected and all verb tenses were changed to the present (i.e., eliminating "ing" and "ed"), unless doing so changed the meaning of the word (e.g., "building" was not changed to "build"). Terms with American spelling (e.g., color) were changed to Canadian spelling (e.g., colour). All classifiers were removed and the root word was kept (e.g., "a", "the", "is", and any adverbs or adjectives). All strings (i.e., responses with more than two words that are not separated by any delimiter) and nonsense words (e.g., "sdgdsfg") were removed (1.22%). All obviously personal responses (e.g., "Georgette") were eliminated (.45%). All synonyms were collapsed (e.g., "penitentiary", "prison" and "jail") where the more frequent term was chosen (2.21%). All responses with more than one word separated by any delimiter (e.g., a comma or backslash) were altered, whereby only the first word was kept (.013%). Finally, all responses that were identical to the cue were removed (.27%). After cleaning, the total number of associates was 14,528. Thus, a total of 98% of associates remained in the analyses.

Semantic strength. Semantic strength was calculated using the frequency of the associates (i.e., words generated by participants) for each cue (i.e., words shown to participants). In order to be considered an associate, the target had to have been generated by at least two participants (i.e., responses given only once were not analyzed). Following the procedures outlined by Nelson et al. (1998), forward semantic strength (FSG) and overlapping semantic strength (OSG) were calculated.

To obtain the FSG values, the number of participants that generated a given associate when shown a cue was first calculated. This yielded each associate's frequency count. Thus, the number of associates per cue varies as a function of how many unique associates were generated.

FSG represents the proportion of times that participants produced a given target in response to a cue. Hence, larger values represent stronger semantic connections.

Next, the OSG values were calculated. They were measured by assessing the overlapping associates between any two cue words and they represent how strongly cues are semantically associated with each other. Thus, each associate's FSG was calculated for cue word pairs that shared at least one associate and multiplied to create a product FSG for each overlapping associate. Finally, the sum of the product FSGs yielded the semantic strength between the cues (i.e., the OSG values). A matrix displaying the OSG values for all cues of interest is shown in Table 5. Again, larger OSG values represent stronger semantic associations. It was found that the strength between psychology and science was weaker than that between science and chemistry, physics, and neuroscience. Surprisingly, however, biology was also only weakly related to science in comparison to the other disciplines.

FSG. To further understand the semantic associations between science and the disciplines of interest, FSG values were also examined for each of the cues of interest.

Cue: Science. Even though the OSG value for biology-to-science was considerably lower than the other cues of interest (and similar to the one generated for psychology), biology was the most commonly elicited word by the cue science (*FSG* = .1077, 95% CI = .0803, .1351). Thus, while the terms that represent the concepts biology and science might differ, the term biology was found to be associated with the concept of science. The cue science also generated other terms of interest such as chemistry (*FSG* = .0854, 95% CI = .0607, .1101), physics (*FSG* = .0183, 95% CI = .0065, .0301), and neuroscience (*FSG* = .0061, 95% CI = -.0008, .0130). For some participants, the first word that came to mind included other disciplines, such as medicine and philosophy. Sadly, psychology was not the first word that came to mind for anyone when the cue science appeared.

Cue: Psychology. When participants were shown the cue psychology, the most commonly generated word was mind (*FSG* = .2710, 95% CI = .2316, .3105). Mind was not an associate that participants generated for the cue science. The second most common associate for the cue psychology was brain (*FSG* = .2382, 95% CI = .2004, .2760). The associate brain was also part of the semantic network for the cue science (*FSG* = .0122, 95% CI = .0025, .0219). Even though no one listed the associate psychology when they saw science, when participants saw the word psychology, seven did say "science". However, this science-to-psychology FSG was comparatively low .0144, 95% CI [.0038, .0249] ($M_{science\text{-}to\text{-}any\ cue}$ = .0199, $\text{Range}_{\text{science-to-any cue}}$ = .0041 to .0690). So, while the associate science is part of the semantic network for the word psychology, the associate psychology is not part of the semantic network for the word science.

