Imagine that John is playing blackjack. He is dealt a 9 and a 4 (13 total), and the dealer is showing a 4. Both are trying to get as close to 21 as possible without exceeding it. Objectively, John’s chance of winning is better if he keeps the hand he has (i.e., stands; 39.85%) than if he asks for another card (i.e., hits; 36.40%). But John has the intuition that 13 is not enough to win and decides to take another card. Unfortunately, he gets a 10—which puts him over 21—and starts $10 in the hole.

Why did John decide to hit? One obvious answer is that John does not have an encyclopedic knowledge of blackjack probabilities. You might assume that if John had known that he had a better chance to win by standing than by hitting, he would not have taken another card. However, as we will demonstrate in this article, John’s decision hinges on more than his knowledge of objective probabilities. People can recognize that one course of action is rationally superior yet choose to follow a different one. John may hit on 13 because of an intuitive belief that he is more likely to win by hitting—even if he recognizes the odds are against him. We suggest that he can maintain his intuitive belief while knowing that it is false, a phenomenon we have called acquiescence (Risen, 2016, in press).

Although we have previously laid out a case that we believe strongly suggests instances of acquiescence (Risen, 2016), to date there has been no definitive demonstration. Thus, in the current studies, we formally tested the three criteria required to meet the definition (Risen, in press):

**Criterion 1:** The individual has a faulty intuition that something is more likely to happen given a certain behavior or state of the world.

**Criterion 2:** The individual is aware that the intuition is irrational.

**Criterion 3:** The individual is guided by his or her intuition, knowing it is irrational.

---

**Keywords:**
cognitive processes, decision making, judgment, open data, open materials, preregistered

---

**Corresponding Author:**
Daniel K. Walco, The University of Chicago Booth School of Business, Department of Behavioral Science, 5807 South Woodlawn Ave., Chicago, IL 60637-1610
E-mail: dwalco@chicagobooth.edu
The notion that people behave in a way that they explicitly recognize to be irrational is both intuitively puzzling and at odds with many models of judgment and reasoning. Consider Kahneman and Frederick’s (2002) corrective dual-process model. System 1 quickly proposes an intuitive judgment, which serves as a default. If System 2 determines that the judgment is accurate (or is unable to determine that it is inaccurate), it endorses System 1’s proposal. If System 2 detects an error, however, then it corrects the judgment.

Although dual-process models are often based on the assumption that error detection and correction are linked (Evans, 2008; Kahneman & Frederick, 2002, 2005; Stanovich, 1999), recent work suggests that the models would be improved by decoupling detection and correction (De Neys, 2014; Pennycook, Fugelsang, & Koehler, 2015; Risen, 2016, in press). Indeed, a host of evidence has accumulated to suggest that people implicitly detect intuitive judgment errors even when they fail to explicitly detect them (De Neys, 2014; De Neys & Glumicic, 2008; De Neys, Moyens, & Vansteenwegen, 2010; De Neys, Rossi, & Houde, 2013).

Acquiescence differs from this previous work by suggesting that people can make intuitive judgment errors even when they explicitly recognize—in advance—that their judgments are wrong. The subjective experience of acquiescence, therefore—knowing that a belief is irrational, but being unable to shake it—is fundamentally different from making an error that is not explicitly detected. In the realm of magical thinking, for example, individuals act on intuitions they seem to recognize are rationally nonsensical (Keinan, 1994; Risen, 2016; Rozin & Nemeroff, 2002).

There are also suggestive examples outside of magical thinking, even when there is a cost. In the ratio-bias paradigm (Denes-Raj & Epstein, 1994; Kirkpatrick & Epstein, 1992; Pacini & Epstein, 1999), many participants choose an objectively inferior lottery, presumably because it feels easier to win when there are more winners (see Reyna & Brainerd, 2008). Most people implicitly detect their ratio-bias errors, which suggests that errors are often due to people’s failure to correct them (Bonner & Newell, 2010; Mevel et al., 2015). But participants are never asked to identify which lottery is rational. Would people choose a lottery after explicitly identifying it as inferior?

Research on probability matching (see Koehler & James, 2009; Newell, Koehler, James, Rakow, & Van Ravenzwaaij, 2013) perhaps comes closest to demonstrating acquiescence. Participants identify whether matching or maximizing is a superior strategy before guessing a sequence of outcomes. Some participants who identify maximizing as the superior strategy occasionally engage in matching nonetheless. However, participants are never asked which strategy is more intuitively appealing, which makes it impossible to determine whether faulty intuitions are driving their decisions. Furthermore, because there is no control condition in which the intuition to engage in probability matching is minimized, deviance could be due to an alternative explanation (i.e., boredom).

Overview of the Present Studies

We tested the criteria for acquiescence in four domains. Study 1 used the ratio-bias paradigm. In Study 2, participants guessed which of three envelopes contained $5. Before opening their envelope, participants could exchange it for both of the other two envelopes. Although it is considered bad luck to exchange a lottery ticket—that is, people believe a ticket becomes more likely to win if they trade it away (Risen & Gilovich, 2007)—participants are objectively twice as likely to win with two envelopes than one. In Study 3, participants played blackjack, including the hand from our opening example. Although people intuitively felt that they should hit, they were more likely to win if they stood. Critically, we provided the objectively rational strategy as they played. Finally, in Study 4, football fans decided whether to punt or “go for it” on fourth down. Although they had the intuition to punt, we provided objective probabilities suggesting they should not.

The experimental condition in each study created conflict between an intuitive and a rational response. We measured three dependent variables, corresponding to the three criteria. We asked participants what they believed was most likely to happen on the basis of their intuition (Criterion 1) and which option was rationally superior (Criterion 2). Lastly, participants made a decision (Criterion 3). After examining decisions for all participants, we restricted our analyses to those who accurately identified the rational response. This approach was more conservative because it excluded participants who were unable to identify the rational response and therefore tested whether people acquiesce to beliefs that they explicitly recognize are irrational.

