

Exploring the Relationship Between a Cognitive Reflection Test and the Psychology as a Science Scale

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Abstract

Although the field of psychology was not originally approached systematically, the scientific method is now applied in order to evaluate psychological theories. To further the body of knowledge concerning the public perception of psychology as a science, community college students were recruited for the Psi Beta National Research Project questionnaire that included the Psychology as a Science Scale (PAS) and the Cognitive Reflection Test 2 (CRT-2). Participants received the CRT-2 at either the beginning or midway through the questionnaire, depending on the last digit of the participant's phone number. The prediction that individuals who received the CRT-2 earlier would score differently on the PAS than those who received it later was not supported. Additionally, the prediction that individuals who are more analytical would score higher on the PAS Scale was supported. The aim of this study was to offer supporting data to further the understanding of the influences of cognitive reflection and public perception of psychology as a science. Implications of these findings may include the recognition of the role cognitive reflection may play in decision-making and provide supporting evidence of the potential for correcting detrimental misconceptions of psychology as a science. Suggestions for future directions include focusing on the relationship between CRT-2 and PAS scores and having more than three CRT-like questions to allow for a more sensitive measure of analytical and intuitive responses.

Keywords: cognitive reflection, CRT-2, analytical thinking, intuitive thinking, psychology as a science

Psychology is defined as “a diverse scientific discipline” studying the mind and behavior (American Psychological Association [APA], n.d., para. 1). Psychology's evolution from introspective philosophy to empirical science was marked by the adoption of the scientific method. The APA's ethical standards require psychologists to use empirical evidence when conducting research, making clinical decisions, and providing client services.

Additionally, empirical studies and metatheoretical examination of the hierarchical arrangement of sciences have demonstrated patterns, structures, and assumptions underlying scientific inquiry in psychology that closely resemble those in other sciences (Simonton, 2015). Using these criteria, Simonton (2015) found that psychology ranked much closer to biology than to sociology, forming a pair of life sciences and reflecting psychology's early

origins in physiology. Older sciences such as physics, chemistry, and biology have had more time to develop and collect data, allowing them to separate themselves from their pre-science days and reinforce their legitimacy as sciences. Psychology, as a younger field of study, despite meeting established criteria for a scientific discipline, still struggles to be recognized as a science. Public perceptions of psychology's scientific credibility vary widely (Ferguson, 2015; Lilienfeld, 2012), which impacts aspects of the field such as funding, policy, and community access (Lilienfeld, 2012; Price, 2011). Moreover, the public or policymakers may undervalue psychological research findings in critical decision-making if psychology is perceived as non-scientific. Stereotypes labeling psychology as unscientific can adversely impact research funding, as resources are often allocated based on perceived scientific merit (Lilienfeld, 2012). Lack of funding can stifle innovative research, limiting insights into human behavior, cognition, emotion, and social interaction, and valuable findings regarding issues such as mental health, education, and workplace efficiency may accordingly be underutilized. Research suggests that individuals who utilize more cognitive reflection tend to hold more pro-scientific beliefs across other domains such as biology and astronomy (Pennycook et al., 2022), and are more inclined to reject unsubstantiated claims, including false news stories (Pennycook & Rand, 2019), and stereotypes (Hammond & Cimpian, 2017).

Cognitive reflection is defined as the ability to bypass an intuitive incorrect response and use analytical reasoning to find the correct response (Fredrick, 2005). Within the structure of the dual-process theory of decision-making, an intuitive response is considered nonconscious, automatic, and the fast “default” response (Type 1 processing; Evans & Stanovich, 2013, p. 227); an analytical response is reflective, requiring conscious thought and cognitive effort, which is typically a slower process (Type 2 processing; Evans & Stanovich, 2013). Due to the reflective and deliberate nature

