Introduction

Hi, thank you for participating in this study!
My name is <<insert name>>, and I'll be the facilitator for today.
Before we go any further, I'll ask you to completely turn off your phone and put it away.

(Demonstrates the full power-off sequence to the participant)

(Verify that the participant followed directions)

I'll be reading from this script to be consistent in the information I provide you and the other people taking part in this study.
Please don't discuss this study with anyone, as we don't want **other** participants to receive any information in advance.

Throughout this study, your computer screen will be captured with a **screen recorder**, and your reactions will be recorded via the **webcam** and **mic** here.

(Points out the webcam and microphone)

(If webcam needs to be adjusted, adjust face above green tick)

Now, click on the red record button in the bottom right of your computer screen.

(Point to REC button)

(Participant presses REC button)

This study is a part of an **eXplainable** Artificial Intelligence research project at <<insert name>>.

Your participation will help us understand what people need to make good assessment decisions regarding an AI.

Today, you will not be playing a game.

Instead, you will be **assessing** an AI playing a “tug of war” like game built within Starcraft 2.

Because this is a custom game, there will be things that are **recognizable** as part of StarCraft 2, but the game, units and resources, work differently here.

Was anything I have said so far unclear to you?

To help you with assessing the AI, I will first explain how the game and the interface work.

On understanding the game, I will explain how the AI explains its decisions in the game.

We can only begin the main task once you have understood these parts.

Please understand that this part of the study will take some time.

Alright, are we good?

UI Tutorial

Now we will go over the user interface.
This bar right here is your timeline.
(points to clicker bar)

You can go to a specific part of the game by clicking at that point in the timeline.
When you click on the timeline, make sure to give the replay time to catch up.
You can give it a try if you want.
(Participant clicks a point on timeline)

Now that you've understood that, please direct your attention to this button.
Don't click on it.
(Points to pause/play button)
With this button, you can pause or play the video.

Whenever your clicker bar reaches the black diamonds, the replay will automatically pause.
I will explain the black diamonds later on, but let's play through a few black diamonds now.
(Participant plays video for 1-2 rounds)

Looks like you got a feel for it.
Next to the pause/play button is a step counter.
(Points to steps on screen)
You can think of steps as "steps" through the replay, or as a unit of time.

This is the drop down menu here.

(Points to the drop down menu)

Please do not click on it until I tell you so.
It is used to switch game replays.

Before I explain the game rules and such, I'd like you to watch this replay to understand how the game works on your own.
If you have questions about the user interface, feel free to ask me.
You may now begin watching the video.

(Participant plays the video)

(Stop participant when they reach round 10)

Game Tutorial

Game Overview:

Now that you've watched the replay, I will explain the game rules.
This will clarify the **important** points of the game, so please bear with me if it gets repetitive.
Unless instructed to do so, please keep your hands off the computer.

In this game, both of the players are AIs.
We call them the "Friendly AI" and the "Enemy AI".
(Point to Friendly and Enemy labels)
The left side is the Friendly AI's side, and the right side is the Enemy AI's side.
(Circles Friendly AI's side and then Enemy AI's side)

You will be watching the game from the perspective of the Friendly AI because that's the AI that you're going to assess today.

Just to check in.
Can you show me which side is the Friendly AI's side?
(Answer: The left side)
[Yes/Actually], it's the left side.

In this game, we have a top and a bottom lane.
(points to lanes)

You can think of each lane as its own separate battlefield between the AIs.
This means that the AIs can not send combat units from one lane to the other.

Let's turn our attention to this structure here.

(points to Friendly AI's top Nexus)

It is called the Nexus.
In this game, you can think of it as the player's base.
Near each Nexus is a box with the amount of health points the Nexus has.

(Point to Friendly AI's top Nexus health points)

Out of the four nexuses on the screen, which ones do you think belong to the Friendly AI?

(Answer: The two leftmost Nexuses)

[Yes!/Actually,] The two left Nexuses belong to the Friendly AI while the two right Nexuses belong to the Enemy AI.

Throughout the game, combat units will spawn behind their Nexus and charge towards the opposing Nexus in their lane.

(point behind the top Friendly Nexus and move right)

Combat units will damage an opposing nexus if they are not killed beforehand by opposing units.
In order for an AI to win, they must bring ***one*** of the opponent's Nexuses to 0 health points.

