SUPPLEMENT TO "CLOCKS AND TREES: ISOMORPHIC DUTCH AUCTIONS AND CENTIPEDE GAMES"

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THE ADDITIONAL MATERIAL provided in this supplement comprises instructions to experimental subjects, data and programs, and figures.

INSTRUCTIONS FOR TREATMENT 1

This is an experiment in the economics of decision-making.

During the experiment you will be participating in a decision procedure in which the participants take turns choosing between two actions. Those actions are Pass and Take.

If the participant whose turn it is to choose were to select the action Take, that would end the decision procedure. On the other hand, if the participant whose turn it is to choose were to decide to Pass, then the proceedings would continue.

In order to choose Take, you would need to click on the arrow labeled Take in the tree diagram. In order to choose Pass, you would wait for the computer to automatically enter a choice of Pass; the computer will do this after 10 seconds have elapsed from the start of your turn.

To illustrate, please take a moment to study an example of the kind of tree diagram that will be displayed on your monitor during the experiment. For each position within the tree, the information in parentheses tells you about what payoff you would get and what payoff the other person would get if the Take arrow were clicked on at that branch of the tree. Your own payoff at a given branch of the tree is in **bold** type. See Figure S1.

Note that while you know your own numerical payoff at each node, what you know about the other participant's payoff is different. You know the numerical payoff for the other participant if you choose Take: that would be 0. However, you do not know the other participant's numerical payoff if he/she chooses Take. All you know is that his/her payoff if chooses Take is equal to some constant number that you cannot see—the value represented by the word Initial—plus some additional number that you can see. Note how this additional number changes as you move through the tree.

Similarly, the other participant knows his/her own numerical payoff at every node and that you will receive a payoff of 0 if he/she chooses Take. However, all he/she knows about your payoff if you choose Take is that it is equal to some constant—which he/she cannot see—plus a changing additional number, which he/she can see.

Please also note the following: for a given tree diagram, such as that shown above, the payoffs change as you move from the start (left end) of the tree to

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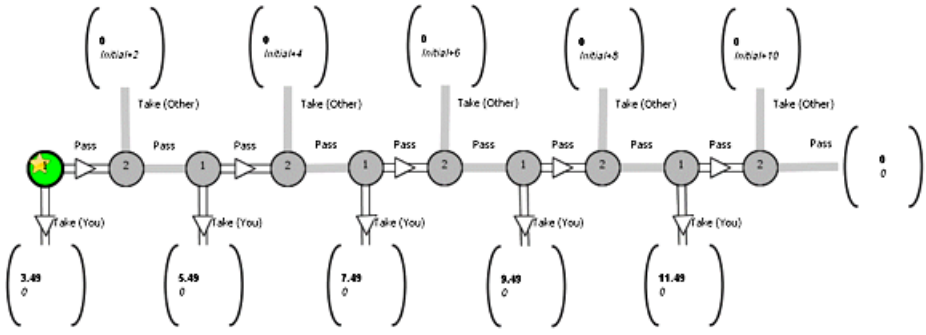

FIGURE S1.

the finish (right end) of the tree. But what determines the payoffs at the start of the figure, that is to say, what determines the payoff for you at the first node where you can choose or the payoff for the other participant at the first node where the other participant can choose? Looking at the first node labeled with a 1 (the node furthest to the left in the tree), the payoff at that node to the participant who chooses Take is determined prior to the start of play by taking a random draw from between \$0.01 and \$10.00 (in \$0.01 increments), then adding \$1.00 to that draw. The payoff to the participant who chooses Take at the first node labeled with a 2 (the second node from the left in the tree) is determined prior to the start of play by taking a second, independent random draw from between \$0.01 and \$10.00 (in \$0.01 increments), then adding \$2.00 to that draw.

Each of these independent random draws is made in a manner such that any number between \$0.01 and \$10.00 (in \$0.01 increments) is equally likely. Every player will receive a differently drawn initial value each round. (The draws are made with replacement, so any initial value is equally likely to be drawn from one round to the next.) Note also that since everyone in the room has their initial value determined by independent draws from the same process, the odds that any two people will have the exact same initial value down to the penny place is 1/1000 times 1/1000, which is 1/1,000,000.

