

response

**Ukie response
to the House
of Lords Select
Committee
on Artificial
Intelligence's
call for
evidence**

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ukie

THE ASSOCIATION FOR UK INTERACTIVE ENTERTAINMENT

Introduction

UK Interactive Entertainment (Ukie) welcomes the opportunity to respond to this inquiry. Our response is intended to provide the Committee with a robust understanding of the role the games industry is playing in the development of artificial intelligence (“AI”), as well as the innovative and creative uses of AI pioneered by the games industry, and why our sector stands to benefit from its continuing development. We also explore how the games industry can play a role in helping improve the public’s engagement with AI, and understanding of the innovative new experiences and tools for creativity it presents. Finally, we outline the creative and computational skills we believe will be fundamental to the growth of the UK’s economy, particularly in light of more widespread use of AI, and what role the government can play in supporting the development of these skills.

About Ukie

Ukie (UK Interactive Entertainment) is the trade body for the UK’s games and interactive entertainment industry. A not-for-profit, it represents games businesses of all sizes from small start-ups to large multinational developers, publishers and service companies, working across online, mobile apps, consoles, PC, eSports, Virtual Reality and Augmented Reality.

Ukie aims to support, grow and promote member businesses and the wider UK games and interactive entertainment industry by optimising the economic, cultural, political and social environment needed for businesses to thrive.

About the UK games industry

The UK games and interactive entertainment industry is an international success story, with the potential to take an ever-larger export share of a global market that will soon be worth

more than \$99 billion.¹ The UK is already well positioned as a significant player in this field and is currently estimated to be the sixth largest video games market in terms of consumer revenues, with an estimated worth of £4.33bn.²

The UK games industry blends the best of British technological innovation and creativity, resulting in successful games and technology which are exported around the world and which cross over into other creative sectors. By way of illustration, *Grand Theft Auto V*, the biggest-selling entertainment product of all time (generating \$1 billion in global revenues in just three days following its release), and ground-breaking video games, such as the *Batman Arkham* trilogy, *No Man's Sky* and *Elite* are the brainchildren of UK developers.

The games industry is also playing a leading role in the development of emerging technologies such as AI as well as big data analysis, virtual reality and augmented reality which are each expected to drive high value growth markets in the games industry as well as other sectors like health and education.

The pace of technological change

Artificial Intelligence & the games industry

This section addresses elements of questions 1, 4 and 6 of the Committee's questions. It will firstly set out the important role that the games industry has played in the research and development of AI, and secondly highlight the innovative and creative ways that AI has been used by the games and interactive entertainment industry to create compelling new experiences for players. It will conclude by explaining how the industry stands to benefit from its ongoing development.

The games industry's role in the development of artificial intelligence

In March 2016, a historic milestone for AI was reached when the Google DeepMind's program, AlphaGo, defeated the world-class Go champion Lee Sedol in the ancient board

¹ <https://newzoo.com/insights/articles/global-games-market-reaches-99-6-billion-2016-mobile-generating-37/>

² <http://ukie.org.uk/research#Market>

game with more possible moves than atoms in the universe.³ This advancement rightly garnered significant global media attention,⁴ and highlighted the important role that games play in the development of AI.

Since as early as 1949, when Claude Shannon published his thoughts on how a computer might be made to play Chess⁵ and 1951 when Alan Turing published his famous algorithm TurboChamp⁶, computer scientists have been using games as an effective tool to measure how good a computer can become at performing specific tasks that challenge the human intellect.

The AI community has made it very clear that they view videogames as the best platform to use to advance AI. In the last twelve months, arguably the two biggest AI research companies in the world - Google's UK-based DeepMind, and Elon Musk's OpenAI - have both made important commitments to using videogames as the main platform for their research. DeepMind is using Atari games as the primary test case for their deep learning research, and recently announced they are partnering with Activision Blizzard to build AI for *Starcraft 2*. In August 2017, OpenAI announced they are partnering with Valve Software to build an AI for *DOTA 2*. In both cases, videogames are seen as a rich and complex environment for AI to tackle, while still being a controllable environment and providing a huge amount of feedback.