The null hypothesis that everyone has accurate intuitions and responds optimally is problematic because of random error. Thus, we always included a control condition, which was matched in terms of the rational response but lacked a competing intuition, providing a benchmark for “noise” or even reactance. If people responded differently in the experimental condition, then that supported Criteria 1 and 3. For Criterion 2, we tested whether people (across conditions) could identify the rational response.
Empirical Case for Acquiescence

Study 1: Ratio Bias

Method

Two hundred one participants (93 female, 108 male; mean age = 31.81 years, SD = 10.12) completed the study for $0.25 on Amazon Mechanical Turk. We predetermined to stop data collection when a sample size of 200 was reached and got 1 extra participant before the study was taken down. We recruited 100 per condition, which is larger than the sample size of most ratio-bias studies because participants made only one decision rather than several decisions.  

Each participant was randomly assigned to one of two conditions. In the experimental condition, participants were presented with a standard ratio-bias paradigm. They were given a choice between a lottery with a lower chance of winning but a greater absolute number of winners, and a lottery with a higher chance of winning but a smaller absolute number of winners. More specifically, participants in the experimental condition were shown illustrations of two trays containing marbles and given the option of choosing to have a marble drawn from either Tray A or Tray B (see Fig. 1). Tray A contained 10 winning red marbles and 90 white marbles, and participants had a 10% chance of winning, whereas Tray B contained 1 winning red marble and 8 white marbles, and participants had an 11% chance of winning.

Thus, the experimental condition was designed to create a conflict in which people would be intuitively drawn to the lottery with more winners (Tray A), even though they rationally knew the lottery with better odds was superior (Tray B). To maximize the chance that people would explicitly recognize Tray B as the rationally superior option, we included the percentage chance of winning for each tray in addition to the number of winners and losers (previous research by Mevel et al., 2015, found that a substantial minority of participants failed to implicitly detect their error when the percentages were not calculated and displayed).

In the control condition, the lotteries matched those in the experimental condition rationally; that is, Tray A offered a 10% chance of winning, while Tray B offered an 11% chance of winning. However, the options in the control condition were designed to attenuate the intuitive appeal of Tray A, as each tray contained an equal number of winning marbles (Tray A contained 1 red marble and 9 white marbles, and Tray B contained 1 red marble and 8 white marbles). Thus, to the extent that people chose Tray A in the control condition, we knew that it was not driven by the intuition that it is easier to win when there are more winning marbles, and their choice instead may have been due to random error.

In both conditions, the information was accompanied by visual representations of the two trays.

Fig. 1. Screenshot of the ratio-bias trays in the experimental condition of Study 1. Participants chose which tray they wanted a marble to be drawn from. Drawing a red marble resulted in a win.
In addition, we assured participants that they would actually play whichever lottery they chose and that they would receive a $3 bonus if they won their lottery.

Prior to choosing which tray they wanted to use for the lottery and before indicating which tray seemed better on the basis of intuition and of reason, participants read a description of decision making:

Some decisions are made mainly on the basis of “intuition,” or by consulting the “gut.” Other decisions are made mainly on the basis of “reason,” or through rational analysis. Sometimes your intuition and rational analysis might tell you the same thing, but sometimes they might disagree. Please look carefully at both trays and consider what it will be like to draw a marble from each of the trays.

The description included so that participants would feel comfortable providing answers that were either the same or different from each other. Then they were asked two questions in a counterbalanced order.

To test Criterion 1—that people in the experimental condition would have the intuition that they would be more likely to win with Tray A than would people in the control condition—they were asked, “Based only on your gut feeling (or your intuition), which tray feels like the one from which you are more likely to draw a red winner?” Note that they reported their intuition for a specific outcome (i.e., drawing a red winner) for which we knew the objective probabilities and could therefore assess the extent to which their intuition was correct or faulty.

To test Criterion 2—that people knew it was rational to choose Tray B—they were asked, “Based on reason (or rational analysis), which tray should you choose if you want to draw a red winner?” Note that here, too, we were careful to provide the specific objective (i.e., “if you want to draw a red winner”). Thus, even if standards for what makes something rational vary, we limited interpretation in our studies by focusing them on a singular goal. Finally, participants were asked to choose a tray and played the lottery. We assumed that participants would have the primary goal of trying to draw a winner and earn money. Thus, we considered the choice of Tray B to be the rational choice in pursuit of that goal.

Although our plan was to investigate individual differences in acquiescence only after establishing its existence, we included three exploratory questions asking about people’s tendency to think intuitively and rationally, adapted from Epstein, Pacini, Denes-Raj, and Heier (1996): (a) “How important is it to you to make decisions based on rational analysis?” (b) “How important is it to you to trust your intuition?” and (c) “If your intuition goes against a rational analysis, how do you respond?” For Questions 1 and 2, the response scale ranged from 1, not at all important, to 5, extremely important. For Question 3, the scale ranged from 1, go with intuition, to 5, go with rationality. We describe the results of the three-item measure in the Supplemental Material available online. We then collected basic demographic information. Finally, we asked participants whether or not they believed that the lottery was conducted fairly and as described. This information is also included in the Supplemental Material.

Results

Criterion 1. When asked which tray felt more intuitively appealing, 44 out of 101 participants (43.6%) chose Tray A in the experimental condition. But how should we interpret the magnitude of this percentage? As mentioned previously, comparing 44 out of 101 to a null hypothesis of 0 out of 101 is problematic because of random error. We therefore tested Criterion 1 by comparing intuitions in the experimental condition with the benchmark set by the control condition. We found that only 11 out of 100 participants (11%) chose Tray A in the control condition, $\chi^2(1, N = 201) = 26.81, p < .001, r = .37, 95\%$ confidence interval (CI) = [.23, .48]. This difference between the experimental and control conditions provides support for Criterion 1.

