Let’s Make a Deal in the Classroom: Institutional Solutions to the Monty Hall Dilemma

Abstract

We describe how the Monty Hall Dilemma, a well-known choice anomaly, can be demonstrated with a simple and versatile classroom experiment. In addition to illustrating the anomaly, the experiment can be used to introduce students to some institutional modifications that have been shown to ameliorate it. This experiment, which can be tailored by instructors to meet specific learning objectives for a variety of courses, can also be used to frame broader discussions about rationality, institutions, and choices under uncertainty.

Keywords: Monty Hall Dilemma; rational choice; institutions

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Running Title: Let’s Make a Deal

The Monty Hall Dilemma (MHD) was inspired by the 1960s TV game show, “Let’s Make a Deal.” On the show, Monty Hall asked the final guest to select one of three doors, only one of which concealed a valuable prize.¹ After the contestant’s initial choice, Monty revealed what was behind one of the unselected doors (always a worthless prize), and then asked if the contestant wanted to switch to the other unselected door. The MHD is thus a two-step decision problem in which a player makes an initial choice
from among three equally probable options, and after the elimination of a non-winning unselected option, makes a second decision to either stay with the initial selection or switch to the remaining unselected option.

A large body of research in a number of disciplines has shown that the majority of players faced with the dilemma irrationally choose to stay with their initial choice in the second step. Many players appear to mistakenly believe that since the doors were all equally likely to contain the prize originally, the two remaining unopened doors are still equally likely to contain the prize. This intuition does not reflect accurate Bayesian updating and leads to irrational behavior. The counterintuitive but rational solution to the dilemma is to switch in the second step, since switching to the remaining unchosen door actually doubles the player’s probability of winning.

This striking and persistent choice anomaly can be explored in a variety of courses and is well suited to the undergraduate classroom for several reasons. First, it presents instructors with an opportunity to have a meaningful discussion of what economists mean by rational choice, one of the most basic and fundamental assumptions made in economics, and possible departures from it. As Frank Knight (1921) explained, rational actors are not assumed to be “as angels, knowing good from evil,” but are supposed to “‘know what they want’ and to seek it ‘intelligently’…They are supposed to *know absolutely the consequence of their acts when they are performed, and to perform them in the light of the consequences*… all their acts take place in response to real, conscious, and stable and consistent motives, dispositions, or desires; nothing is capricious or experimental, everything deliberate” (76-77, italics added). Herbert Simon’s well-known critique of what he called substantive rationality is relevant here as well.
According to Simon (1955), economic decisions are in reality plagued by our inability to process massive amounts of information and calculate the optimal solution; the extreme complexity that characterizes our reality leads to bounded rationality. While complexity can clearly be an issue, the MHD is particularly interesting precisely because of its simplicity. Yet it is clear that even with relatively simple choices like this one, people often fail to “know absolutely the consequences of their actions.” They are sometimes systematically biased in their forecasts of the outcomes and thus make predictably wrong decisions (Richard Thaler and Cass Sunstein 2009), which is precisely what is frequently observed in the Monty Hall Dilemma. As Tilman Slembeck and Jean-Robert Tyran (2004) indicate, Bayes’ law – and the rationality assumption on which it is based - is an important foundation for modern economic theory, so choice anomalies like this one raise concerns about the predictive power of the economics of uncertainty and information.

Second, discussions of the MHD can promote dialogue on how institutions can affect incentives. Rational choice is of course at the heart of economic theory, and we know that institutional frameworks are important for understanding market outcomes. Yet both ideas often strike students as abstract theoretical constructions with little connection to reality. In our experience with running the classroom version of the MHD, students leave with a much more concrete understanding of what we mean by rational behavior, the implications of irrational behavior, and the role of institutions in shaping incentives.

