

# A Human-AI Collaboration Study using the Geometry Friends Game

## Demographics, Gaming Habits and Previous Experience with AI

Before you start playing the game, please respond to the following questions concerning your demographic information, gaming preferences, and prior experience with artificial intelligence. This section will allow us to characterize the participants of the study.

### What is your age range? \*

- ☐ Under 18 years old
- ☐ 18-24 years old
- ☐ 25-34 years old
- ☐ 35-45 years old
- ☐ 45-55 years old
- ☐ 56-70 years old
- ☐ 70 and above

### What is your gender? \*

- ☐ Female
- ☐ Male
- ☐ Non-binary
- ☐ Prefer not to say

### What is your highest level of education? \*

- ☐ Less than a high school certificate (less than or equal to grade 12)
- ☐ High school certificate (grade 12 or equivalent)
- ☐ Higher Diploma (typically 1-2 years of post-secondary education)
- ☐ Bachelors (typically 3-4 years of post-secondary education)
- ☐ Master Degree (typically 1-2 years of post-graduate education following a bachelors degree)
- ☐ Doctorate (typically 3-5 years of post-graduate education following a master degree)

### How often do you play video games? \*

- ☐ Never
- ☐ Rarely (less than once a month)
- ☐ Sometimes (1-2 times per month)
- ☐ Often (1-2 times per week)
- ☐ Always (3 or more times per week)

**If it applies, please select the gaming devices you use to play.**

- ☐ Computer
- ☐ Console
- ☐ Mobile Phone
- ☐ Outros

**Are you familiar with puzzle video games? \***

- ☐ I don't know this game genre
- ☐ I am familiar with this genre and I played at least one game with this genre
- ☐ This game genre is one of my favourites
- ☐ None of the above

**Are you familiar with platformer video games? \***

- ☐ I don't know this game genre
- ☐ I am familiar with this genre and I played at least one game with this genre
- ☐ This game genre is one of my favourites
- ☐ None of the above

**Please rate how much you enjoy playing the following types of video games. If you do not play video games, please select "Does Not Apply".**

	Does Not Apply	Strongly Dislike	Dislike	Neutral	Like	Strongly Like
Competitive multiplayer games (games where players compete against each other to win)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Cooperative multiplayer games (games where players work together towards a common goal)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Single-player games (games that can be played alone)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Consider that "Artificial intelligence (AI) refers to the simulation of human intelligence in machines that are programmed to think like humans and mimic their actions. The term may also be applied to any machine that exhibits traits associated with a human mind such as learning and problem-solving." (Investopedia)

**Please rate the degree to which you agree or disagree with each of the following statements related to Artificial Intelligence.**

Prefer Not to Answer   Strongly Disagree   Disagree   Neutral   Agree   Strongly Agree

For routine transactions, I would rather interact with an AI system than with a human.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
AI can provide new economic opportunities for this country.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
AI systems can help people feel happier.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I am impressed by what AI can do.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I am interested in using AI systems in my daily life.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
AI can have positive impacts on people's wellbeing.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
AI is exciting.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
An AI agent would be better than an employee in many routine jobs.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
There are many beneficial applications of AI.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
AI systems can perform better than humans.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Much of society will benefit from a future full of AI.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I would like to use AI in my own job.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Organisations use AI unethically.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I think AI systems make many errors.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I find AI sinister.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
AI might take control of people.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I think AI is dangerous.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I shiver with discomfort when I think about future uses of AI.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
People like me will suffer if AI is used more and more.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
AI is used to spy on people.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

## Learn to play the game

To familiarize yourself with the controls of the game, you will now play a few single-player levels of the Geometry Friends game as the green rectangle character. Click "Next" once you believe you are ready for the next phase of the study - playing with an AI partner.

## Play the game with AI partner 1

Now you will have 5 minutes, as controlled by the experimenter, to play one or more levels of the Geometry Friends game, again as the green rectangle character, with **AI partner 1** playing as the yellow circle character. After the allocated time has passed, click "Next" to fill a post-gaming questionnaire.