Criterion 2. We tested Criterion 2 by determining whether participants (across conditions) accurately identified the rational response. When asked which tray they should choose on the basis of a rational analysis, 190 out of 201 participants (94.5%) accurately selected Tray B. In the experimental condition, 91 out of 101 participants (90.1%) answered correctly, and in the control condition, 99 out of 100 participants (99%) answered correctly. This provides support for Criterion 2.

Criterion 3. We tested Criterion 3 by comparing decisions in the experimental condition with the benchmark set by the control condition. We predicted that more people would choose Tray A in the experimental condition, in which the intuition was present even though there was an expected cost to choosing the normatively inferior lottery. As expected, when asked to choose a tray for their lottery, 17 out of 101 participants (16.8%) opted to draw from Tray A in the experimental condition, while only 7 out of 100 (7%) chose to draw from Tray A in the control condition, $\chi^2(1, N = 201) = 4.62, p = .032, r = .15, 95\%$ CI = [.01, .28]. When we removed participants from the analysis who did not accurately identify Tray B as the rational option, however, we found that 12 out of 91 participants (13.2%) in the experimental condition chose Tray A, and 7 out of 99 participants (7.1%) in the control condition chose Tray A, $\chi^2(1, N = 190) = 1.97, p = .160,$
$r = .10, 95\% CI = [-.04, .24]$. Because there was not a significant difference across conditions, this does not provide statistically significant support for Criterion 3.

Although our definition requires that participants have a faulty intuitive belief, we did not condition on Criterion 1 when comparing across conditions, because our study was designed to manipulate the presence (experimental condition) or absence (control condition) of the intuition. However, we estimated the prevalence of acquiescence in the experimental condition by conditioning on both Criteria 1 and 2. Specifically, we estimated the prevalence of acquiescence by limiting our analysis to solely those participants in the experimental condition who accurately identified the rational option and reported having a faulty intuition (i.e., experienced the System 1–System 2 conflict). In the experimental condition, 38 out of 101 participants (37.6%) reported experiencing the conflict. Of those participants, 12 out of 38 (31.6%) followed their intuition to draw from Tray A (see Fig. 2).

What about people who reported a faulty intuition and followed that intuition in the control condition? It is possible that this, too, is acquiescence—participants may have faulty intuitions for reasons that are not understood. But we are hesitant to make this claim. Without knowing whether it is a “real” intuition or random error and without being able to specify the cause of the faulty intuition, we are reluctant to claim this behavior as evidence for acquiescence (see Fig. S1 in the Supplemental Material).

**Discussion**

The results of Study 1 met Criteria 1 and 2 but not Criterion 3. While significantly more participants chose Tray A in the experimental than in the control condition, this difference was not significant for participants who identified Tray B as the rational option.

**Study 2: Envelopes**

**Method**

Study 2 tested the same criteria with a paradigm designed to create a more powerful intuition shared by more participants. Each of 150 participants (61 female, 89 male) completed the study in one of two lab locations in Chicago, Illinois, each drawing from a community pool with similar demographics. We predetermined to stop data collection once a sample of 75 participants per condition was reached because we anticipated that the intuition would be stronger than in the ratio-bias paradigm and because our labs could support 150 participants in a reasonable time frame. Participants received $1, with an opportunity to earn an additional $5. Participants were seated at a table across from the experimenter. Prior to the study, we placed three slips of paper on the table labeled “1,” “2,” and “3.” After sitting down at the table, participants were handed three envelopes and asked to arrange them in any order in front of the three labels while the experimenter looked away. Participants were then told that one of the three envelopes contained a $5 bill, while the other two were empty. As in Study 1, each participant was assigned to either the experimental condition or the control condition.

In the experimental condition, participants had the opportunity to guess which envelope had the money, and they were told that they would be allowed to keep the money if they chose correctly. Participants then wrote their name on the envelope they selected. Before revealing whether or not they chose the winning envelope, participants were given an opportunity to trade their envelope for the other two envelopes. To clarify, if a participant accepted the exchange, he or she would win the money if it was located in either of the other two envelopes but not if the money was located in the original envelope. This situation drew on research showing that people hold an intuitive belief that it is bad to trade a lottery ticket (Risen & Gilovich, 2007). We hypothesized that participants would intuitively believe that their original envelope was more likely to contain the money if they exchanged it than if they did not. Importantly, participants were given a packet of instructions so that they could read along with the experimenter throughout the study. The second page of the packet included information about the exchange. Participants therefore knew that that the experimenter would have offered them the exchange regardless of which envelope they chose. Because the experimenter did not know where the money was and because they offered the exchange to everyone, it is extremely unlikely that participants believed they were being tricked by the offer.

In the control condition, participants did not choose an envelope. Instead, after discovering that one of the three envelopes contained $5, they were asked whether they wanted one specific envelope (randomly determined for each participant) or the other two envelopes. For instance, a participant might be asked whether he or she would prefer to have Envelope 1 or both Envelope 2 and Envelope 3. As in Study 1, the control condition was designed to reduce the intuitive appeal of the single envelope but match the experimental condition in terms of rationality. In other words, although selecting the two-envelope option was the rational strategy for participants in both conditions because it doubled the chance of winning, the intuition that it is
bad to exchange a ticket (Risen & Gilovich, 2007) conflicted with the rational strategy only in the experimental condition, in which participants started by choosing an envelope.