Finally, note two more points. First, you will participate in the decision procedure many times; each participation repetition is called a *round*. In each round who you face as the other player will vary; specifically, who you are matched with will be randomly determined for each round. Second, whether you are able to choose at the nodes labeled with a 1 or the nodes labeled with a 2 will vary randomly from round to round.

Do you have any questions at this time? If so, please raise your hand to notify the experimenter. ONCE YOU CLICK Done, YOU WILL ENTER THE EXPERIMENT, SO PLEASE ASK ANY QUESTIONS YOU MAY HAVE FIRST. When you have finished reading and have asked any questions you might have, please click Done.

INSTRUCTIONS FOR TREATMENT 2

This is an experiment in the economics of decision-making.

In this experiment you will have the opportunity to engage in multiple rounds of a decision procedure. In each round, you will have the opportunity to purchase one unit of a fictitious commodity. If you buy the unit, your earnings will be given by

EARNINGS = RESALE VALUE − PURCHASE PRICE.

If you do not buy the unit, your earnings will be zero for that round.

Take some time now to read about how each of two entities, resale value and purchase price, are to be determined.

First, note some facts about resale value. The resale value of a unit of the fictitious good is the dollar amount for which you can sell that unit to the experimenter. Units of the fictitious good are available for purchase during each round of the decision procedure. Resale value is determined prior to the beginning of each round by random draws. Specifically, in any given round, a resale value for each participant (including yourself) will be determined randomly by independent draws where any number between $11.01 and $21.00 is equally likely. Those draws are made with replacement, which means that any unit, for any subject, in any round will have an equal likelihood of being a value anywhere between $11.01 and $21.00, in increments of $0.01. Your resale value is independent of the resale values of other participants. If your resale value is, say, $5.00, that tells you nothing about others' resale values; all you know about their resale values is that they are between $11.01 and $21.00.

Second, note how purchase price is determined. In this decision procedure, a unit of the fictitious good can be purchased by one of the participants. Which participant will purchase a given unit? A given unit will be purchased by the participant who offers the highest dollar amount in exchange for that unit. *The purchase price of that unit for that participant will then be the dollar amount they had submitted.*

To summarize:

— The participant who submits the highest dollar amount in exchange for a unit purchases that unit.

— The purchase price will be the dollar amount which that participant offered in exchange for that unit.

— That participant will then earn the number of dollars equal to resale value less purchase price on that unit. If resale value is LARGER than purchase price, then the buyer makes a PROFIT.

— The other participant, who does NOT offer the highest dollar amount, has zero earnings for that round.

Finally, take note of how one can submit a dollar amount in order to attempt to purchase a unit. In each round the Current Price displayed in the middle of the screen will decrease by $1.00 every 10 seconds. The first participant to click Purchase will be assigned the unit in question and will pay the price on the