While evidence of the anomaly is persistent in a variety of settings in the laboratory, there is also evidence that the anomaly can be largely eliminated by simple changes in the institutional structure of the game. Slembeck and Tyran (2004)
demonstrate that introducing two institutional variations, group communication and competition, dramatically increases the switch rates observed in the laboratory. The experiment described here allows the introduction of these two types of institutional variations into the classroom choice setting. Since institutions play a vital role in structuring market decisions and can produce optimal outcomes even in the presence of individually irrational choices, this experiment provides instructors with a valuable opportunity to illustrate their role in shaping every day decisions.iii

Finally, the experiment can also be used to initiate discussions addressing the possible biases, both cognitive and emotional, that might lead to irrational behavior. Cognitive bias suggests that players are incorrectly calculating probabilities and are assigning too low a probability to the switching strategy. Emotional bias occurs when people are attached to their original choice for a variety of reasons, which may lead to less switching.

**What is the Anomaly and Why Does it Matter?**

While the Monty Hall Dilemma involves a fairly straightforward application of Bayes’ law, the majority of observed behavior is consistent with the presence of a probability judgment error. Since Bayes’ rule is a basic requirement for rational decision-making under uncertainty, the presence of behavior that is inconsistent with its use has important implications. Many people participating in the MHD appear to incorrectly apply Bayes’ rule and have the faulty intuition that the final probabilities continue to be equally distributed. The rational choice results from recognizing that the probability of winning when choosing to stay with the original choice is one-third, while
switching increases the probability of winning to two-thirds. Since expected payoffs are
twice as high for switching as for staying, the rational choice is to always switch.

There are several ways of intuitively explaining why this is true, but the basic idea
is that switching is a bad idea only if one’s initial choice was the correct one, which only
happens with one-third probability. If this occurs, then switching will move the player
from a winning to a losing door. But, again, this only occurs with probability 1/3. There
is, by contrast, a 2/3 probability that the initial choice was a loser. In that case, switching
to the one unopened door will move the player from a loser to a winner. Therefore,
pursuing the switching strategy doubles the player’s probability of winning from 1/3 to
2/3.

Concern with and interest in the MHD is widespread. Researchers in various
disciplines (including economics, psychology, sociology, educational science, finance,
and mathematics) have explored the MHD and have found that subjects systematically
choose the inferior option of remaining with their initial choice, even with repeated trials.
Multi-period studies exploring the basic MHD often find switch rates below 20 percent in
initial periods, and rarely find switch rates much above 75 percent even in the final
periods.iv

The irrational choice has also received considerable attention in mainstream
discussions of the dilemma, including in a series of “Ask Marilyn” columns in Parade
magazine (Marilyn vos Savant 1990a, 1990b, 1991). These columns generated numerous
critical responses, many coming from highly educated people in technical fields who,
when presented with the rational solution, vehemently insisted that vos Savant was wrong
and that the irrational choice was in fact not irrational.
Because of its counterintuitive solution, Jason Rosenhouse (2009) refers to the MHD as one of the most contentious of all brainteasers. Massimo Piattelli-Palmarini (1994) suggests that it is the “most expressive example of cognitive illusions or mental tunnels in which even the finest and best-trained minds get trapped” (161). Jeffrey Stibel, Itiel Dror and Talia Ben-Zeev (2009) claim that “few problems defy common sense as much as the MHD. Not only does it almost always lead people to give the wrong answer, but it is so powerful that when the correct answer is presented and explained, people continue to answer it incorrectly” (151). After finding behavioral consistency across several cultures, Donald Granberg (1999b) goes so far as to suggest that the tendency to irrationally stay with the initial choice in the MHD reflects a universal human propensity.

The general consensus is that the failure of so many people to solve the dilemma correctly is evidence of the presence of a persistent violation of a key rationality postulate. As Daniel Friedman (1998) wrote, “I am not aware of any anomaly that has produced stronger departures from rationality in a controlled laboratory environment” (936). This widespread evidence of a rational choice anomaly has even led some economists to question whether the discipline should search for alternatives to Bayes’ rule (Nalebuff 1987).