Prior to deciding whether they wanted the single envelope or the other two envelopes, all participants heard an explanation about the difference between intuitive and rational decision making similar to the one

---

**Fig. 2.** Results from the experimental conditions in Studies 1 through 4. For each study, the pie chart on the left depicts participants’ responses to the questions regarding their intuitive and rational beliefs, and the pie chart on the right depicts the decisions of just those participants who experienced the conflict between those beliefs.
used in Study 1. Then they were asked two questions. First, to test Criterion 1, the experimenter asked about their intuition. Participants in the experimental condition were asked, “Imagine that you exchange your envelope. The experimenter is about to open the envelopes. Based on your gut feeling (or your intuition), where do you feel the money is most likely to be located?” They could respond by selecting “Your original envelope” or “Either of the other two envelopes.” Participants in the control condition were asked, “Imagine that you choose Envelopes 2 and 3. The experimenter is about to open the envelopes. Based on your gut feeling (or your intuition), where do you feel the money is most likely to be located?” They could respond by selecting “Envelope 1” or “Either of the other two envelopes (Envelope 2 or Envelope 3).”

Then, to test Criterion 2, we asked all participants for their rational analysis: “Based on rational analysis, with which envelope(s) are you most likely to win?” Participants in the experimental condition responded by selecting “Your envelope” or “Both of the other two envelopes together,” and participants in the control condition selected either “Envelope 1” or “Envelope 2 and Envelope 3 together.” Finally, participants were asked to decide which envelope (or envelopes) they wanted.

As in Study 1, we included three exploratory questions to measure individual differences in intuitive versus rational thinking, as well as basic demographic questions. However, because of a miscommunication with our research assistants, these exploratory data were not collected for many participants. This made our exploratory analyses difficult for Study 2, but it did not affect analyses of any of our central hypotheses.

**Results**

**Criterion 1.** We tested Criterion 1 by comparing intuitions in the experimental condition with the benchmark set by the control condition. When asked where they felt the money was most likely to be located on the basis of their intuition, 42 out of 75 participants (56%) chose the single envelope in the experimental condition, while only 20 out of 75 (26.7%) chose the single envelope in the control condition. \( \chi^2(1, N = 150) = 13.31, p < .001, r = .30, 95\% CI = [.14, .44] \). This provides support for Criterion 1.

**Criterion 2.** We tested Criterion 2 by determining whether participants (across conditions) accurately identified the rational response. When asked which envelope or envelopes offered the best chance to win on the basis of rational analysis, 118 out of 150 participants (78.7%) accurately selected the two envelopes. In the experimental condition, 53 out of 75 participants (70.7%) answered correctly, while in the control condition, 65 out of 75 participants (86.7%) answered correctly. This provides support (albeit weaker than in Study 1) for Criterion 2.

**Criterion 3.** Finally, we tested Criterion 3 by comparing decisions in the experimental condition with the benchmark set by the control condition. When participants in the experimental condition were asked whether or not they wanted to exchange their envelope for the other two, 32 out of 75 participants (42.7%) refused the exchange, opting instead to keep their single envelope. In the control condition, only 11 out of 75 (14.7%) chose the single envelope over the other two, \( \chi^2(1, N = 150) = 14.38, p < .001, r = .31, 95\% CI = [.15, .45] \). Next, as in Study 1, we restricted the comparison to only those participants who accurately identified that the two-envelope option was the rational option. Here, we found that 13 out of 53 participants (24.5%) chose to keep their single envelope in the experimental condition, while only 6 out of 65 (9.2%) chose the single envelope in the control condition. \( \chi^2(1, N = 118) = 5.06, p = .025, r = .21, 95\% CI = [.03, .37] \), which provides support for Criterion 3.

As in Study 1, we estimated the prevalence of acquiescence. In the experimental condition, 24 out of 75 participants (32%) reported experiencing the conflict. Of those participants, 12 out of 24 (50%) chose to keep their original envelope (see Fig. 2).

**Discussion**

The results of Study 2 met all three criteria. More than half of the participants in the experimental condition (and significantly more than those in the control condition) had the faulty intuition that the money was in the single envelope (Criterion 1). The majority of participants identified that, on the basis of rational analysis, they were more likely to win with two envelopes than with one (Criterion 2). Finally, significantly more participants chose the single envelope than the two envelopes in the experimental condition. This result held among participants who correctly identified the rational option (Criterion 3). Thus, participants who knew it was irrational to keep their original envelope still did so, even though they were half as likely to win.

**Study 3: Blackjack**

Study 3 tested acquiescence in a real-world domain—blackjack. Every starting hand in blackjack (player’s two cards and dealer’s upcard) implies an optimal strategy. These strategies are commonly depicted in a table (Fig. 3) known as a basic-strategy table.

We confirmed in a pretest (detailed in the following section) that for one hand, players’ intuition diverges
from the basic strategy—players believe they should hit, while the optimal strategy is to stand. We also used the pretest to find a matched control hand for which the objective difference between hitting and standing was equal to that in our experimental hand, but for which players' intuition would match—rather than conflict with—the optimal strategy.

**Pretest method and results**

To determine people’s intuitions for different starting hands, we conducted a pretest with 101 participants on Amazon Mechanical Turk (29 female, 72 male; mean age = 32.18 years, SD = 9.58). Participants saw nine different blackjack starting hands. For each hand, they were asked to indicate on two separate slider scales how likely they felt they were to win or lose the hand if they hit and how likely they felt they were to win or lose the hand if they stood. These slider scales ranged from 0 (very likely to lose) to 100 (very likely to win). Then all participants were asked whether they would choose to hit or stand. Participants did not have the chance to play any of these hands.