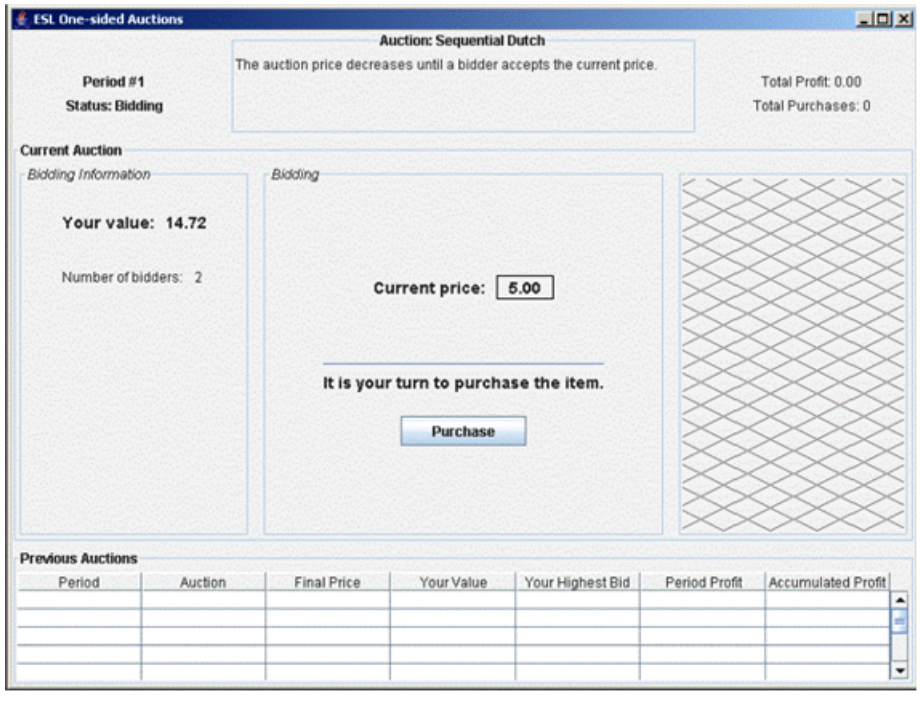

FIGURE S2.

countdown display at the time Purchase was clicked. An example of how one's screen will appear is shown in Figure S2.

As you can see, you have a resale value for the unit and you have the opportunity to purchase that unit at the price shown. You may purchase the unit by clicking Purchase with your mouse.

Note that the picture shown above illustrates what the screen will look like if it is your turn to be able to purchase. However, it will not always be your turn to purchase! When will it be your turn—or not your turn?

Whose turn it is will alternate between you and the other participant. If the participant whose turn it is to be able to purchase does not purchase, then after 10 seconds it will become the other participant's turn. This will continue either until some participant purchases or until the price reaches zero—in which case the round ends without either participant purchasing.

Keep in mind that while this is going on, the price of the unit drops every 10 seconds. This means that if the participant whose turn it is does not purchase, after 10 seconds it becomes the other participant's turn and the price of the unit will be $1.00 lower.

Finally, note two more points. First, that you will participate in the decision procedure many times; each repetition is called a *round*. In each round who

you face as the other participant will vary; specifically, who you are matched with will be randomly determined for each round. Second, whether or not you have the first opportunity to purchase will vary randomly from round to round.

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If the participant whose turn it is to choose were to select the action Take, that would end the decision procedure. On the other hand, if the participant whose turn it is to choose were to decide to Pass, then the proceedings would continue.

In order to choose Take, you would need to click on the arrow labeled Take in the tree diagram. In order to choose Pass, you would wait for the computer to automatically enter a choice of Pass; the computer will do this after 10 seconds have elapsed from the start of your turn.

To illustrate, please take a moment to study an example of the kind of tree diagram that will be displayed on your monitor during the experiment. For each position within the tree, the information in parentheses tells you about what payoff you would get and what payoff the other person would get if the Take arrow were clicked on at that branch of the tree. Your own payoff at a given branch of the tree is in **bold** type. See Figure S3.

Note that in this example, your payoffs are negative amounts at the first two branches where it is your turn to Take or Pass. If you were to Take at the first branch, you would LOSE $3.49. If you were to Take at the third branch, you would LOSE $1.49. In contrast, if you were to Take at any later branches, you would GAIN money. Therefore, it is important to look carefully to see if a payoff amount at a branch has a negative sign (−) in front of it.

Note that while you know your own numerical payoff at each node, what you know about the other participant's payoff is different. You know the numerical payoff for the other participant if you choose Take: that would be 0. However, you do not know the other participant's numerical payoff if he/she chooses Take. All you know is that his/her payoff if he/she chooses Take is equal to some constant number that you cannot see—the value represented by the word Initial—plus some additional number that you can see. Note how this additional number changes as you move through the tree.

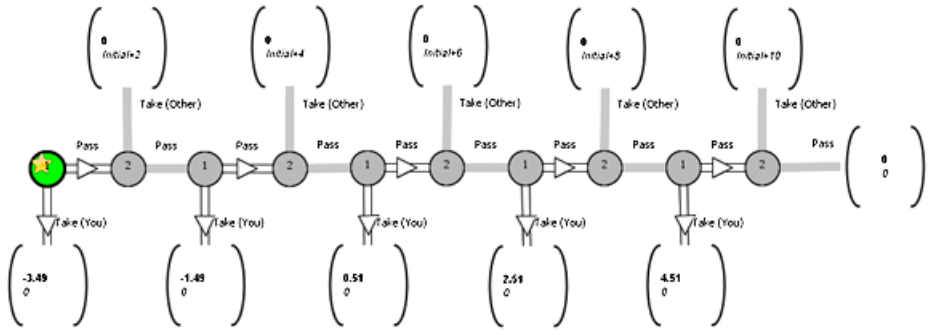

FIGURE S3.