## Post-Game Perceptions

Please answer the following questions related to your perceptions of AI partner 1, yourself, and the team after completing the previous levels.

### How well do the words presented apply to AI partner 1?

	Absolutely inappropriate	Inappropriate	Slightly inappropriate	Neutral	Slightly appropriate	Appropriate	Absolutely appropriate
Pleasant	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Sensitive	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Friendly	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Helpful	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Affable	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Likeable	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Approachable	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Sociable	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Intelligent	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Organized	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Expert	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Thorough	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

**In the levels you just played with AI partner 1, how satisfied are you with...**

	Very dissatisfied	Dissatisfied	Slightly dissatisfied	Neutral	Slightly satisfied	Satisfied	Very satisfied
your performance?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
your AI partner performance?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
the overall team performance?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

**Concerning AI partner 1, how much do the following statements apply to the human-AI team you were a part of?**

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
I feel strong ties with this team.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I experience a strong sense of belonging to this team.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I feel proud to work in this team.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I am sufficiently acknowledged in this team for my expertise.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I am glad to be a member of this team	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

## **AI Partner Behaviour and Collaboration Strategies**

Please answer the following questions related to the behaviour of AI partner 1 and the collaboration techniques employed during the game levels you just completed.

**How challenging did you find the levels played with AI partner 1? \***

- ☐ Very difficult
- ☐ Difficult
- ☐ Moderate
- ☐ Easy
- ☐ Very easy

**How much initiative did AI partner 1 show during the previous levels of the game? Initiative refers to the extent to which the AI partner followed their own plan or made decisions independently, rather than simply following the participant's lead. \***

- ☐ None at all
- ☐ A little

- ☐ Moderate
- ☐ A lot
- ☐ A great deal

**How much did the initiative level of AI partner 1 shift within each one of the previous levels? Please consider whether this AI partner changed from showing a lot of initiative (following their own plan) to showing no initiative (following the participant's lead) or vice versa within the same level. If you did not observe any change of initiative level within a level, please select "Not at all". \***

- ☐ Not at all
- ☐ A little
- ☐ Moderately
- ☐ A lot
- ☐ A great deal

**Please describe the specific strategies you used to collaborate with AI partner 1 to finish the previous game levels. How did you communicate and coordinate with this AI partner, and what techniques or approaches did you find most effective? \***

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## Play the game with AI partner 2

Now you will have 5 minutes, as controlled by the experimenter, to play one or more levels of the Geometry Friends game, again as the green rectangle character, with **AI partner 2** playing as the yellow circle character. After the allocated time has passed, click "Next" to fill a post-gaming questionnaire.

## Post-Game Perceptions

Please answer the following questions related to your perceptions of AI partner 2, yourself, and the team after completing the previous levels.

**How well do the words presented apply to AI partner 2?**

	Absolutely inappropriate	Inappropriate	Slightly inappropriate	Neutral	Slightly appropriate	Appropriate	Absolutely Appropriate
Pleasant	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Sensitive	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Friendly	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Helpful	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Affable	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Likeable	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Approachable	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Sociable	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Intelligent	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Organized	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Expert	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Thorough	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

**In the levels you just played with AI partner 2, how satisfied are you with...**

	Very dissatisfied	Dissatisfied	Slightly dissatisfied	Neutral	Slightly satisfied	Satisfied	Very satisfied
your performance?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
your AI partner performance?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
the overall team performance?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

**Concerning AI partner 2, how much do the following statements apply to the human-AI team you were a part of?**

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
I feel strong ties with this team.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I experience a strong sense of belonging to this team.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I feel proud to work in this team.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I am sufficiently acknowledged in this team for my expertise.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I am glad to be a member of this team	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

## AI Partner Behaviour and Collaboration Strategies

Please answer the following questions related to the behaviour of AI partner 2 and the collaboration techniques employed during the game levels you just completed.