We hypothesized that participants’ intuitions would be egocentric, meaning that their beliefs would be driven by their own cards without much consideration for the dealer’s upcard. For instance, we included our eventual experimental hand (player: 13, dealer: 4), because 13 is a relatively low starting hand for the player. If the dealer does not bust (i.e., go over 21), the player cannot win with 13. We included our eventual control hand (player: “soft” 18, dealer: 8), because 18 is a relatively high starting hand for the player (unlike the experimental hand, it is possible for the player to win with 18 even if the dealer does not bust). The results of the pretest can be found in Table 1. Although, objectively, the chances of winning the two hands would be improved by nearly the exact same amount (~3%) by standing rather than hitting, participants had the faulty intuition that they would be more likely to win by hitting on the experimental hand.

**Method**

One hundred ninety seven participants (62 female, 135 male; mean age = 33.62 years, SD = 10.88) completed the study on Amazon Mechanical Turk. We predetermined to stop data collection once a sample of 200 was reached, to match the Mechanical Turk sample from Study 1. Three participants initiated the study but failed to complete it, which we suspect may have been due to using a nonrecommended browser. Participants

<table>
<thead>
<tr>
<th>Measure</th>
<th>Experimental condition</th>
<th>Control condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cards (player vs. dealer)</td>
<td>13 vs. 4</td>
<td>Soft 18 vs. 8</td>
</tr>
<tr>
<td>Subjective likelihood of winning if player hits</td>
<td>60.14</td>
<td>47.33</td>
</tr>
<tr>
<td>Subjective likelihood of winning if player stands</td>
<td>29.13</td>
<td>58.26</td>
</tr>
<tr>
<td>Participants who chose to hit (%)</td>
<td>67.3</td>
<td>13.9</td>
</tr>
<tr>
<td>Objective win probability of hitting (%)</td>
<td>36.40</td>
<td>52.05</td>
</tr>
<tr>
<td>Objective win probability of standing (%)</td>
<td>39.85</td>
<td>55.40</td>
</tr>
<tr>
<td>Objective win probability difference (%)</td>
<td>3.45</td>
<td>3.35</td>
</tr>
</tbody>
</table>

*In blackjack, an ace can count as either 1 or 11. A “soft” 18 means that one of the two cards is an ace—so the total score on that hand can be considered either 18 or 8.*
earned a base payment of $0.55 and had an opportunity to earn an additional $0.50 in the blackjack game. The study consisted of two rounds. Round 1 was designed to elicit participants’ intuitions for both the experimental and control hands. Using the same likelihood scales as in the pretest, participants were asked how likely they felt they were to win or lose if they hit and how likely they felt they were to win or lose if they stood, for the two critical hands and three additional hands. The order of these five starting hands was randomly determined. As in the pretest, participants did not have an opportunity to play out the hands in this round.

After Round 1, participants were told that in Round 2, they would need to use the basic-strategy table. They were told that they could only hit or stand and that the game would not include other strategies (e.g., split, double down). Therefore, the basic-strategy table with which they were provided only depicted these two possibilities. Participants received the following description of the table:

In Round 2, you will need to use the table on the right. This table is adapted from what is called “blackjack basic strategy.” Given any starting hand (the player’s two cards and the dealer’s upcard), the table displays the optimal strategy based on calculated probabilities. The player’s total is labeled along the left side of the table, while the dealer’s upcard is labeled along the top of the table. Therefore, every possible starting hand is represented by a single cell in the table. A red box with an “S” means that a player should stand, while a green box with an “H” means that a player should hit. The table was created by running computer simulations of millions of blackjack hands. Therefore, a player using reason and rational analysis would follow the table’s advice. Nonetheless, for any given hand, the player will not win every hand by following the table’s advice. Nonetheless, for any given hand, following the table offers the best possible chance of winning.

All participants were then given a short quiz, in order to confirm that they understood how to use the basic-strategy table.

In Round 2, participants were given 10 blackjack hands, including the two critical hands. The order of these 10 hands was randomized. For each hand, participants were asked to perform the following actions:

(a) Click the cell in the table that corresponds with their starting hand and the dealer’s upcard.

(b) Respond to the following question: “Based only on reason (or rational analysis), what should you do if you want to maximize your chance of winning this hand?”

(c) Play out the hand on the following page.

While the 10 starting hands (the players’ two cards and the dealer’s upcard) were preselected, all other cards in the game were completely randomized. Participants were told that they would earn an additional $0.05 for each hand that they won, which gave real financial stakes to their decisions. Before starting Round 2, participants read about the difference between intuitive and rational decision making, just as participants did in Studies 1 and 2.

Lastly, all participants were asked three questions about their level of blackjack experience and basic demographic information. Details about these questions can be found in the Supplemental Material.

**Results**

**Criterion 1.** Judgments in Round 1 replicated those in the pretest. For the experimental hand, participants wrongly felt that they were more likely to win if they hit \((M = 53.63, SD = 22.51)\) than if they stood \((M = 34.57, SD = 24.10)\), \( \chi^2(196) = 6.95, p < .001, d = 0.49 \). For the control hand, participants rightly felt that they were more likely to win if they stood \((M = 61.42, SD = 23.22)\) than if they hit \((M = 49.44, SD = 61.42)\), \( \chi^2(196) = 4.14, p < .001, d = 0.29 \).