Similarly, the other participant knows his/her own numerical payoff at every node and that you will receive a payoff of 0 if he/she chooses Take. However, all he/she knows about your payoff if you choose Take is that it is equal to some constant—which he/she cannot see—plus a changing additional number, which he/she can see.

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Each of these independent random draws is made in a manner such that any number between −$9.99 and $0.00 (in $0.01 increments) is equally likely. Every player will receive a differently drawn initial value each round. (The draws are made with replacement, so any initial value is equally likely to be drawn from one round to the next.) Note also that since everyone in the room has their initial value determined by independent draws from the same process, the odds that any two people will have the exact same initial value down to the penny place is 1/1000 times 1/1000, which is 1/1,000,000.

Finally, note two more points. First, you will participate in the decision procedure many times; each participation repetition is called a *round*. In each round who you face as the other player will vary; specifically, who you are matched with will be randomly determined for each round. Second, whether

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INSTRUCTIONS FOR TREATMENT 4

This is an experiment in the economics of decision-making.

In this experiment you will have the opportunity to engage in multiple rounds of a decision procedure. In each round, you will have the opportunity to purchase one unit of a fictitious commodity. If you buy the unit, your earnings will be given by

$$\text{EARNINGS} = \text{RESALE VALUE} - \text{PURCHASE PRICE}.$$

If you do not buy the unit, your earnings will be zero for that round.

Take some time now to read about how each of two entities, resale value and purchase price, are to be determined.

First, note some facts about resale value. The resale value of a unit of the fictitious good is the dollar amount for which you can sell that unit to the experimenter. Units of the fictitious good are available for purchase during each round of the decision procedure. Resale value is determined prior to the beginning of each round by random draws. Specifically, in any given round, a resale value for each participant (including yourself) will be determined randomly by independent draws where any number between $1.01 and $11.00 is equally likely. Those draws are made with replacement, which means that any unit, for any subject, in any round will have an equal likelihood of being a value anywhere between $1.01 and $11.00, in increments of $0.01. Your resale value is independent of the resale values of other participants. If your resale value is, say, $5.00 that tells you nothing about others' resale values; all you know about their resale values is that they are between $1.01 and $11.00.

Second, note how purchase price is determined. In this decision procedure, a unit of the fictitious good can be purchased by one of the participants. Which participant will purchase a given unit? A given unit will be purchased by the participant who offers the highest dollar amount in exchange for that unit. *The purchase price of that unit for that participant will then be the dollar amount they had submitted.*

To summarize:

— The participant who submits the highest dollar amount in exchange for a unit purchases that unit.

— The purchase price will be the dollar amount which that participant offered in exchange for that unit.

— That participant will then earn the number of dollars equal to resale value less purchase price on that unit. If resale value is LARGER than purchase price, then the buyer makes a PROFIT. If resale value is SMALLER than purchase price, then the buyer LOSES money.

— The other participant, who does NOT offer the highest dollar amount, has zero earnings for that round.

Finally, take note of how one can submit a dollar amount in order to attempt to purchase a unit. In each round the Current Price displayed in the middle of the screen will decrease by $1.00 every 10 seconds. The first participant to click Purchase will be assigned the unit in question, and will pay the price on the countdown display at the time Purchase was clicked. An example of how one's screen will appear is shown in Figure S4.

As you can see, you have a resale value for the unit and you have the opportunity to purchase that unit at the price shown. You may purchase the unit by clicking Purchase with your mouse.