**How challenging did you find the levels played with AI partner 2? \***

- ☐ Very difficult
- ☐ Difficult
- ☐ Moderate
- ☐ Easy
- ☐ Very easy

**How much initiative did AI partner 2 show during the previous levels of the game? Initiative refers to the extent to which the AI partner followed their own plan or made decisions independently, rather than simply following the participant's lead. \***

- ☐ None at all
- ☐ A little
- ☐ Moderate
- ☐ A lot
- ☐ A great deal

**How much did the initiative level of AI partner 2 shift within each one of the previous levels? Please consider whether this AI partner changed from showing a lot of initiative (following their own plan) to showing no initiative (following the participant's lead) or vice versa within the same level. If you did not observe any change of initiative level within a level, please select "Not at all". \***

- ☐ Not at all
- ☐ A little
- ☐ Moderately
- ☐ A lot
- ☐ A great deal

**Please describe the specific strategies you used to collaborate with AI partner 2 to finish the previous game levels. How did you communicate and coordinate with this AI partner, and what techniques or approaches did you find most effective? \***

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## Play the game with AI partner 3

Now you will have 5 minutes, as controlled by the experimenter, to play one or more levels of the



Geometry Friends game, again as the green rectangle character, with **AI partner 3** playing as the yellow circle character. After the allocated time has passed, click "Next" to fill a post-gaming questionnaire.

## Post-Game Perceptions

Please answer the following questions related to your perceptions of AI partner 3, yourself, and the team after completing the previous levels.

### How well do the words presented apply to AI partner 3?

	Absolutely inappropriate	Inappropriate	Slightly inappropriate	Neutral	Slightly appropriate	Appropriate	Absolutely appropriate
Pleasant	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Sensitive	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Friendly	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Helpful	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Affable	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Likeable	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Approachable	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Sociable	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Intelligent	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Organized	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Expert	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Thorough	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

### In the levels you just played with AI partner 3, how satisfied are you with...

	Very dissatisfied	Dissatisfied	Slightly dissatisfied	Neutral	Slightly satisfied	Satisfied	Very satisfied
your performance?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
your AI partner performance?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
the overall team performance?	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Concerning AI partner 3, how much do the following statements apply to the human-AI team you were a part of?

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
I feel strong ties with this team.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I experience a strong sense of belonging to this team.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I feel proud to work in this team.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I am sufficiently acknowledged in this team for my expertise.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I am glad to be a member of this team	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

## AI Partner Behaviour and Collaboration Strategies

Please answer the following questions related to the behaviour of AI partner 3 and the collaboration techniques employed during the game levels you just completed.

**How challenging did you find the levels played with AI partner 3? \***

- ☐ Very difficult
- ☐ Difficult
- ☐ Moderate
- ☐ Easy
- ☐ Very easy

**How much initiative did AI partner 3 show during the previous levels of the game? Initiative refers to the extent to which the AI partner followed their own plan or made decisions independently, rather than simply following the participant's lead. \***

- ☐ None at all
- ☐ A little
- ☐ Moderate
- ☐ A lot
- ☐ A great deal

**How much did the initiative level of AI partner 3 shift within each one of the previous levels? Please consider whether this AI partner changed from showing a lot of initiative (following their own plan) to showing no initiative (following the participant's lead) or vice versa within the same level. If you did not observe any change of initiative level within a level, please select "Not at all". \***

- ☐ Not at all
- ☐ A little
- ☐ Moderately
- ☐ A lot
- ☐ A great deal

**Please describe the specific strategies you used to collaborate with AI partner 3 to finish the previous game levels. How did you communicate and coordinate with this AI partner, and what techniques or approaches did you find most effective? \***

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## AI Partner Preference

Please answer the following questions concerning your preference on the AI partners you have played with.

**Which of the following AI partners did you enjoy playing with the most? \***

Please Select

**Please explain why you enjoyed playing with the AI partner you selected the most. What specific aspects of their behaviour or gameplay style made them the most enjoyable to play with? \***

## Review your answers

Please take a moment to thoroughly review your responses by clicking on the "Review Answers" button before submitting your form. This will ensure that all of your answers for each AI partner are accurate and complete. If everything looks good, feel free to submit the form. However, if there are any changes that you would like to make, simply navigate back to the relevant sections of the form.

Submit