We also examined this as a dichotomous measure by looking at the percentage of participants who gave a higher intuitive rating for hitting than for standing and tested Criterion 1 by comparing responses for the experimental hand with the benchmark set by the control hand. We found that 133 out of 197 participants (67.5%) had the intuition to hit for the experimental hand, while 71 out of 197 participants (36%) had the intuition to hit for the experimental hand. We tested Criterion 2 by determining whether participants accurately identified the rational response, regardless of their hand. In Round 2, when asked to indicate which decision offered the best chance to win on the basis of rational analysis, participants accurately selected “stand” on 368 out of 394 trials (93.4%). For the experimental hand, 182 out of 197 participants (92.4%) answered correctly, and for the control hand, 186 out of 197 participants (94.4%) answered correctly. This provides support for Criterion 2.
Criterion 3. Finally, we tested Criterion 3 by comparing decisions for the experimental and control hands. When playing the experimental hand, 77 out of 197 participants (39.1%) chose to hit, thereby going against the optimal strategy. For the control hand, only 30 out of 197 (15.2%) chose to hit. This difference is highly significant, $\chi^2(1, N = 197) = 28.34, p < .001, r = .39, 95\% CI = [0.25, .50]$. Again, we also analyzed the decisions of only those participants who accurately identified the optimal strategy. For those participants who accurately identified the optimal strategy for the experimental hand, we found that 63 out of 182 participants (34.6%) chose to hit on the experimental hand. For participants who accurately identified the optimal strategy for the control hand, only 22 out of 186 participants (11.8%) chose to hit on the control hand, $\chi^2(1, N = 190) = 26.89, p < .001, r = .38, 95\% CI = [0.24, .50]$. This provides strong support for Criterion 3.

As in previous studies, we estimated the rate of acquiescence for the experimental hand. We classified a participant as having a faulty intuitive belief using the dichotomous transformation discussed above. For the experimental hand, 123 out of 197 participants (62.4%) experienced the System 1–System 2 conflict. Of those, 48 out of 123 (39%) acquiesced to their intuition to hit on the experimental hand. For participants who accurately identified the optimal strategy, the proportion of acquiescence was only 16 of 197 participants (8.1%). This provides strong support for Criterion 3.

Because we had a continuous measure of intuition in Study 3, we were able to test the extent to which participants’ intuitions predicted their decisions. We first calculated an intuitive score for each participant for each hand by subtracting his or her Round 1 ratings of likelihood to win by hitting from his or her Round 1 ratings of likelihood to win by standing. We then regressed each of their decisions in Round 2 (hit or stand) on this intuitive score using a binomial logistic regression. For the experimental hand, participants’ intuitions significantly predicted their decisions, $b = -0.014, z(195) = -3.24, p = .001$. This result held when we included only those participants who accurately identified the optimal strategy, $b = -0.013, z(180) = -2.90, p = .004$. Thus, the stronger participants’ intuition was that they would win by hitting on 13, the more likely they were to hit, despite having just correctly identified the optimal strategy as standing. Participants’ intuitions did not significantly predict their decisions for the control hand.

Discussion

Participants had a faulty intuition, acknowledged it was incorrect, but acquiesced nonetheless. Thus, Study 3 offers clear evidence of acquiescence in a real-world domain and provides direct evidence that intuitions are driving decisions. Note that if participants simply wanted to go against the table to make the game more fun (Keren & Wagenaar, 1985), they could have done so on either hand. But as we have shown, they were significantly more likely to do so when the table conflicted with their intuitive beliefs.

Study 4: Football

In Study 4, we replicated our findings in another real-world domain: fourth-down decisions in football. But what constitutes “objective information” in football? The New York Times has developed the “NYT 4th Down Bot” (2014), which uses historical data to calculate the best strategy in all fourth-down situations. In a pretest (detailed in the next section), we confirmed that for a particular situation, people had the intuition to punt even though the 4th Down Bot estimated that they would be significantly better off trying to run or pass for the first down (i.e., “going for it”).

Pretest method and results

Fifty participants (13 female, 37 male; mean age = 32.82 years, $SD = 10.38$) completed the pretest on Amazon Mechanical Turk. Because the study required participants to read about and comprehend a situation in a National Football League (NFL) game, we specifically recruited participants who have a “fairly strong understanding of the NFL and its rules.” Furthermore, prior to starting the study, participants were asked to complete a six-item football knowledge quiz (included in the Supplemental Material). We did not exclude any participants on the basis of their responses to this quiz. Instead, immediately after the quiz, participants were told, “If you still feel like you have a fairly strong understanding of the NFL and its rules, please continue with the rest of the study. Otherwise, please close this window.” Participants who continued then read the following scenario:

Imagine that you are the coach of an NFL football team. Your team is locked in a close battle with an evenly matched rival. The lead has flip-flopped back and forth all game. You are currently winning 17-13 with just a couple minutes left in the fourth quarter.

You start the drive on your own 30-yard line. After three short plays, you find yourself on your 36-yard line, 4th down and 4 yards to go. There are two minutes left on the clock. You now have to make a decision.

You can choose to either punt or go for it.

This text was accompanied by a picture of the scoreboard and a diagram of the field offering visual
reinforcements for the relatively complex scenario. On the following page, we asked two attention-check questions about the score and field position to ensure that participants fully understood the scenario. Participants were required to answer correctly before proceeding.

Next, participants were again given the full scenario and were asked to indicate on separate slider scales how likely they felt they were to win or lose the game if they punted and how likely they felt they were to win or lose the game if they went for the first down. These slider scales ranged from 0 (very likely to lose) to 100 (very likely to win). Then all participants were asked whether they would choose to punt or go for it. Throughout the study, the order of the two options was counterbalanced, such that half of the participants always saw “punt” first, while the other half of the participants always saw “go for it” first. Results were not affected by order, so we collapsed across this variable in our analyses.

As predicted, even though this situation is one which the 4th Down Bot estimates that a team is 9% more likely to win by going for it than punting, participants wrongly felt they were significantly more likely to win by punting ($M = 72.04$, $SD = 20.22$) than by going for it ($M = 42.82$, $SD = 20.91$), $t(49) = 5.95$, $p < .001$, $d = 1.41$, 95% CI = [0.97, 1.85]. Additionally, 42 out of 50 participants (84%) said that they would choose to punt.