of analytical reasoning, an individual who tends to be more analytical may view psychology as more scientific, recognizing that psychology meets the requirements for science. Alternatively, those who tend to use intuitive reasoning may rely on their heuristics and biases of psychology, leading to the stereotype that psychology is not a science because it does not look like sciences such as physics or chemistry. Some evidence suggests that individuals who rely more on intuition may view psychology as less scientific (Amsel et al., 2011; Sibicky et al., 2020). In addition to the influence of intuition on perceptions of psychology's scientific nature, it is important to consider another factor: response or context effects. These effects arise from the analysis and impact of stimuli based on prior experiences. Question order, in particular, plays a significant role, as receiving certain questions before others can elicit different responses (Stark et al., 2018). For example, receiving certain measures in a questionnaire before others may affect how an individual approaches the rest of the questionnaire. Factors such as the environment in which a study is administered can also affect an individual's performance as a result of priming, anchoring, framing, or other contextual cues.

The present study assessed an individual's cognitive processes, perception of psychology as a science, and potential order effects. We assessed an individual's cognitive processes with the use of the Cognitive Reflection Test 2 (CRT-2; Thomson & Oppenheimer, 2016). An individual's beliefs about the scientific nature of psychology were assessed with the use of the Psychology as a Science (PAS) Scale (Friedrich, 1996), which asked participants to rate their responses to statements about psychology. The CRT-2, in particular, may encourage an individual to use cognitive reflection and prompt analytical reasoning throughout the remainder of the study questionnaire. We hypothesized that individuals who received the CRT-2 earlier would score differently on the PAS Scale than those who received it later due to context effects. Additionally, we hypothesized that individuals who are

more intuitive would score lower on the PAS, while individuals who are more analytical would score higher.

Method

Participants

The research study included an original sample of 1,212 college students from over 25 community colleges and used data from 1,110 participants who fully completed the survey. Participants were between the ages of 18-70 ($M = 22.60$; $SD = 7.72$). Individuals who did not give consent, were under the age of 18, and/or had incomplete/invalid data were excluded. Gender responses included 61.5% women ($n = 683$), 33.2% men ($n = 369$), 3.4% non-binary/nonconforming ($n = 38$), 0.1% genderfluid ($n = 1$), 0.8% transgender ($n = 9$), and 1.0% prefer not to answer ($n = 10$). Racial demographic responses included 40.8% White/European American ($n = 453$), 25.8% Hispanic/Latino ($n = 286$), 12.4% Asian/Asian American ($n = 138$), 8.2% Black/African American ($n = 91$), 7.2% Mixed race ($n = 80$), and 4.4% other responses ($n = 47$).

Procedure

This study used data from the National Research Project (2022-2023; NRP) study designed by Psi Beta's National Research Committee. The questionnaire was distributed by sharing an electronic link to participating chapters across the nation. The first question on the questionnaire obtained informed consent, and participants were debriefed following data collection, in compliance with the requirements of the Institutional Review Board (IRB# DES-4081). Each participating chapter was required to recruit a minimum of 30 participants to gain access to the full data set. Participating chapters were instructed to collect data in a computer lab on their community college campuses to prevent participants from looking up the answers. Data collection occurred from November 1, 2022, to February 15, 2023. The NRP questionnaire consisted of three measures: the CRT-2, the PAS Scale, and a Psychological Belief (PB) Scale. The order of the measures received varied depending on the last digit of the participant's phone

number, with 0-4 receiving the CRT-2 first, then the PB Scale and PAS Scale. Those with phone numbers ending in 5-9 received the PB Scale first, then the CRT-2 and the PAS Scale. The PB Scale consisted of 14 True/False questions and corresponding confidence scales, derived from Lilienfeld et al.'s (2010) source of psychological myths and misconceptions.

Cognitive Reflection Test 2

Cognitive reflection was measured using the CRT-2, which assessed an individual's ability to override an intuitive but incorrect response and to arrive at an analytical and correct response through cognitive reflection (e.g., "A farmer had 15 sheep and all but 8 died. How many are left?" Intuitive answer: 7; Analytical answer: 8). There were three questions formatted with an analytical answer, intuitive answer, and three other incorrect answers. Participants who gave two or more analytical responses were coded as Analytical, two or more intuitive responses as Intuitive, and all other combinations as Other.