Given the significance of rational choice and the important role of institutions in economics, these issues are certainly worth exploring in some detail in the classroom. As Friedman (1998, p. 933) pointed out, the MHD “is not just theoretical. Economists’ traditional analytical tools are based squarely on rational choice theory, so anomalies provoke debates about the practical value of these tools.” As economic educators, we use these traditional analytical tools on a daily basis in our classrooms. Discussions about the
presence of these violations of rationality, their possible causes, and potential solutions are therefore important. The classroom experiment described here makes this discussion much easier to have and generates student enthusiasm and interest in the topic as well.

**What Might Cause the Anomaly?**

As indicated earlier, irrational behavior in the MHD may be related to the existence of two general types of biases -- cognitive and emotional. Cognitively, people might simply misapply Bayesian updating in various ways (see Camerer 1995 for a survey), and may not assign the correct probabilities of winning to staying and switching. People may act more like intuitive statisticians, using a variety of simple cognitive heuristics that can produce erroneous judgments (Daniel Kahneman, Paul Slovic, and Amos Tversky 1982). In the naïve probabilistic reasoning model proposed by Johnson-Laird (1983), players believe that the probability of winning is simply the number of prizes divided by the number of remaining alternatives. This approach would lead to the erroneous belief that the probability of winning is the same with staying or switching. Donald Granberg and Thad Brown (1995) suggest that people seem to be especially prone to error when faced with problems involving conditional probability, so the anomaly may result from the human brain being ill-equipped to process conditional information.

However, somewhat surprisingly, the anomaly may not only be about the misapplication of Bayes’ rule. When Andrew Morone and Annamaria Fiore (2008) do not reveal what is behind one of the unchosen doors after the initial choice, but instead simply ask if the subject would like to switch from their initial chosen door to both of the
two remaining unopened doors, they find that irrational behavior is reduced but not eliminated. Since no new information is presented between the first and second step in this setting, Bayes’ rule is not required. The presence of irrational behavior even in this simple setting could indicate that something even more basic than a misunderstanding of Bayes’ rule could be involved in the irrational choices observed in the MHD.

Even if people correctly calculate the probabilities, a tendency to stay may still be present because of emotional bias. The typical cognitive bias appears to be one of perceiving equal probabilities of winning from staying or switching. However, if that were the only bias involved, one might expect to observe at least equal switch and stay responses rather than the large percentage of stay responses that is actually observed. It therefore appears that an emotional bias may also be involved. The existing literature discusses a variety of psychological mechanisms that might cause people to be attached to their original choices. These include the illusion of control (Langer 1975; Camerer 1995), the non-rational escalation of commitment (Bazerman 1990), the endowment effect (Knetsch 1989), belief perseverance (Ross, Lepper, and Hubbard 1975), the anticipation of regret (Gilovich, Medvec, and Chen 1995; Stibel et al. 2009), the omission bias (Ritov and Baron 1990), and the status quo bias (Samuelson and Zeckhauser 1988).

Does Practice Make Perfect?

There is evidence that experience with the task can help to improve the incidence of rational choice in the MHD, but the anomaly rarely disappears. Tubau et al. (2015) note that the attraction to the initial choice often prevents people from exploring the
consequences of switching and learning about the outcome probabilities. Slembeck and Tyran (2004) suggest that the intuition of equal chances of winning for the two remaining options is so strong that players ignore information that switching is the better strategy, apparently attributing that to chance rather than to a superior strategy. They also show that the incorrect belief that switch and remain are equally likely to be successful is more difficult to reject with less experience and is quite likely not to be rejected even by the end of the experiment. John Petrocelli and Anna Harris (2011) find that the memory for losses that result from switching is significantly overestimated, possibly because people may feel stronger about losses resulting from acts of commission than acts of omission (Ritov and Baron 1990). Memory for previous MHD trials may therefore be biased in ways that inhibit learning about the optimal choice.