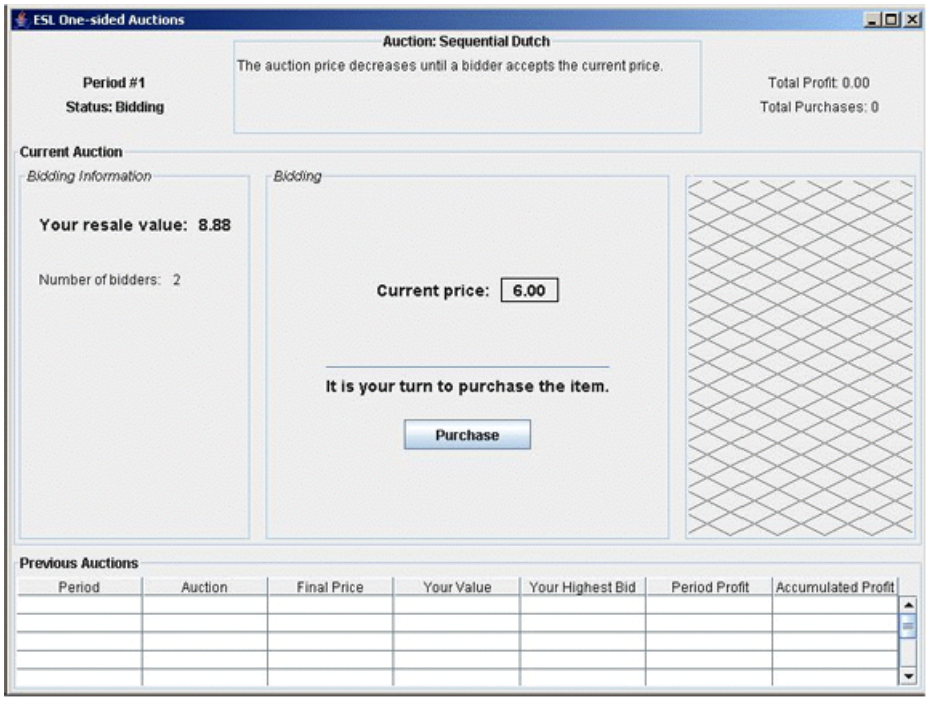

FIGURE S4.

Note that the picture shown above illustrates what the screen will look like if it is your turn to be able to purchase. However, it will not always be your turn to purchase! When will it be your turn—or not your turn?

Whose turn it is will alternate between you and the other participant. If the participant whose turn it is to be able to purchase does not purchase, then after 10 seconds it will become the other participant's turn. This will continue either until some participant purchases or until the price reaches zero—in which case the round ends without either participant purchasing.

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Done

INSTRUCTIONS FOR TREATMENT 5

This is an experiment in the economics of decision-making.

During the experiment you will be participating in a decision procedure in which the participants choose between two actions. Those actions are Pass and Take.

If either participant were to select the action Take, that would end the decision procedure. On the other hand, if both participants decide to Pass, then the proceedings would continue.

In order to choose Take, you would need to click on the arrow labeled Take in the tree diagram. In order to choose Pass, you would wait for the computer to automatically enter a choice of Pass; the computer will do this after 10 seconds have elapsed if neither person chooses Take.

To illustrate, please take a moment to study an example of the kind of tree diagram that will be displayed on your monitor during the experiment. For each position within the tree, the information in parentheses tells you about what payoff you would get and what payoff the other person would get if the Take arrow were clicked on at that branch of the tree. Your own payoff at a given branch of the tree is in **bold** type. See Figure S5.

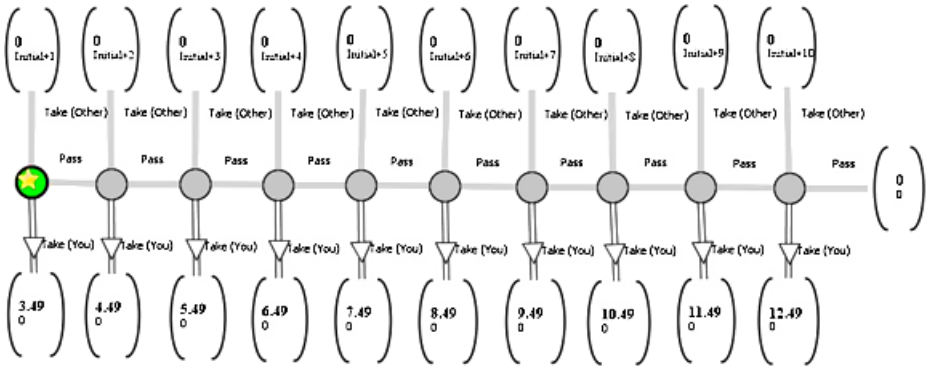

FIGURE S5.