For the Friendly AI to win, how many of the Enemy's nexuses need to be destroyed?

(Answer: One)

[Yes!/Actually,] the AI just needs to take out at least *one* of the Enemy AI's nexuses to win.

Do you have any questions about this part?

Rounds and Decision Points:

I will now explain how the **Timeline** works in this game, which is this bar right here.

(Points to clicker bar)

These black diamonds are what we call “decision points”.
Pay close attention to these as it is an important part of the game.
At these decision points, the AIs will decide on two things.
1. What units to buy, **if any**, and...
2. Which lane to place them in for the upcoming round.

I have a question for you.
What does the AI do at a decision point, besides choosing which units to buy?

(Answer: Chooses a lane)

[Yes!/Actually/Close, but], at a decision point, the AI also has to decide on which lane to place the purchased units in.

You can think of a round as a small battle in an overarching war.
Here, a round starts after one decision point, **like here**, and ends at the next decision point.

(Points to two DPs)

Each round lasts 10 seconds in this replay.

So which comes first: a decision point or a round?

(Answer: A Decision point)

[Yes!,/good guess, but] a decision point happens before a round. This is because the AI makes its decisions before the round actually begins.

Do you have any questions about rounds and decision points?

Income:

Now I'm going to talk about income.
Before we start, let's make a guess.

Can you show me where the Friendly AI's minerals are on the screen?

(Answer: Top left corner, noted by "Minerals")

[Yes/Actually], they are found here.

(Points to minerals)

You can't see the Enemy AI's mineral count, because the Friendly AI doesn't have that information while playing the game.

You can think of minerals as money in this game.
Each AI starts with 150 minerals in the beginning of the game.
Every round, the two AIs will ***automatically*** receive 100 minerals, and with the minerals they have, the AIs can spend it to get combat units or pylons.
I will explain combat units and pylons later.

Just to check in.
How many minerals are the AIs guaranteed to get every round?

(Answer: 100 minerals)

[Yes/Actually], the AIs are always going to get 100 minerals every round.

Now move your clicker bar between decision point 10 and 11.
How many minerals does the Friendly AI have?

(Answer: 400 minerals)

[Yes!/Good guess, but] it's 400 minerals.

Now, can you point to the number of Pylons for the Friendly AI?
(Answer: Top left corner saying Pylons)
[Yes/Actually], you can find them here.
(Points to the Pylons counter)

Okay, how about for the Enemy AI?
(Answer: Top right corner saying Pylons)
[Yes/Actually], you can find them here.
(Points to the Pylons counter)

You can see both counts because the AIs can see how many pylons the other AI have when they play the game.

So Pylons are a source of additional minerals in this game.
If you've played StarCraft 2 before, these are not the Pylons you know.
Purchasing a pylon is similar to investing your money or in this case, minerals.
Here, each Pylon generates an **additional** 75 minerals per round, and each AI can have up to three Pylons.

It costs minerals to purchase a pylon.
As the players buy more pylons, the cost of a pylon increases.
We will give you more information on the costs later, in the form of a Cheat sheet.

Here's a question for you.
How many minerals does each pylon generate per round?
(Answer: 75 minerals)
[Yes/Actually], each pylon generates 75 minerals.

Let's say that I bought my first pylon.
Instead of getting 100 minerals per round, I now get **175** minerals per round.
So you can think of pylons as a way to increase how much minerals you can get in the game.

I want you to now press play and let the video run.
Can you see how there's a +1 here next to the number of pylons?
(Points to +1)
This means that the Friendly AI bought **one** pylon at this decision point.

If this says NA instead, it means the AI did not purchase a pylon.
As I said before, since we're watching from the perspective of the Friendly AI, we cannot see what purchases the Enemy AI makes, including those for pylons.
If the Enemy AI bought any pylons, its pylon count will be updated when the next round starts.

Does anything need clearing up?

Combat units:

The AIs can buy combat units using minerals.
Once you buy a combat unit, that combat unit will always spawn in every round thereafter.
These units charge towards their opponent's Nexus in their lane, and they fight any opposing units in their way.
In regards to which combat unit attacks the other combat unit first, that is randomized in this game.

Just to check in.
If an AI purchases a combat unit at a decision point, will that combat unit spawn for only that upcoming round or for every upcoming round?