In an effort to discover the cause of irrational behavior, some of the research done on the MHD elicits information from the subjects on the reasoning they employ. In these studies, correct reasoning is rarely observed. Tubau et al. (2015) discuss the fact that repeated practice enhances sensitivity to the different reward probabilities but does not seem to correct Bayesian reasoning. Elisabet Tubau and Diego Alonso (2003) find that participants who report that switching is more advantageous after some practice tend to switch more often. However, they often cannot explain why it is more advantageous. In fact, most subjects report a belief that the odds are 50:50 and often suggest that the computer must be programmed to behave in a way that they cannot understand. Stibel et al. (2009) find that even in a MHD with 100 options (which corresponds to a 99 percent probability of winning with switching), the reported probability judgments of those switching were often 50:50. A large number of alternatives thus leads to better
performance without necessarily leading to a better understanding of the problem or its underlying probabilities. Scott Page (1998) finds that people who correctly estimate the probabilities with a larger number of doors are unable to apply the same logic to the three-door case.

**Institutional Remedies to the Choice Anomaly**

Given that the Monty Hall anomaly is persistent, widespread, and appears to originate from a variety of sources, searching for an institutional solution has been one of the primary avenues of economic research in this area. While institutional economics most clearly developed with the early 20th century work of Thorstein Veblen, John Commons, and Wesley Mitchell, scholars have recognized the importance of institutional rules to the functioning of markets at least since the 18th century. But starting with the neoclassical models of frictionless market exchange, the role of institutions was downplayed in much of the 20th century scholarship, at least until the emergence of the so-called new institutional economics of Ronald Coase, Oliver Williamson, and Douglass North. Thanks to both the older and newer institutional economics literature, we know that varying the institutional arrangements can significantly impact market outcomes.

For the purposes of the present paper, institutions are important because they can mitigate the problems associated with individual irrationality. As Richard N. Langlois (1986) put it, institutions “serve as behavioral guides that reduce the knowledge and cognitive skills necessary for successful action” (247). As we described in the previous section, cognitive limitations appear to be an important factor in the MHD, so it is well suited to illustrating how institutions can help deal with those limitations. Imposing
particular institutional structures on the Monty Hall game can serve as a vivid illustration to students of just how important they are not only in this simple setting but also in more complex decision-making.

Brian Kluger and Steve Wyatt (2004) find that in asset markets in which at least one third of the traders had correctly estimated probabilities in earlier individual trials of the MHD, market prices reflect the correct probability beliefs, despite the presence of twice as many irrational subjects. Some nonmarket institutions have also been able to largely eliminate the choice anomaly in the Monty Hall Dilemma, as Slembeck and Tyran (2004) demonstrate. They run a multiple period experiment in which subjects receive information each period not only about their own current and past decisions and earnings, but also about the hypothetical earnings of someone who always stays and someone who always switches (replicating the track treatment in Friedman 1998). Reporting these hypothetical earnings allows subjects the opportunity to explicitly observe the payoffs from the two possible stationary strategies which, as discussed earlier, they likely do not observe from the history of their own choices. In addition, Slembeck and Tyran (2004) introduce two institutional variations – communication and competition among decision-makers. Communication is introduced by having small groups of subjects jointly determine their choice after some discussion period. Competition is introduced by rewarding subjects for their performance, relative to the performance of others. Each subject’s decisions and earnings rank are reported publically every 10 periods, with the exchange rate used to convert experimental earnings into cash payments determined by their ranking in the final period.
The various treatments in Slembeck and Tyran (2004) allow for three types of learning: learning from one’s own experience (multiple periods); learning from discussions with others (communication); and imitation learning (from observing other players’ decisions – whether real or hypothetical -- in competition and track). Similar to most other studies, Slembeck and Tyran (2004) find that learning from one’s own experience leads to higher switch rates over time, but they remain clearly below 50 percent, even after 40 periods. Their institutional changes of communication and competition each individually increase the incidence of optimal behavior, but the anomaly virtually disappears when these two institutional changes are simultaneously introduced. This combination of institutional changes improves rationality in initial choices as well as enhancing learning from repetition of the decision. The classroom experiment described here is designed to clearly demonstrate the extent to which these institutional modifications help solve the MHD.