Note that while you know your own numerical payoff at each node, what you know about the other participant's payoff is different. You know the numerical payoff for the other participant if you choose Take: that would be 0. However, you do not know the other participant's numerical payoff if he/she chooses Take. All you know is that his/her payoff if he/she choose Take is equal to some constant number that you cannot see—the value represented by the word "Initial"—plus some additional number that you can see. Note how this additional number changes as you move through the tree.

Similarly, the other participant knows his/her own numerical payoff at every node and that you will receive a payoff of 0 if he/she chooses Take. However, all he/she knows about your payoff if you choose Take is that it is equal to some constant—which he/she cannot see—plus a changing additional number, which he/she can see.

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Each of these independent random draws is made in a manner such that any number between \$0.01 and \$10.00 (in \$0.01 increments) is equally likely. Every

player will receive a differently drawn initial value each round. (The draws are made with replacement, so any initial value is equally likely to be drawn from one round to the next.) Note also that since everyone in the room has his/her initial value determined by independent draws from the same process, the odds that any two people will have the exact same initial value down to the penny place is 1/1000 times 1/1000, which is 1/1,000,000.

Finally, note that you will participate in the decision procedure many times; each participation repetition is called a *round*. In each round, who you face as the other player will vary; specifically, who you are matched with will be randomly determined for each round.

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INSTRUCTIONS FOR TREATMENT 6

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— The other participant, who does NOT offer the highest dollar amount, has zero earnings for that round.

Finally, take note of how one can submit a dollar amount in order to attempt to purchase a unit. In each round the Current Price displayed in the middle of the screen will decrease by $1.00 every 10 seconds. The first participant to click Purchase will be assigned the unit in question, and will pay the price on the countdown display at the time Purchase was clicked. An example of how one's screen will appear is shown in Figure S6.

As you can see, you have a resale value for the unit and you have the opportunity to purchase that unit at the price shown. You may purchase the unit by clicking Purchase with your mouse.

The round will continue either until one of the two participants purchases the unit or until the price reaches zero—in which case the round ends without either participant purchasing.

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Done

INSTRUCTIONS FOR TREATMENT 7

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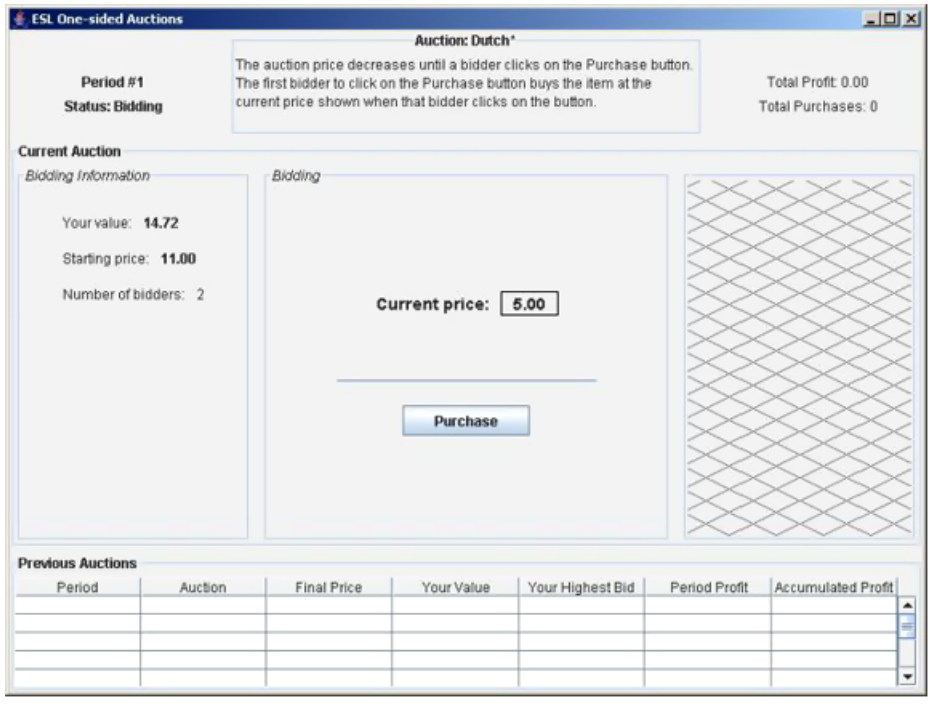