Psychology as a Science Scale

Beliefs about the scientific nature of psychology were measured using the PAS Scale, which consisted of 15 items. It asked participants to rate their response to statements about psychology (e.g., "The study of psychology should be seen primarily as a science.") on a seven-point Likert scale from strongly agree to strongly disagree.

Data Analysis

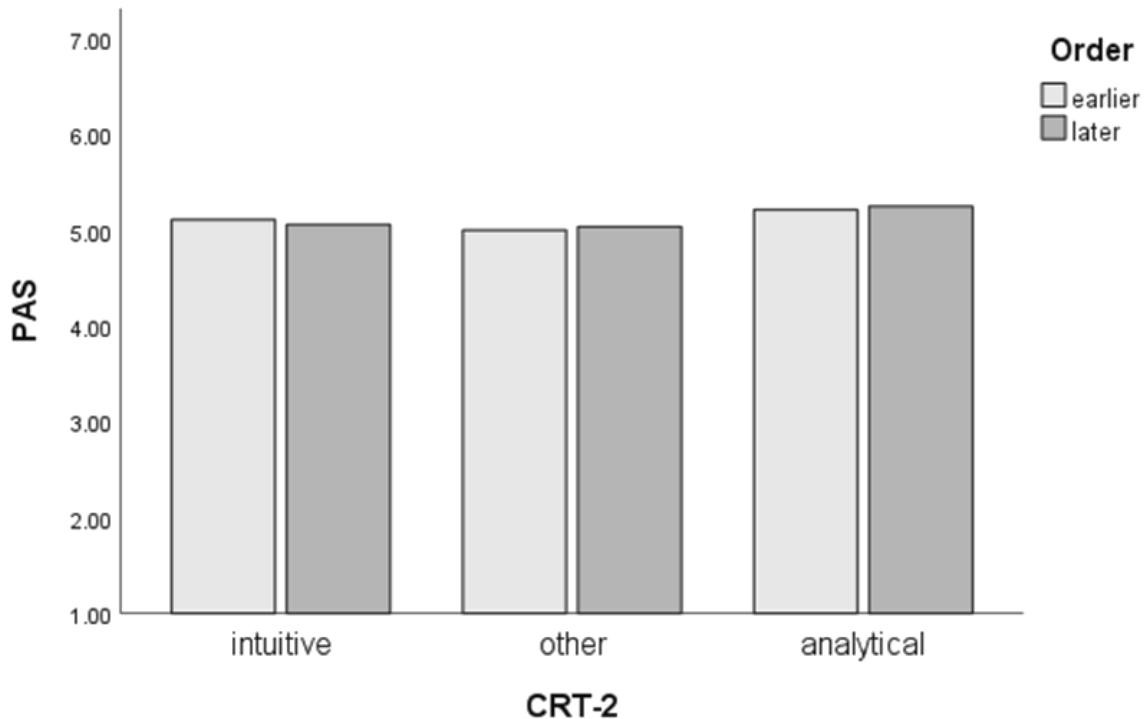
A 2 (Order: Earlier, Later) x 3 (CRT-2: Analytical, Intuitive, Other) Factorial Analysis of Variance (ANOVA) was used to predict PAS scores.

Results

We were unable to conclude that the order of receiving the CRT-2 influenced PAS scores, $F(1, 1103) = 0.02$, $p = .885$, $\eta^2 < .01$. However, we found that the CRT-2 was related to PAS scores, $F(2, 1103) = 9.51$, $p < .001$, $\eta^2 = .02$. We conducted a Tukey's HSD test and found the Analytical group scored higher on the PAS scale ($M = 5.23$, $SD = 0.65$), than the Intuitive ($M = 5.08$, $SD = 0.63$) and Other ($M = 5.02$, $SD = 0.66$) groups,

with $p < .05$. We were unable to conclude that there was an interaction between the order and the CRT-2. PAS means are displayed in Figure 1.