(Answer: Every upcoming round)

[Yes/Actually], once the AI buys a combat unit, that unit will spawn for every round until the end of the game.

There are three combat units the AIs can buy: Marines, Banelings, and Immortals.
Each combat unit have their own advantages and disadvantages.
If you played StarCraft 2 before, these combat units may seem familiar, but they are different in this game.

Now move your clicker bar between decision point 17 and 18.

(Participant is at DP 17 and 18)

Here is a marine.

(Points to Marines)

Marines are small, low cost units.
They have the lowest amount of health out of the three combat units, and they attack with small, quick shots.

Can you point to another marine on the screen?

(Participant points at a combat unit)

[Yes/Actually], that is a marine.

Here is a baneling.

(Points to Banelings)

Banelings are explosive bug units with a moderate cost.
They have a medium amount of health, and they explode upon contact with an opposing unit.
This is quite effective against Marines.

On the screen, can you show me another unit that is a baneling?

(Participant points at a combat unit)

[Yes/Actually], that is a baneling.

Last but not least is the immortal.

(Points to Immortals)

Immortals are large units that are the most expensive unit in the game.
They have the highest health, because they have a shield that absorbs damage from Baneling explosions.
Immortals attack with slow shots that are effective against Nexuses.

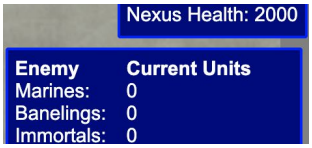
Can you show me a unit that is an immortal on the screen?

(Participant points at a combat unit)

[Yes/Actually], that is an immortal.

In these four boxes, around your screen,

(points at each units box)



We can see how many combat units the AIs have bought in the game so far with the "Current Units" column.

(Points to the Current Units column)

Once the AI buys a combat unit, we know it will spawn for every round until the game ends, so this **also** tells us how many units have spawned for that round.

For example, in this round, I know that 13 Friendly AI marines have spawned for the top lane.

(Points to Friendly's top marines in units box)

So my question for you is…

How many Friendly AI marines were spawned in the bottom lane for this round?

(Answer: 3 marines)

[Yes/Actually], 3 marines were spawned for this current round.

Now, click on the play button.

(Wait for the video to pause at DP 18)

With the "Adding Units" column, we get to see what units the Friendly AI bought and for which lane at the decision point.

(Points to "Adding Units" column in Friendly AI's bottom lane)

To know how many combat units will spawn for the next round, we simply add the number in the "Current Units" column with the number in the "Adding Units" column.

For example, for the marines in the bottom lane, 5 will spawn for the next round because 4 + 1 = 5.

(Point to each number in columns)

If you see “NA” in the “Adding Units” column, you can think of it as 0 combat units.

So here, for immortals in the bottom lane, 0 will spawn for the next round because 0 + 0 is 0.

When the round starts, whatever number was in the Adding Units column will be added to the Current Units column for the Friendly AI.

For the Enemy AI, the Current Units column will be updated when the round starts.

Now, I want you to click play, and let the replay run.

(Wait until video pauses at DP 19)

My question for you is...

For the Friendly AI’s nexus in the bottom lane, how many banelings will spawn for the next round?

(Answer: 10)

[Yes!/Good guess, but] there will be 10 banelings spawning in the next round.

That is because there are 8 banelings in the current round, and there will be 2 more for the upcoming round.

Do you have any questions about combat units?

Explanations:

Let's turn our attention away from the screen now.
As you know, today, you will be assessing the Friendly AI's performance.
To explain its decisions, the Friendly AI uses a diagram as an explanation for every round.
You can think of it as a **diagram of decisions**, where the Friendly AI decides what actions or **decisions** it must take to complete a round in the game.

Let's turn our attention to this one as an example.

(Show sample explanation)

First, this box here

(Point to first state node)

explains the state the game is currently in.
It shows the number of combat units in the top and bottom lanes as well as the number of pylons, currently present in the game.
You can see both the Friendly AI's and the Enemy AI's information here.

(Point to Friendly and Enemy)

Q: Currently, our Friendly AI has 150 minerals and 0 combat units in both lanes.
The Enemy AI also has 0 combat units in both lanes.
Knowing this information, what actions do you think the Friendly AI can take?
To help you, I provide you this cheat sheet that has the costs of the combat units.

(Participant gives random answer)

That's great.