Associate: Science. Because seven participants listed science as the first word to come to mind when they saw *psychology*, the frequency by which science was listed as an associate for any cue was calculated. Physics (*n* = 34), chemistry (*n* = 28), physics (*n* = 17), computing (*n* = 12) and neuroscience (*n* = 12) were all more likely to evoke the term science than psychology (*n* = 7).

Shared Associates for the Cues Science and Psychology. In order to investigate the similarities between science and psychology, the shared associates for the cues psychology and science were examined. First, associates were coded for semantics (i.e., topic, object, method, or other). None of the common associates for the cues psychology and science included object associates and the only two topic associates that were common between the disciplines were brain and neuroscience. However, 4 of the 15 common expressions for psychology and science included words that exemplify methodologies common in science (i.e., experiment, theory, research, and study). By comparison, the most common associates between the other cues of interest (i.e., biology, chemistry, neuroscience, and physics) and science were topics and objects.

The examination of the shared associates for psychology and science led to three additional findings of interest. Sadly, it was observed that the FSG for the associate Freud to the cue psychology (.0164, 95% CI = .0051, .0277) was somewhat greater than that of the associate Einstein to the cue science (.0102, 95% CI = .0013, .0190). Second, the only cue of interest that did not generate "difficult" as an associate was psychology. Finally, the term "lab" was generated as an associate for the cues science, biology, chemistry, and physics. No participant thought to list it when they saw psychology, however.

Discussion

The erroneous belief that psychology is not a science has generated much discussion considering the field's emphasis on teaching its students the science of psychology. As such, the goal of this study was to examine students' conceptualization of psychology and science to understand how introductory psychology courses can help improve the perception of psychology as a science.

Is Psychology Perceived to be a Science?

Of the most troublesome misconceptions about psychology are the beliefs that it is unscientific or unimportant (Janda et al., 1998). Many scholars have discussed the causes and implications of this problem both within and outside academia (e.g., Lilienfeld, 2012; Stanovich, 2019; Zimbardo, 2004). Yet, the undergraduate students in our sample were generally willing to agree that psychology is a science when forced to make a dichotomous judgement. Additionally, not one upper-level psychology student said "no" when asked "Is psychology a science?"

Minimally, this shows that undergraduate students who take psychology courses are willing to give the normative answer with regards to the scientific nature of their discipline.

Still, when participants were given a chance to provide graded responses, they rated psychology as less scientific as well as less important, difficult, and concrete than other scientific disciplines. Hence, although participants explicitly expressed the belief that psychology is a science when asked the question directly, their ratings suggested a more complex picture. Individuals might have the explicit knowledge that psychology is a science without necessarily associating its characteristics with science in semantic memory. If this conjecture is correct, it would be in line with dual-processing accounts of cognition (Kahneman, 2011; Stanovich, 2004). Dual-processing puts forth that human reasoning comprises two different kinds of thought processes that are controlled by differential operations. System 1 is an implicit system with low capacity requirements. It operates automatically and unconsciously. System 2 is a rule-based system with high capacity requirements. It operates in a controlled and conscious manner. Thus, when asked if psychology is a science, participants may have been engaging a System 2 process: they retrieve the answer "yes" taught in class from episodic memory. When rating the extent to which psychology is a science, however, they may have been using System 1 heuristics (i.e., a mental "short cut"). For instance, they might have retrieved a feature that is characteristic of science like difficulty, importance, or concreteness, and decided that psychology was not particularly scientific. This line of argumentation is supported by the finding that the ratings for difficulty and concreteness were related to the extent to which the disciplines were rated as scientific. Moreover, biology, chemistry, physics, and neuroscience were all rated as more difficult and concrete than psychology.

The Semantic Networks associated with the Disciplines

To further explore the participants' implicit conceptualization of psychology and science, the semantic networks for the cues of interest were examined. The free association results demonstrated that psychology and science were not strongly associated. This further supported a dual-processing account of the results. A few key findings from these analyses can be used to help understand what aspects of the disciplines might be influencing this semantic dissociation and ultimately the conceptual difference between psychology and science.