Figure 1. Bar Graph of PAS Scores by CRT-2 and Order



Discussion

In this study, we aimed to identify a relationship between cognitive reflection and perception of psychology as a science. Results of the present study support our hypothesis that Analytical individuals would score higher on the PAS scale. We were unable to conclude that the order of receiving the CRT-2 influenced PAS scores. The finding of a significant correlation between scores on the CRT-2 and the PAS Scale suggests a relationship between individuals' cognitive reflection capacities and their perceptions about psychology as a science — i.e., that the propensity to deliberate may play an important role in an individual's attitudes toward psychology. If psychology is viewed as less scientific, it may be deemed less deserving of funding, as evidenced by psychology's absence from

some agencies' lists of STEM disciplines (Price, 2011). Therefore, implications of these findings may include the recognition of the role cognitive reflection, specifically analytical reasoning, may play in decision-making, especially for concerns such as research funding and curriculum planning (e.g., implementing psychological research into teaching at all levels of education, including psychology courses earlier in education alongside other sciences). Furthermore, additional evidence of the relationship between analytical reasoning and perspectives of psychology as a science may support the potential for correcting detrimental misconceptions.

Statistical validity for the CRT-2 was good, shown by the p value being less than .001; however, the effect size was small. The CRT-2 has been

shown to have high face validity, even though cognitive reflection was measured by only 3 questions (Thomson & Oppenheimer, 2016). The external validity was good, with a nationwide sample of over 25 community colleges, although all participants were students, which may limit the generalizability of the findings. In regard to internal validity, there are potential confounds, such as age, gender, more education (especially psychology courses), and socioeconomic status, as well as a potential threat due to variation in the location of individuals participating in the survey.

As with any study, there are limitations that must be addressed. One of the biggest limitations was that we had no control over the design of the research questionnaire, or the order of the measures presented in it. The CRT-2 always preceded the PAS Scale, while the CRT-2 and PB Scale order varied for participants. This may be a contributing factor to not finding a difference between participants who received the CRT-2 earlier or later. Similarly, the PAS Scale was not emphasized in the survey, as it was the last measure, which may lead to burnout and less attention to the questions. Another limitation was the format of the question concerning the number of psychology courses completed by each participant. The question was open-ended and may have been misunderstood by participants, making it difficult to code due to written answers (e.g., “Alot” [sic], “Currently completing,” “At least 10”) and to look for a relationship with measures such as the CRT-2 and PAS Scale. Additionally, no question assessed the participant's level of education completed, so we were unable to evaluate this variable and the possible relationship with scores on the CRT-2 and PAS Scale. Furthermore, participation was limited due to supervision and computer lab requirements per the guidelines of the Psi Beta NRP, although not all participants adhered to these guidelines and there was no discernable difference between participants who completed the study in a lab setting and those who did not.

Taking into consideration the results of this study, a logical future direction for testing would be to construct a questionnaire with two versions, one order being the CRT-2 then the PAS Scale, and the other order being the PAS Scale then the CRT-2. This variation of measure order may better evaluate context effects. Ideally, the PB Scale would be removed to emphasize the PAS Scale and focus on the relationship between CRT-2 and PAS scores. To have more than three questions would allow for a more sensitive measure of analytical and intuitive response. The Cognitive Reflection Test (CRT; Frederick, 2005) may be used in conjunction with the CRT-2 to implement more questions that prompt Type 2 processing. To counter the limitation of being unable to evaluate the number of psychology courses an individual completed, the question should be modified to only allow quantitative responses. Future research could better address multicultural dimensions by (1) removing the requirement of completing the research questionnaire in a lab setting, (2) including a question addressing the participants' level of education completed, and (3) integrating transmasculine and transfeminine gender identity responses, allowing for a broader, more diverse, and accurate sample.

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