**The Classroom Version of Monty Hall**

Adapting the choice problem and the particular institutional solutions explored by Slembeck and Tyran (2004) to a classroom setting presented a variety of challenges that we dealt with in a number of iterations of the experiment. An experiment done for research purposes is designed to collect valid data. One done for teaching purposes is designed to illustrate and demonstrate important concepts, and to allow students first-hand experience in creating, as well as observing, the data. The two purposes rarely result in the same experimental designs. Converting the basic experimental design from a laboratory experiment into one suitable for the classroom can be quite challenging.
The original Slembeck and Tyran (2004) experiments use a typical experimental design for exploring the MHD (originally developed by Friedman 1998). Subjects participated in the Slembeck and Tyran experiment individually via a computer, so implementing this in a classroom in a simple and straightforward way required designing a process that could be easily carried out by the instructor rather than by a computer. This necessitated thinking about the decision process in a very different way, determining how data could be presented most effectively, writing a set of instructions designed for students rather than experimental subjects, and creating a set of record sheets that are easy for students to work with.

In the process of modifying the MHD experiment for the classroom, we developed several different procedures for introducing the dilemma and the institutions of interest to our students, two versions of which are presented below. There are a variety of good options for exploring this dilemma, depending on what the instructor wishes to focus. Indeed, one of the appealing features of this classroom experiment is its flexibility. We have run the experiment with junior economics majors, although it would also work well for introductory students. The main difference would be in the nature of the explanations, with more advanced students being able to follow the Bayesian updating explanations, for example. In our experience, both versions of the experiment presented here can easily be completed in approximately 50 minutes and can work well for classes of any size, although the Entire Class version may be easiest to manage for large classes.

We have provided instructions and record sheets in the Appendix for the two versions of the experiment. Each of the versions can be further modified depending on
the desired emphasis and the learning objectives that the instructor wishes to achieve, but they are straightforward to implement with no modifications. We briefly discuss possible modifications later in the paper.

The Entire Class version is the easiest to implement because the instructor runs the experiment for all of the students together. A single student serves as the class leader and makes the initial choice for the class. Each student then individually makes the second decision of whether to remain with the class choice or switch after the instructor (acting as host) reveals a losing card. This version is good for instructors who may not be used to running experiments in their classroom or for those who teach either large classes (more than 30) or very small classes (less than 12), where dividing students into multiple small groups is either unmanageable or simply not feasible. Simplifying the experimental procedure necessitated placing the initial choice in the hands of a class leader so it is taken out of the hands of the other students, which likely limits the presence of emotional biases and may decrease irrational behavior somewhat.

The Small Groups version creates multiple separate small games that are run by the students in each group. This version requires more organization by the instructor and is more manageable in medium-sized classes (12-30 students). While it is slightly more complicated and time consuming to run, each individual player makes their own first decision. Only a portion of the students actually make the choices, but emotional biases are more likely to be present, and therefore, more irrational behavior is likely to be observed. This version is also effective because it allows some of the students to experience the MHD from the vantage point of the host. Because the Small Groups version requires more organization, a list of suggested procedures is included with the
instructions in the Appendix. There are tradeoffs associated with implementing each
version of the experiment, and we discuss both versions in more detail below.

**Entire Class Version**

This version is straightforward and fairly simple to implement because the
instructor, playing the role of the host, runs the experiment with the entire class at once.
The instructor places three cards (only one of which is black, the winning color) face-
down on a table. A student chosen to serve as the “Class Leader” makes the original
card choice, and then each student (including the Class Leader) decides individually
whether to stay or to switch using the record sheet found in the Appendix. As discussed
previously, because the Class Leader makes the first choice, the students may feel less
attached to it than if they had made it themselves, and the dilemma may therefore be less
striking. To help create a greater attachment to the initial choice, we tried a variety of
different wording choices in the instructions. We ultimately settled on framing the
decision as a “Class Choice” made by the “Class Leader,” and by referring to staying as
“participating with the class,” and switching as “rejecting” the Class Card.