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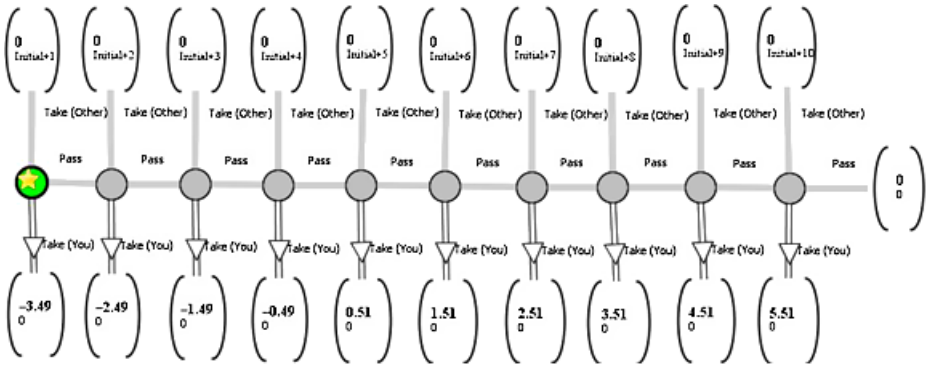

FIGURE S7.

However, you do not know the other participant's numerical payoff if he/she chooses Take. All you know is that his/her payoff if he/she chooses Take is equal to some constant number that you cannot see—the value represented by the word "Initial"—plus some additional number that you can see. Note how this additional number changes as you move through the tree.

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initial value determined by independent draws from the same process, the odds that any two people will have the exact same initial value down to the penny place is 1/1000 times 1/1000, which is 1/1,000,000.

Finally, note that you will participate in the decision procedure many times; each participation repetition is called a *round*. In each round, who you face as the other player will vary; specifically, who you are matched with will be randomly determined for each round.

Do you have any questions at this time? If so, please raise your hand to notify the experimenter. ONCE YOU CLICK Finished reading, YOU WILL ENTER THE EXPERIMENT, SO PLEASE ASK ANY QUESTIONS YOU MAY HAVE FIRST. When you have finished reading and have asked any questions you might have, please click Finished reading.

INSTRUCTIONS FOR TREATMENT 8

This is an experiment in the economics of decision-making.

In this experiment you will have the opportunity to engage in multiple rounds of a decision procedure. In each round, you will have the opportunity to purchase one unit of a fictitious commodity. If you buy the unit, your earnings will be given by

$$\text{EARNINGS} = \text{RESALE VALUE} - \text{PURCHASE PRICE}.$$

If you do not buy the unit, your earnings will be zero for that round.

Take some time now to read about how each of two entities, resale value and purchase price, are to be determined.

First, note some facts about resale value. The resale value of a unit of the fictitious good is the dollar amount for which you can sell that unit to the experimenter. Units of the fictitious good are available for purchase during each round of the decision procedure. Resale value is determined prior to the beginning of each round by random draws. Specifically, in any given round, a resale value for each participant (including yourself) will be determined randomly by independent draws where any number between $1.01 and $11.00 is equally likely. Those draws are made with replacement, which means that any unit, for any subject, in any round will have an equal likelihood of being a value anywhere between $1.01 and $11.00, in increments of $0.01. Your resale value is independent of the resale values of other participants. If your resale value is, say, $5.00 that tells you nothing about others' resale values; all you know about their resale values is that they are between $1.01 and $11.00.