We can represent the Friendly AI's actions in the diagram as these pictures here.

(Show action node)

Now, there are many more actions that the Friendly AI can also take, but we're only showing the most rewarding ones here for the sake of simplicity.

If you'll look closely here,

(Choose green action node, point at it)

You'll find that it says 1 baneling in the bottom lane, because this 1 black line here means 1 unit.

(Point to black line)

This means that if the Friendly AI chooses this action, 1 baneling will be spawned in the bottom lane.
You'll also notice that the top lane is missing.
This is because, you'll remember from the game rules, you can take action in only one lane during a round.
Another thing to keep in mind is that each line means one unit.

(Points to the lines of an action node)

Finally, each action has this number associated with it, right below it.

(Point to reward value)

This is called its **reward**.
Our Friendly AI uses an AI algorithm to calculate these values.
All you need to remember is its reward falls between 0 and 1, and that you want to **accumulate** as much reward as you can.
The more the reward, the more are the Friendly AI's chances to win and the lesser for the Enemy AI.

Do you have any questions about the state and actions?

For the Friendly AI to make the best decision, it also estimates the decisions the Enemy AI **might** take.
Again, there are many actions that the Enemy AI can take, but we're showing only the most rewarding ones here.

(Point to Enemy action nodes)

Now, can you tell me what the Enemy AI will do here?

(Point to green Enemy action node)

[Yes/Actually], this picture represents the Enemy AI spawning 1 marine and 1 baneling for the round.

How much reward is this action estimated to receive?
A: This action will give it a reward of 0.72522.
(Point to reward)
Very good!

Keep in mind that there is **no** dependency between the Friendly AI's and the Enemy AI's decisions.
For example, this action
(Point to green Friendly AI action node)
can occur with any of these Enemy AI actions.
(Point to Enemy AI action nodes under it)
This does not mean that this action
(Point to Enemy AI action node)
will occur **only if** this action occurs.
(Point to Friendly AI action node)
Again, the AIs are not dependent on each other for their actions.
Their actions occur at the same time in the game.

After **estimating** these actions,
(Point to green actions)
we reach the Friendly AI's **predicted** state of the game, which you'll see right here.
(Show the predicted state node)
Keep in mind that the rewards of the Friendly AI's actions that you see here
(Point at Friendly AI's actions)
would generally be higher for itself and lower for the Enemy AI.
(Point to Enemy AI's actions)

Do you have any questions so far?

Alright, let's talk about the overall diagram.
Basically, these **four** levels represent one round in the game.
(Points to first four layers)

This is the current state of this round, and
(Point to root node)
this
(Point to predicted state node)
is a **prediction** of the state of the next round.

These actions, which is the Friendly and Enemy AI actions
(Point to Friendly and Enemy AI actions)
reflect the actions taken in this round in the game that helped us reach this **predicted** state of the game.
(Again point to predicted state node)

Ideally, this diagram will be generated until it reaches its "goal": which is the Friendly AI winning the game.
(Point to goal state)
So, you can imagine multiple such "**rounds**"
(Point at the 4-level chunk until the winning state)
until we reach the "AI winning the game" state.
On this sheet, we're showing you two of such rounds.

Does anything need clearing up?

Now, you can imagine how **huge** the diagram would be, with so many possible actions and so many rounds.
This is why, in reality, the Friendly AI actually only generates the diagram until a **certain round**.
We are not sure at which round because each round has different possibilities for actions which means a different amount of rounds generated.
At this point, it uses a **technique** to evaluate the actions that would maximize the Friendly AI's chances of winning the game.
The **technique** here is as a method that evaluates actions in general.

After looking at its options for Friendly and Enemy AI actions here, our Friendly AI decides that this

(Point at the trail)

is the most important set of actions it should consider to win. This trail is highlighted in green because it is the most rewarding trail estimated by the Friendly AI.

On taking this action, the Friendly AI **estimates** that this choice

(Point to chosen action node)

might maximize its chances to win the game.

(Point to "AI winning the game" phrase on example)

Do you have any questions on this?

Alright, I'll now explain how you can **interact** with the diagram. If you "click", or "point" at a picture in the diagram, like so,

(Point to any action node)

This should expand the entire space below it, showing more actions or states underneath it.

(Draw out sample nodes branching from it)

Let me know if you want to "click" on any part of the diagram for more information.