During Part I of the experiment, students make their own individual decisions as
to whether to participate with the class or reject the Class Card each period. The students
each fill out a record sheet that allows them to observe all of their previous decisions and
earnings. The instructor keeps track of the potential earnings of a hypothetical person
who always participates with the class (stays) and a hypothetical person who always
rejects the Class Card (switches), and displays this information to the class each period.
This reporting allows each student to compare their actual payoffs with what would have
happened if they had pursued an always stay strategy or an always switch strategy.\textsuperscript{vii} Points earned during Part I can be converted into the reward medium chosen by the instructor (e.g. bonus points, raffle tickets for a prize, etc.) at a specified exchange rate.\textsuperscript{viii} It typically works well to run Part I for 5-10 periods.

In Part II, we implement the two types of institutional changes described earlier that have been shown in laboratory experiments to help correct the anomaly (Slembeck and Tyran 2004). Communication is introduced by dividing the students into 3-person decision-making teams, and competition is created by ranking the teams by their cumulative point earnings and making that ranking public (only by group number), along with each team’s record sheet, which shows all of their past decisions and earnings. We have found that doing this ranking every five periods works well in providing the information to the entire class often enough without being overly disruptive. (This could be modified slightly in either direction if needed because of time constraints.) Exchange rates for Part II points are based on the group rankings in the last decision-making period, with more highly-ranked groups receiving lower exchange rates. It works well to run Part II for 10 or 15 periods (or at least two rankings).

\textbf{Small Groups Version}

This version is slightly more complicated to run than the Entire Class version, and it requires more monitoring on the instructor’s part, but since it allows players to make their own initial choice, it may lead to a more striking observation of the anomaly. In this version, the students run the experiment in multiple small groups. A more detailed description of recommended procedures for this version can be found in the Appendix.
Students are separated into groups, each including: a “Director” who directs the experiment and deals the cards (Monty Hall); a “Player” who makes the decisions; and a “Monitor” who keeps track of the potential earnings of a hypothetical Player who always stays and a hypothetical Player who always switches, and reports these potential earnings to their group at the end of each decision-making period. The Player in the group can use this information to easily compare their actual earnings in each period with the earnings they would have had by pursuing an always stay or an always switch strategy.

The Director and Monitor perform most of the tasks that the computer would perform in a research experiment and that the instructor performs in the Entire Class version. In our experience, the students who play these roles are interested enough in the Monty Hall game and are involved enough in running the experiment that they enjoy participation as much as the Players. It also allows for some good discussion of the dilemma from the host’s perspective, which can help with the intuition behind the rational solution.

During Part I of the experiment, each Player makes his or her own individual decisions and fills out a record sheet (see the Appendix) that allows them to keep track of all their previous decisions and earnings. The Director and Monitor are instructed to facilitate the experiment, but not to be involved in any decision-making. This is reinforced by informing the Director and Monitor that they will be rewarded with a fixed amount for appropriately facilitating the experiment, rather than basing their payment on the earnings of the Player. “ Appropriately facilitating” the experiment is likely to simply involve making a good faith effort to do so. Points earned during Part I can be converted
into the reward medium chosen by the instructor at a specified exchange rate (see endnote viii). Again, it works well to run Part I for 5-10 periods.

During Part II of the experiment, the two institutional changes discussed above are implemented. Communication is introduced by combining the original groups into larger groups, creating teams of players who make team decisions. In addition, competition is introduced by ranking the teams by their cumulative point earnings and making that ranking public (by group number), along with each team’s decisions and earnings every five periods. (Again, this could be modified slightly in either direction if needed because of time constraints.) Exchange rates for the Players’ Part II points are based on the group rankings in the last decision-making period, with exchange rates decreasing in rank. The exchange rate for the Directors’ and Monitors’ points remains as it was in Part I since they are paid a fixed amount for facilitating the experiment for their group. It works well to run Part II for 10 or 15 periods. Again, detailed procedures can be found in the Appendix.ix