Topics versus methods. First, even though psychology was less semantically related to science than to physics, chemistry, and neuroscience, the common associates generated for psychology and science were methodological terms (i.e., research, study, theory, and experiment). This result suggests that students associate psychology with an empirical, theory-driven approach. Yet, psychology's association with these terms was insufficient to make it as strongly associated to science as other natural sciences. When the semantics of the associates that were generated for the more typical sciences were investigated, it was found that the strongest associates were topics and objects of the discipline. Perhaps students conceptualize academic disciplines by their topics and objects. As such, rather than its methodology, science might also be conceptualized by its topics and objects of study. This suggestion is supported by Krull and Silvera's (2013) research where participants rated psychology topics (e.g., happiness) and objects (e.g., questionnaires) as less scientific than those from the natural sciences.

Psychology as the helping profession. Another common psychology myth is that all psychologists are clinicians (Stanovich, 2019). The data provided support for the existence of this myth. For instance, the strength of the semantic association between psychology and psychiatry (*OSG* = .0235) was considerably stronger than the one between psychology and science (*OSG* = .0047). This may suggest that psychology might be more readily thought of as a helping profession than a scientific one.

Laboratories. This study provided evidence to suggest that one key difference between psychology and the natural sciences was the association between the term *lab* and the sciences. It is important to note that the university from which the sample was recruited (i.e., Carleton University) does award bonus credit to students for participating in research. Still, even though students listed the term *lab* when they saw biology, chemistry, and physics, not one of them did so when they saw the word psychology. Therefore, strengthening the association between psychology and laboratory work, by systematically including a laboratory component in introductory psychology courses, might help improve students' perception of psychology as a science. Some researchers have argued that one component psychology lacks, compared to other sciences, is the hands-on research component (e.g., designing a study, collecting data, analyzing data) in introductory courses (Peterson & Sesma, 2017). Research has shown that when students are offered out-of-class research activities, such as a lab component or participating in studies, they tend to demonstrate increased satisfaction with the course and an improvement in their understanding of the scientific nature of psychology (Bowman & Waite, 2003; Taylor & Kowalski, 2004).

The brain/mind relation. Perhaps one of the most striking findings within the free association data was the way in which the cues science, psychology, and neuroscience elicited the targets brain and mind. When students saw the word psychology as a cue, the two most common terms that they listed were mind (n = 132) and brain (n = 116). For neuroscience, the strongest associate was by far the brain (n = 311 vs. n = 14 for the mind). Finally, the word brain was generated by participants when they saw the cue science, but the word mind was not. These data become even more suggestive when they are compared with Nelson et al.'s (1998) word norms for which the collection started in 1973. The most common word to be cued by psychology was *mind* and the mind-to-psychology semantic strength was almost identical for both samples (*FSG* = .2730 for Nelson et al. vs. .2710 for the present one). Yet, even though *brain* was the second most common associate for psychology in the present study, not one person in Nelson et al.'s sample listed *brain* as an associate for psychology or science. These comparisons suggest that the brain has emerged as an important topic of scientific study in recent years. Thus, it is not surprising that the brain has become increasingly more associated with science. It is surprising, however, that this does not help psychology's status as a scientific discipline when the dimension rankings and free association measures are considered. Moreover, the data suggest that the mind still does not appear to be perceived as a legitimate object of scientific study. This finding is odd considering the scientific study of the mind was the driving idea behind the cognitive revolution (Pinker, 2002; Miller, 2003).

This misconception that the brain is inherently a more scientific topic of study than the mind has been the focus of much discussion (Satel & Lilienfeld, 2013; Weisberg et al., 2008; Weisberg et al., 2015) and it has raised many possible explanations (Schwartz, Lilienfeld, Meca, & Sauvingé, 2016). For instance, it might reflect an intuitive brand of dualism; that is, a belief that brains are open to scientific investigation but that minds are not. It might also show people's preference for reductionist explanations. A brain that can be seen using imaging technology might seem like a stronger causal explanation for behavior than an abstract psychological construct. Or it might be driven by the erroneous belief that a given object of study or methodological approach cannot be adopted by more than one discipline. Perhaps some people think that brain research belongs to medicine or neuroscience and thus cannot be a topic of psychological investigation. This perception might be further enhanced by the fact that some academic institutions (including that from which this present sample was recruited) even have programs and departments for neuroscience separate from psychology (Cleland, 2002). Whatever the case may be, this perceived cleavage between the brain and the mind will remain a challenge for those who teach the science of psychology.