Because these pictures are prototypes, some of the pictures might be glitchy.

You might find duplicates of certain pictures like here

(Points to duplicate empty nodes)

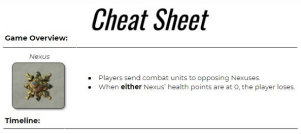
But even so, the explanations are still sound.

Is there anything that needs clearing up?

Game Refresher:

Now that we learned how the diagrams work, I understand I threw a lot of things at you.
So we provide you with the cheat sheet for your reference.

(Gives Cheat Sheet to participant)



It has information about the game overview, income, combat units, and timeline.

I'll let you go over the cheat sheet on your own.
Let me know if you have any questions about the game.

Explaining Main Task:

Now that we have finished the tutorial, I will explain your main task.
Today, you will be evaluating the Friendly AI's actions in this replay, and I am here as a facilitator to guide you through the assessment process.

As you watch the replay, you are free to think aloud and react to it.
Once you have finished watching three rounds, I will ask you a few questions.
After answering these questions, I will hand you a sheet where you will write down anything interesting, good, or bad done by the Friendly AI.
You will find that whatever you write down will be helpful when you do the post task questionnaire in the end.

Again, I understand I threw a lot of things at you, so whenever you have questions about the game, the cheat sheet should help you.
If not, I am here to help the best I can.
Is everything clear so far?

Alright, let's move on.
I want you to click on this drop down menu here.
(Points to drop down menu for replays)
And click on the row named "Game".
(Wait for Game to be loaded)
Now that our game is loaded, we can start the main task!

Main Task

What do you think should happen in the next three rounds?
(What do you think should happen in the next round?)

Could you briefly explain about what actually happened in these past three rounds?
(Could you briefly explain about what actually happened in the past round?)

Why do you think the rounds happened the way they did?
(Why do you think the round happened the way it did?)

Here is your sheet.
(You can summarise what happened in a phrase or a word here.)
(Gives participant worksheet and point to "what" line)
(You can also write or draw the good, the bad, and the interesting things you found about the Friendly AI or the rounds.)

Here is the AI's explanation for decision point _ (for why it did the things it did).
I want you to think aloud about why the Friendly AI did the things it did.
(Hands explanations to the participant)

(In case they click on a node, draw a "star" on it.
"Alright, so there's a catch: we just want to know if you wanted to click here, and see the branches. I will not be able to show you the actual branches. I'll just save your response.")

Would you allow the Friendly AI to make these decisions on ***your*** behalf?
What changes would you make in the decisions made by the Friendly AI to improve it?
Would you allow the Friendly AI to make this category of decisions on ***your*** behalf?

Post-Task Questionnaire

Great!
So we've completed the main task.
I would like to ask you a few questions, just for feedback.
After this, I would provide you with a formal post-task questionnaire as well.
So let's start.

1. In the main task, did you find these cards useful or not useful? *(show card)*
2. Did the process of the questions I asked you, help you understand and assess the AI better or did it hinder it?
3. Do you think the AI's diagrams have enough detail or not enough detail?
4. Did you understand that the AI only generates the diagram until a certain round? Did you find this information useful or not?
5. Did you find that knowing the AI uses a technique to evaluate the actions useful? Or was it not useful?
6. Would you prefer the width of the diagram to be narrower or wider? Or did you like it the way it is?
7. What kind of actions would you have liked to see on the diagram?
8. Is there any way you would have liked to interact with the diagram, apart from clicking on it?

Note: Can follow up with, "Could you elaborate on that?" or "Is there anything you wanted to add to that?" or "Can you explain more about that?"

Step 6: Summarize and formalize learning
Alright, finally, I would like you to complete a post-task questionnaire.
You may rewind through the game to help you answer these questions.
If you need clarification on a question or have any more questions, feel free to ask me.

(Gives Post-Task Questionnaire to participant)

(Participant finish questionnaire)
(Tutorializer prepares receipts and prepare money for participant)

(If questionnaire is not complete, give it back to the participant)
(If complete, continue script)

Okay.
I will have you sign these two receipts.
One for me, and one for you.
(Participant signs and give back the receipts)
Here is your money for completing the study.
Please don't discuss this study with anyone, as we don't want other participants to receive any information in advance.
Before you leave, make sure you have all your items with you.
Thank you for your time, and have a nice day!