**Possible Variations**

The Entire Class and Small Group versions described here are two basic versions of the experiment that are fairly easy to implement. However, one of the advantages of this classroom experiment is its considerable flexibility. Once comfortable with the basic experiment, instructors can easily make simple modifications to the experimental designs discussed here to suit their particular learning objectives. As discussed previously, a significant body of research in various disciplines has been devoted to exploring the existence of, causes of, and solutions to the Monty Hall anomaly. This body of literature
provides numerous ideas for possible modifications and extensions of the classroom experiment described here. Among the many possible modifications, instructors could simply illustrate the basic effects of repetition without introducing any institutional solutions, introduce a variety of different learning mechanisms into the dilemma, compare different psychological and framing effects, change the number of options in the dilemma, as well as introduce a variety of other institutional changes. The ability to tailor the basic experiment to fit the needs of each individual instructor and course is one of the main advantages of this particular classroom experiment. More detailed information on various treatments that have been used in the laboratory and implementing these ideas can be found in the original research papers, a list of which is available in the endnotes.

Conclusion

Classroom experiments in economics can enhance student learning and retention while generating greater enthusiasm for the study of economics. Our experience with ‘making a deal in the classroom’ suggests that this particular experiment is enjoyable for students and makes key points about rationality and the importance of institutions in ways that are difficult (and certainly less enjoyable) to otherwise do. Students tend to find this dilemma fascinating. In addition, it is hard to think of a concept more central to economics than that of rationality, so illustrating this concept in some detail is valuable.

Adapting the MHD to a classroom setting posed a number of challenges that we dealt with in the versions described here, so that instructors can easily implement the experiment described here in less than a one hour block of class time. The benefits to
students are likely to be well worth the relatively modest time requirement. Our experience strongly suggests that students have a clearer sense of what irrational choice means after participating in the experiment. We have found that switch rates increase noticeably when the institutional changes in Part II are introduced, which allows instructors to then discuss how and why institutional rules can modify behavior even to the point of “correcting” irrational behavior. These abstract concepts, which are often difficult to convey to students, are clarified once students have hands-on experience with them. Our post-experiment discussion with students confirms that not only did they enjoy playing the game, but they had a clearer sense of what we mean by rationality, irrationality, and the role of institutions in shaping market outcomes.

It is hard to think of something more basic to the study of economics than the assumption of rationality. The Monty Hall Dilemma is one of the most persistent choice anomalies in economics, and it points to the possibility of more widespread violations of the narrow rationality assumptions on which we rely. While rational choice is a useful framework, economists have recognized for some time that there are plenty of important deviations from it; despite this recognition, the rational choice framework still dominates undergraduate instruction. Instructors may avoid teaching students about irrational behavior and institutional issues for fear that they are overly complex or too difficult to incorporate into the traditional classroom material. The experiment we have described here shows that this need not be the case – classroom discussions of irrational choice and institutional remedies can be initiated in a memorable and effective way through this simple demonstration of the classic MHD.
Notes

i They were actually curtains on the show, but the problem is usually described in terms of doors.

ii There is much more that could be said about the rationality assumptions used in economics. See Tyler Cowen (2001) for a more detailed discussion of these issues.

iii Vernon Smith (1982) found, for example, that individual anomalies can be eliminated by the institutions of the double auction market. See also Dhananjay Gode and Shyam Sunder (1993) who illustrated that markets can generate allocative efficiency even when populated by zero-intelligence computerized traders.

iv The large majority of laboratory experiments exploring the MHD involve multiple decision-making periods. The number of periods tends to range from 10 to 40.

v Both versions of the experiment are flexible in terms of the number of students that can be involved. It would be very straightforward to run the Entire Class version with very large classes. The Small Groups version could also be run in a large class, but would require more organization. We have effectively conducted the experiment with classes as small as 10 students.

vi The class leader could be chosen in a variety of ways. For example, they could be selected in a competitive manner through a trivia quiz, randomly selected, or they could simply be someone who is already seen as a leader in the class for various reasons.