AI researchers are continuing to find games to be an invaluable tool for a number of reasons. Firstly, games can provide AI a safe training ground to gather data which can then be used and adapted to the real world. By way of illustration, last year, AI researcher Artur Filipowicz of Princeton University discovered that the immensely popular – UK developed - game *Grand Theft Auto V* could be used to help develop an appropriate algorithm for autonomous vehicles to recognise stop signs. By making small modifications to the game, he was able to develop software that could navigate the traffic and read stop signs. *Grand*

³ <https://research.googleblog.com/2016/01/alphago-mastering-ancient-game-of-go.html>

⁴ <http://www.theguardian.com/technology/2016/mar/09/google-deepmind-alphago-ai-defeats-human-lee-sedol-first-game-go-contest>

⁵ <http://www.andreykurenkov.com/writing/a-brief-history-of-game-ai/>

⁶ <http://www.andreykurenkov.com/writing/a-brief-history-of-game-ai/>

Theft Auto V has winding city streets, mountains, and highways that can be explored in 257 different cars through 14 different weather simulations, making it an ideal simulated test-driving range for autonomous cars. This discovery subsequently led to OpenAI, in partnership with the DeepDive Project, releasing an open-source integration that enables *Grand Theft Auto V* to be used as a driving simulator for autonomous vehicles software, thereby notably accelerating the development of self-driving vehicle technology and making it cheaper, more accessible and safer than test driving autonomous vehicles on physical roads.⁷

Secondly, games offer researchers repeatable and safe learning environments which help machines improve their learning skills. For instance, DeepMind exposed its AI agent to Atari games without first teaching it how to play these games. The DeepMind program was eventually able to master all the Atari games it played, demonstrating how the repeatable and controlled environment of video games can enable AI agents to learn on their own.⁸

Thirdly, because different games require different cognitive skills, numerous AI researchers believe that games play a crucial role in helping them understand how the problem of intelligence can be broken down into smaller, more manageable chunks, and could potentially even help to develop a proper AI theory.⁹ By exposing its agent to Atari games and identifying which ones it found harder to master, DeepMind researchers were able to determine what tasks their agent struggled to achieve and improve their algorithms accordingly. They published research into how, by understanding why their agent failed at the Atari game *Montezuma's Revenge*, they could adapt its agent to be more curious, thereby enabling it to become more likely to develop good problem-solving strategies.¹⁰ The advancements made in this area by DeepMind were not only confined to mastering skills in a virtual world, but have been used to solve real world problems like reducing energy usage in Google's data centres by 40%.¹¹

⁷ <https://www.inverse.com/article/26307-grand-theft-auto-open-ai>

⁸ <https://deepmind.com/research/publications/playing-atari-deep-reinforcement-learning/>

⁹ <https://www.economist.com/news/science-and-technology/21721890-games-help-them-understand-reality-why-ai-researchers-video-games>

¹⁰ <https://deepmind.com/research/publications/unifying-count-based-exploration-and-intrinsic-motivation/>

¹¹ <https://deepmind.com/blog/deepmind-ai-reduces-google-data-centre-cooling-bill-40/>

By providing an ideal training ground for the real world, games and game technology have been invaluable tools for AI researchers to test and improve their systems, and the games industry therefore stands to continue to play a significant role in the future development of AI.

The use and development of artificial intelligence within the games industry

The games and interactive entertainment industry has not only provided valuable tools for AI researchers from other fields, but is itself a sector which has significantly benefitted from developing and using AI as a creative tool to continuously create innovative, engaging and high-quality experiences for its consumers.

AI is fundamental to bringing virtual worlds to life and determining the way a player interacts with a game. It has been used as a tool in the games industry since not long after the origins of video games, where it was initially designed for creating non-player opponents in classic arcade games like *Pong* and *PacMan*.¹² Games companies continue to research and push the boundaries in creating more realistic, human-like opponents and companions for video games. For example, EA's SEED team recently developed a goal-based multi-action AI character that learns how to play a video game from using only visual and audio inputs that a human would have playing a game.¹³

As games have grown increasingly sophisticated, AI has been used to make games more entertaining and challenging to players, by allowing games developers to build engaging non-player characters (NPCs) and model the way NPCs interact, to simulate events taking place within games, as well as discerning the emotional state of a player and tailoring the game appropriately. A notable example of how AI enables games developers to create more compelling and rich experiences for players is the smash hit game franchise, *The Sims* which provides players with a household of intelligent characters who form relations and develop behaviours that emulate emotional depth and authenticity.¹⁴