Second, note how purchase price is determined. In this decision procedure, a unit of the fictitious good can be purchased by one of the participants. Which participant will purchase a given unit? A given unit will be purchased by the participant who offers the highest dollar amount in exchange for that unit. *The purchase price of that unit for that participant will then be the dollar amount they had submitted.*

To summarize:

— The participant who submits the highest dollar amount in exchange for a unit purchases that unit.

— The purchase price will be the dollar amount which that participant offered in exchange for that unit.

— That participant will then earn the number of dollars equal to resale value less purchase price on that unit. If resale value is LARGER than purchase price then the buyer makes a PROFIT. If resale value is SMALLER than purchase price then the buyer LOSES money.

— The other participant, who does NOT offer the highest dollar amount, has zero earnings for that round.

Finally, take note of how one can submit a dollar amount in order to attempt to purchase a unit. In each round the Current Price displayed in the middle of the screen will decrease by $1.00 every 10 seconds. The first participant to click Purchase will be assigned the unit in question, and will pay the price on the countdown display at the time Purchase was clicked. An example of how one's screen will appear is shown in Figure S8.

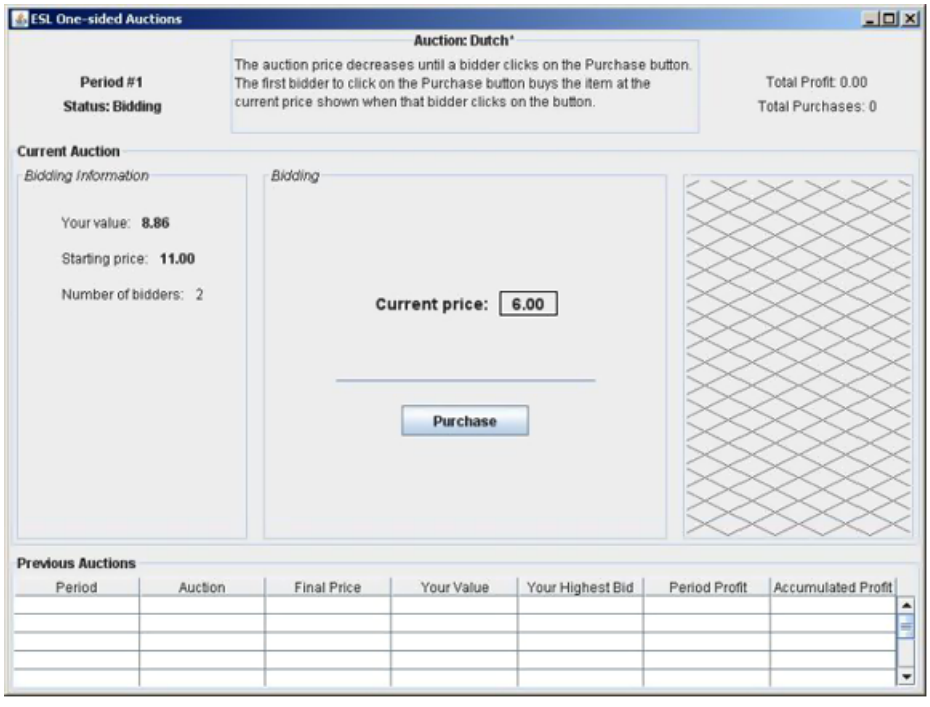

FIGURE S8.

As you can see, you have a resale value for the unit, and you have the opportunity to purchase that unit at the price shown. You may purchase the unit by clicking Purchase with your mouse.

The round will continue either until one of the two participants purchases the unit or until the price reaches zero—in which case the round ends without either participant purchasing.

Keep in mind that the price of the unit drops every 10 seconds. This means that if neither participant purchases the unit, after 10 seconds the price of the unit will be $1.00 lower.

Finally, note that you will participate in the decision procedure many times; each repetition is called a *round*. In each round who you face as the other participant will vary; specifically, who you are matched with will be randomly determined for each round.

Do you have any questions at this time? If so, please raise your hand to notify the experimenter. ONCE YOU CLICK Done, YOU WILL ENTER THE EXPERIMENT, SO PLEASE ASK ANY QUESTIONS YOU MAY HAVE FIRST. When you have finished reading and have asked any questions you might have, please click Done.

Done

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