vii This reporting could initially be left out and then added in later in the experiment to illustrate the effects of learning from others (fictitious in this case). This replicates the “track” treatment in Friedman (1998).
Note that if class points (bonus or otherwise) are used as the reward medium, the instructor can determine the weight he or she wishes to place on experiment participation for a particular course. It usually works well to make participation worth doing, but not so valuable as to dramatically change a student’s grade. (Frankly, most students enjoy participating and do not tend to need much additional motivation.) For example, an instructor could decide to make the maximum reward from the experiment worth 5 bonus points (or about 5 percent of a midterm exam score) and then determine appropriate exchange rates, given the number of periods they plan to run in each part of the experiment and expected earnings each period. Estimation of average experimental earnings depends on switch rates, and the switch rates we observe in the classroom tend to vary with the version run and the particular backgrounds and experiences of the students. We often see average switch rates around 40-50% across periods in Part I, with significant increases, often nearing 100%, in the final periods of Part II.

It’s even simpler to determine specific exchange rates after the experiment is completed in order to allow students to earn 5 points on average, for example, since experiments generally work well even when students do not know the exact number of bonus points they will earn. This is typically the way in which we determine exchange rates in our classes for experiment participation. Simply informing the class that more experimental earnings translate into more bonus points is typically enough to motivate them to take the task seriously. Everyone would receive the same exchange rate for Part I and then slightly varying exchange rates that decrease with rank for Part II.
Note that students typically find it easy to follow the instructions, but we have occasionally encountered students who misunderstand their roles. This is generally avoided with an initial trial run. The template we include in the appendix provides instructors with another tool that can help avoid any confusion.

The following is a brief summary of some of the treatments that have been shown to increase rational choice in the MHD. While the summary is not exhaustive, it indicates some of the treatment effects that have been reported in the literature. Better performance is often found with experience or practice with the decision, although the anomaly does not disappear (Granberg and Brown, 1995; Frieman, 1998; Granberg, 1999a; Palacios-Huerta, 2003; Tubau and Alonso, 2003; Kluger and Wyatt, 2004; Slembeck and Tyran, 2004; Herbranson and Schroeder, 2010; Petrocelli and Harris, 2011;). Increases in rational choices have also been observed with: introducing a larger number of alternatives (which corresponds to higher reinforcement percentages and increases the probability of winning from switching) (Page, 1998; Stibel et al., 2009; Mazur and Kahlbaugh, 2012; Saenen et al., 2014;); intensifying rewards (Granberg and Brown, 1995); learning from others through social interactions, joint decisions, or putting the dilemma in a market setting (Palacios-Heurta, 2002; Kluger and Wyatt, 2004; Slembeck and Tyran, 2004;); tracking of one’s own previous decisions and earnings (Friedman, 1998; Mazur and Kahlbaugh, 2012); receiving information on the decisions and earnings of other subjects’ or making payoffs dependent on relative earnings (Friedman, 1998; Slembeck and Tyran, 2004); providing advice on decisions (Friedman, 1998); locking subjects into decisions for five consecutive trials/reporting potential earnings for consistent strategies (Franco-Watkins et al., 2003; Slembeck and Tyran,
2004); **elimination of the second step in the dilemma** (Morone and Fiore, 2008); and **representation of probabilities using frequencies** (Tubau, 2008; Saenen et al., 2015).

Research exploring settings in which **staying is the optimal choice** (Granberg and Brown, 1995; Herbranson and Schroeder, 2010; Granberg, 1999b) also leads to higher initial levels of rational behavior, and Palacios-Heurta (2002) finds that **individuals’ initial abilities** are positively correlated with switching percentages. Framing the choice as an **adversarial game** (Tubau and Alonso, 2003) or taking the **game show host’s perspective** (Krauss and Wang, 2003) has also been shown to increase switching rates. They observed more correct answers to the dilemma when a **frequency-based formulation** was used in conjunction with a perspective change to that of the host.

*x* See Durham, McKinnon, and Schulman (2007) for a discussion of various studies examining the effects of experiments in the classroom and Durham, Henson, and Hodges (2017) for additional discussion of the differing effects across types of introductory courses.
References