**Method**

Four hundred participants (151 female, 249 male; mean age = 36.01 years, $SD = 11.47$) completed the study on Amazon Mechanical Turk. We predetermined to stop data collection once a sample of 400 participants was reached in order to have 100 participants in each condition, as in Study 1. Participants earned $0.71 for completing the study. We used the same recruitment process and knowledge quiz as in the pretest.

In the experimental condition, participants read the scenario described in the pretest (winning by 4, own 36 yard line, 4 yards to go), in which people reported having the intuitive belief that they should punt, even though the 4th Down Bot estimates that they are 9% more likely to win if they go for it. As in Study 3, we included a control condition in which the objective probability was matched (the 4th Down Bot estimates that their team is 9% more likely to win by going for the first down than by punting), but we anticipated that people would have the correct intuition to go for the first down in this scenario because of the score, the field position, and the shorter distance to go (losing by 1, other team’s 49 yard line, 2 yards to go).

We also manipulated the timing of the statistical information to be presented either before or after participants reported their intuition. Thus, each participant was assigned to one of four conditions in a 2 (scenario: experimental vs. control) × 2 (objective information revealed: before intuition reported vs. after intuition reported) between-subjects design. We describe the protocol for the information-before condition here in the text (see the Supplemental Material for a description of the information-after condition and the results presented by the timing manipulation).

In the information-before condition, participants read and answered two questions about the 4th Down Bot immediately after the football knowledge quiz and before reading about the specific scenario that they would be judging:

Deciding whether to punt or go for it on fourth down can be a very difficult decision. Data experts have developed a method to provide precise estimates for a team’s win probability for each possible strategy on fourth down. This method is called the “4th Down Bot.”

The 4th Down Bot uses historical data to calculate the best strategy in all 4th-down situations that real NFL teams face. Using factors like the score, field position, time remaining, yards to go for a first down, and other variables, the bot determines the optimal strategy based on calculated probabilities. A coach using rational analysis would follow the bot’s advice in all 4th-down situations if he or she wanted to maximize the chance of winning the game.

It turns out that some conventional wisdom—that is, strategies that coaches have been using for decades—may actually be suboptimal. In certain situations, coaches and fans have assumed that their team would be more likely to win by following one strategy (i.e., punting), while in reality, they would be better off with the other strategy (i.e., going for it).

Importantly, a team will not win every game by following the 4th Down Bot’s advice. Nonetheless, for any given game, following the bot’s advice offers the best possible chance of winning. Click here to open a different window to view the 4th Down Bot: http://nyt4thdownbot.com.

Each participant was then given either the experimental or control scenario. At the bottom of the page, participants were given the 4th Down Bot’s win probabilities for punting and for going for it. On the following page, participants answered two attention-check questions about the scenario, as participants did in the pretest. Next, they read an explanation about
the difference between intuitive and rational decision making similar to the ones used in Studies 1 through 3 and then reported their intuition.

When reporting their intuition, participants were asked to indicate on separate slider scales how likely they felt they were to win or lose the game if they punted and how likely they felt they were to win or lose the game if they went for it. These slider scales ranged from 0 (very likely to lose) to 100 (very likely to win). The scoreboard and field diagram were presented on the same page in order to remind participants of the details of the situation.

Next, participants were asked what they should do on the basis of rational analysis. In addition to seeing the scoreboard and field diagram, participants also saw the 4th Down Bot’s win probabilities for each strategy, as well as a comprehension check for these probabilities.

Finally, participants were asked to decide whether they wanted to punt or go for it. At the end of the study, we asked participants about their level of football knowledge and whether or not they believed that the given statistics were accurate. We include these analyses in the Supplemental Material.

**Results**

**Criterion 1.** We first calculated the difference between participants’ responses for the likelihood of winning with each strategy (punt – go for it). A positive score indicated that participants had the intuition that they should punt, while a negative difference score indicated the intuition to go for it. Greater absolute values indicated a stronger intuition. We tested Criterion 1 by comparing intuitions for the experimental scenario with the benchmark set by the control scenario. We used a 2 (scenario: experimental vs. control) × 2 (information revealed: before intuition reported vs. after intuition reported) analysis of variance to test whether participants had a faulty intuition for the experimental scenario but not for the control scenario. As predicted, we found a main effect of scenario, $F(1, 396) = 178.33, p < .001, \eta^2_p = .31$. Participants who read the experimental scenario incorrectly felt that they were more likely to win if they punted ($M = 69.20, SD = 20.72$) than if they tried for the first down ($M = 51.64, SD = 26.69$), $t(204) = 6.32, p < .001, d = 0.44$. Participants who read the control scenario correctly felt that they were more likely to win if they tried for the first down ($M = 61.57, SD = 21.11$) than if they punted ($M = 30.37, SD = 23.91$), $t(194) = 12.90, p < .001, d = 0.92$.

We also examined this as a dichotomous measure by looking at the percentage of participants who gave a higher intuitive rating for punting than for going for the first down. We found that 130 out of 205 participants (63.4%) had the intuition to punt in the experimental scenario, while only 27 out of 195 participants (13.8%) had the intuition to punt in the control scenario, $\chi^2(1, N = 400) = 102.98, p < .001, r = .51, 95% CI = [.42, .58]$. This provides support for Criterion 1, as participants demonstrated a faulty intuitive belief for the experimental scenario.

**Criterion 2.** We tested Criterion 2 by determining whether participants (across conditions) accurately identified that the rational response was to go for it. When asked which strategy they should choose on the basis of rational analysis, 335 out of 400 participants (83.8%) accurately reported that they should go for it. In the experimental condition, 153 out of 205 participants (74.6%) answered correctly, while in the control condition, 182 out of 195 participants (93.3%) answered correctly. This provides reasonable support for Criterion 2.