Limitations and Future Directions

The vast majority of the sample consisted of participants who were currently enrolled in an introductory psychology course. This might explain the overwhelming number of participants who agreed that psychology should be considered a science. Future studies should attempt to more concretely measure the differences between the general public, students with no psychology-specific education, and students with varying degrees of psychology-specific education and their conceptualizations of psychology as a scientific field of study.

Another limitation that should be noted is that, due to the exploratory nature of this present study, there were no means to calculate the likelihood that participants would be willing to categorize psychology a science compared to the other scientific disciplines. Future studies could include questions like "Is biology a science?" or "Is philosophy a science?". This would give positive controls that would assist in contextualizing the results of this present study.

Conclusions

A review of the literature suggested that the majority of students would categorize psychology as unscientific. However, our data demonstrated that the majority were actually willing to agree with psychology's scientific status when asked explicitly. So, it appears that the students' psychology-specific education does clearly communicate the idea that psychology is a science. However, the conceptual problem persists; that is, when the task of assessing psychology's scientific nature became more tacit, the data demonstrated that psychology was not as strongly associated with science as the other natural sciences. So, teaching students that psychology is a science may be insufficient to change their conceptions about psychology as a science: Their explicit attitudes toward psychology may not be matched by their implicit ones (Wilson, Lindsey, & Schooler, 2000). Some research from the social cognitive literature suggests that individuals can display a shift in explicit attitudes while their implicit attitudes remain intact (e.g., Petty, Tormala, Briñol, & Jarvis, 2006). Future research should focus on comparing students' implicit and explicit perceptions about psychology as a science more directly. This would serve as another step toward finding a way to change students', and ultimately the public's, perceptions of psychology as a science.

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Footnotes

[1] The intention was to demonstrate differences in the perception of psychology as scientific between these populations. Since the number of participants recruited from the general public (i.e., SPN) was far fewer than anticipated, this analysis would have relied on comparing 19 persons from the general public to 510 undergraduate students. Moreover, the data suggested no differences between the samples. Therefore, the 19 persons from the general public were included in the analyses.

Table 1

Participants' Mean Dimension Ratings for Each Discipline

Cue	Scientific	Important	Difficult	Concrete	Imageable	Specific
Science	4.84	4.44	4.21	3.80	3.45	2.96
Chemistry	4.78	4.03	4.31	3.97	3.62	3.67
Neuroscience	4.71	4.18	4.32	3.57	3.36	3.97
Biology	4.70	4.27	3.98	4.07	3.73	3.57
Physics	4.70	3.95	4.45	3.59	3.06	3.56
Medicine	4.67	4.65	4.58	4.18	3.93	3.75
Engineering	4.11	4.31	4.48	3.95	3.35	3.41
Astronomy	4.00	3.06	3.50	3.31	3.76	3.41
Psychiatry	3.68	3.82	3.57	2.87	3.07	3.38
Psychology	3.63	3.96	3.11	2.78	3.30	2.97
Mathematics	3.43	3.93	4.26	3.26	3.38	3.34
Computing	3.41	3.72	3.75	3.47	3.25	3.44
Agriculture	3.08	3.92	2.79	3.99	3.78	3.26
Statistics	2.99	3.48	3.71	3.02	2.98	3.62
Archaeology	2.97	2.92	3.10	3.69	3.53	3.28
Architecture	2.94	3.82	3.78	3.97	4.03	3.63
Geography	2.80	3.33	2.70	3.71	3.72	3.24
Criminology	2.60	3.81	3.15	2.90	3.20	3.23
Anthropology	2.60	2.89	2.61	2.80	2.77	2.79
Economics	2.47	3.70	3.49	2.87	2.69	3.14
Sociology	2.47	3.27	2.53	2.52	2.79	2.64
Linguistics	2.20	3.27	3.06	2.76	2.66	3.21
Business	2.10	3.88	3.34	3.01	3.38	2.97
Law	2.05	4.31	3.77	3.01	3.44	3.40
Humanities	2.03	3.19	2.58	2.45	2.48	2.41
Philosophy	1.95	2.70	2.86	2.00	2.58	2.37
Theology	1.88	2.45	2.54	2.05	2.39	2.50
History	1.81	3.36	2.66	2.83	3.41	2.80
Music	1.67	3.34	2.65	3.06	3.99	2.74
Art	1.59	3.14	2.55	3.11	4.23	2.24
M	***3.10***	***3.64***	***3.41***	***3.22***	***3.31***	***3.16***
SD	***1.07***	***.55***	***.69***	***.59***	***.49***	***.44***

Note: The mean scores for participants' ratings of each of the 30 disciplines for six pre-determined dimensions, using a 5-point Likert scale, whereby 1 indicated a lower rating and 5 indicated a high rating. Cues are sorted based on Scientific rating scores.

Table 2

Demographics

Demographic	Items	(N = 481)
Gender	Male	196 (40.75%)
	Female	280 (58.21%)
	Did not disclose	5 (1.04%)
Age		M = 20
Country of Origin	Canada	446 (92.72%)
	USA	14 (2.91%)
	China	9 (1.87%)
	One of 9 other countries	12 (2.49%)
English Fluency	Excellent	360 (74.84%)
	Very Good	82 (17.05%)
	Good or lower	39 (8.11%)
Other Fluent Languages		M < 1, Max = 5
Scientific Training	None	111 (23.08%)
	Beginner	274 (56.97%)
	Intermediate	91 (18.92%)
	Advanced	5 (1.04%)
Program Major	Psychology Major	94 (20.80%)
	Non-Psychology Major	358 (79.20%)
Psychology-Specific Education	First Year Students	253 (56.00%)
	Upper Year Psychology Students	59 (13.05%)
	Upper Year Non-Psychology Students	140 (31.00%)

Note: The Program Major and Psychology-Specific Education information is provided for only participants who listed their program major and their current year of study (n = 452). Any participant who included "psychology" as their major (including those declaring a double major) was considered a Psychology major. Otherwise, any participant that listed any other major (e.g., history, journalism, and linguistics) was considered a Non-Psychology major. Because it is likely that all first-year students in introductory psychology courses have similar psychology-specific educational backgrounds, all first-year students comprised the group First Year Students. Conversely, those in the upper year groups (i.e., students in second year or higher) were divided into two groups: Upper Year Psychology Students and Upper Year Non-Psychology Students.

Table 3

How Psychology-Specific Education Levels Affect Participants' Responses to the Question "Is Psychology a Science?"

Group of Students	Yes	No	Total
Upper Year Psychology	59 (100%)	0 (0%)	59
Upper Year Non-Psychology	119 (85%)	21 (15%)	140
First Year	235 (92.89%)	18 (7.12%)	253
Undisclosed Group	26 (86.67%)	4 (13%)	30
Total	439 (91.08%)	43 (8.92%)	482

Table 4

Correlations Among Dimensions

Dimensions	1	2	3	4	5
1. Scientific					
2. Important	.66				
3. Difficult	.79	.80			
4. Concrete	.66	.61	.65		
5. Imageable	.20	.35	.24	.75	
6. Specific	.74	.62	.84	.71	.33

Note: Correlations between participants' ratings of the 30 disciplines on the six dimensions on a 5-point Likert scale, whereby 1 indicated a low rating and 5 indicated a high rating. Correlations greater than .37 are significant at the .05 level, two tailed; Correlations greater than .47 are significant at the .01 level, two tailed.

Table 5

Overlapping Semantic Strength Values (OSG) for Main Cues of Interest

	Science	Neuroscience	Biology	Chemistry	Physics
Psychology	.0047	.1652†	.0039	.0014	.0014
Science		.0106†	.0036	.0154†	.0106†
Neuroscience			.0096†	.0022	.0032
Biology				.0027	.0034
Chemistry					.0097†

Note: † OSG values above the mean (*M* = .0066). Higher values indicate a stronger semantic strength between the words.