**Criterion 3.** Finally, we tested Criterion 3 by comparing decisions for the experimental scenario with the benchmark set by the control scenario. When participants in the experimental condition were asked to make a decision, 95 out of 205 participants (46.3%) chose to punt. In the control condition, only 14 out of 195 (7.2%) chose to punt. $\chi^2(1, N = 400) = 77.31, p < .001, r = .44, 95% CI = [.35, .52]$. Next, we restricted the comparison to only those participants who accurately identified that the optimal strategy was to go for it. Here, we found that 46 out of 153 participants (30%) chose to punt in the experimental condition, while only 4 out of 182 (2.2%) chose to punt in the control condition, $\chi^2(1, N = 335) = 50.84, p < .001, r = .39, 95% CI = [.29, .48]$. These results provide strong support for Criterion 3.

Once again, we estimated the rate of acquiescence in the experimental condition. We classified participants as having a faulty intuitive belief if they assigned a higher likelihood to win by punting than by going for it. In the experimental condition, 81 out of 205 participants (39.5%) experienced the System 1–System 2 conflict. Of those, 45 out of 81 (55.6%) acquiesced to their intuition to punt (see Fig. 2).

As in Study 3, because we had a continuous measure of intuition, we were able to test the extent to which participants’ intuitions predicted their decisions. We regressed their decision (go for it or punt) on their intuitive difference score using a binomial logistic regression. For the experimental scenario, participants’ intuitions significantly predicted their decisions, $b = −0.06, z(203) = −7.27, p < .001$. This result held if we included only those participants who accurately identified the optimal strategy, $b = −0.06, z(151) = −5.90, p < .001$. Thus, the stronger participants’ intuition was that they would win by punting, the more likely they were to punt, despite having just correctly identified the optimal strategy as going for it. Participants’ intuitions did
not significantly predict their decisions for the control scenario.

**Discussion**

Study 4 provided further evidence for acquiescence by meeting all three criteria and, as in Study 3, participants' intuitions guided their decisions.

**General Discussion**

We provide clear empirical support for acquiescence. Unlike past work, the current research measured intuition and explicit knowledge of what is rational, in addition to behavior. We also compared responses when there was an intuitive-deliberative conflict with responses in situations without conflict. Thus, guided by the three criteria, the present studies formally establish that a person can have a faulty intuitive belief about the world, explicitly acknowledge the belief is wrong, but follow the intuition nonetheless. Moreover, because there was an expected cost to following intuition, acquiescence was more than a “tiebreaker”—people deviated from what they knew was rational even though it was costly.

In addition to testing the criteria, we also provided data about its prevalence. The data cannot speak to its frequency in everyday life. But we can ask how often people follow their intuition when it conflicts with what they know to be true. When we focus on those who experienced the intuitive-deliberative conflict in the experimental condition, acquiescence rates range from one-third to one-half (see Fig. 2). Thus, more than providing evidence for its existence, these data suggest that acquiescence is a fairly typical response.

To accommodate acquiescence, researchers must refine corrective dual-process models to allow for the possibility that System 2 can detect an error but not correct it. In contrast, parallel dual-process models can accommodate acquiescence as is. Although parallel models do not require that (or test whether) people who follow a faulty intuitive belief explicitly recognize the belief is false, they allow for this possibility. Hybrid models, which propose that System 1 generates both heuristic and logical intuitions and that error detection is automated (De Neys, 2012, 2014; Handley & Trippas, 2015; Pennycook et al., 2015), can also accommodate acquiescence but should specify that people can maintain an intuition even when System 2 acknowledges an error detected by System 1.

We are currently investigating factors that might influence acquiescence. We have initial evidence from Studies 3 and 4 that the strength of participants’ intuitive beliefs significantly affects their decision to acquiesce. We hope to unpack the properties that make intuitive beliefs stronger to investigate this further. In addition to the forces that encourage acquiescence, future research should examine factors that allow people to put aside what they know to be true. For instance, we predict that individuals are more likely to acquiesce if it is easy to rationalize a decision, if the costs of ignoring rationality are low, and if they are feeling epistemological modesty for what can be known with certainty.

Recognizing acquiescence can also guide interventions to improve decision making. It seems that the obvious way to avoid irrationality is to teach decision makers the objectively correct answer. However, if someone is already aware that a decision is irrational, then teaching him or her what is rational would be futile. Blackjack players who want to hit knowing they are statistically more likely to win by standing are unlikely to be swayed by statistics. We plan to investigate interventions that go beyond helping people detect their errors and might be effective in these situations.

**Action Editor**

Timothy J. Pleskac served as action editor for this article.

**Author Contributions**

The concept for the studies is based on theoretical work by J. L. Risen. Both the authors contributed to the study designs. D. K. Walco analyzed the data and drafted the manuscript. J. L. Risen provided revisions and assisted in drafting the manuscript. Both authors approved the final version of the manuscript for submission.

**Declaration of Conflicting Interests**

The authors declared that they had no conflicts of interest with respect to their authorship or the publication of this article.

**Supplemental Material**

Additional supporting information can be found at http://journals.sagepub.com/doi/suppl/10.1177/0956797617723377. The complete Open Practices Disclosure for this article can be found at http://journals.sagepub.com/doi/suppl/10.1177/0956797617723377. This article has received badges for Open Data, Open Materials, and Preregistration. More information about the Open Practices badges can be found at http://www.psychologicalscience.org/publications/badges.
Notes
1. Although intuitive thinking is not necessarily more error prone than deliberative thinking (Evans & Stanovich, 2013; Handley & Trippas, 2015; Morsanyi & Handley, 2012), we focused on situations in which intuitive processing was likely to be associated with errors, and deliberative processing was likely to be associated with rationality. We considered choices that maximized expected value to be rational and expectations that conflicted with objective probability to be faulty.
2. For all studies, we report how we determined our sample size, all data exclusions (if any), all manipulations, and all measures in the all the studies.

References