¹² https://sites.google.com/site/myangelcafe/articles/history_ai

¹³ <https://twitter.com/seed/status/894708178289602561>

¹⁴ <https://www.theguardian.com/technology/2016/oct/12/video-game-characters-emotional-ai-developers>

The games industry provides a powerful example of a sector where advancements in technology have continuously enabled and fuelled the development of new forms of expressions and creativity. Similarly to how advances in motion sensing and capture technology spurred the development of a new generation of gaming systems, such as Microsoft's Kinect and Nintendo's Wii, operated through body movements rather than controllers, developments in AI are empowering games developers to create more compelling and realistic characters and richer worlds for their players.

Moreover, it is envisaged that developments in conversational interfaces, powered by AI, will change the way we interact with video games. For example, instead of a game using a dialogue menu system players will be able to use words to interact with non-player characters (NPCs). Thereby making NPCs feel more lifelike and helping to build more meaningful relationships between game characters and humans. Conversational interfaces could also help interact with games while offline (e.g. by telling a voice assistant to auction off certain in-game items without even entering the game).

Advances in AI are not only impacting characters inhabiting virtual worlds, but every aspect of game development. For example, procedural generation - the use of algorithms to create part of a game - has led to the development of huge games like *Minecraft* and *No Man's Sky*, which can create seemingly endless bespoke worlds while the player is playing. The UK developed game *No Man's Sky*, demonstrates the innovative and imaginative player experiences that can be created through using AI, by placing players in the role of an astronaut exploring a cosmos made of 18 quintillion procedurally generated life-size planets which each feature their own life, ecology, lakes, caves and canyons.¹⁵

Developments in AI have consistently provided games businesses with new tools to experiment and innovate with. As a sector we therefore stand to benefit from its continued use and advancement.

¹⁵ <https://www.theguardian.com/technology/2015/jul/12/no-mans-sky-18-quintillion-planets-hello-games>

The future of artificial intelligence in the games industry over the next decade

Developments in AI are also impacting the way games are designed and produced. Massive open world games, like *No Man's Sky*, would have traditionally required large teams of developers (and associated development budgets) to design and draw every element of their game, but now, by using AI, such games can be produced by much smaller teams of game developers. This provides new creative development opportunities for start-ups and independent games studios and helps further democratise games development.

Advances in AI are also beginning to change the way game developers are working. By way of illustration, at the 2017 London Games Festival's AI Summit, Imre Jele - co-founder of UK-based Bossa Studios, makers of the best-selling game *Surgeon Simulator* - gave a talk titled "Your Next Hire Should Be An AI", where he explained how Bossa Studios is using generative AI algorithms to contribute ideas and art assets to their art team. This highlighted how AI could bring significant changes to the way games companies are run, the scale of what they can achieve, and the way they contribute to the UK economy.

Moreover, as the preceding example demonstrates, these advances in AI could potentially transform the role computers play in the games development process: from simple tools employed by developers to becoming genuine collaborators in the creative process. Julian Togelius, a Professor at New York University's School of Engineering and AI consultant at British-based games startup Spirit AI, explains how game engines could use procedural generation, AI, and creative computing techniques to dynamically build environments and experiences to suit every individual player's unique desires.¹⁶ Similarly, AI developments could enable non-player characters to themselves generate new stories and dialogue based on player preferences entirely unique to that player's individual experience. In both examples, the traditional games design process is altered as the role of the games designer becomes to design a set of rules which vests creative power in AI to then invent and develop experiences for players itself.

¹⁶ <http://pcgbook.com/>

These recent and forthcoming developments help to convey the significant creative potential of AI developed and applied in the games industry both in terms of empowering game developers to explore wholly new ways of creating games, and by offering players innovative interactive entertainment experiences that are uniquely relevant to them.

Public perception

The way new technologies and their risks and benefits are presented can markedly influence their development, regulation and place in public opinion. We believe that the games industry can play an important role in both helping to improve the public's engagement and technical understanding of AI, as well as foster a positive perception of AI and the innovative new experiences and tools for creativity it offers to players and creators alike.

A major barrier to the widespread adoption of AI across society is overcoming some of the misconceptions and fears people might have, which can often come from a lack of everyday experience in interacting with intelligent software. Games provide a unique opportunity to prepare society for the future, offering them a safe space where people can take risks, make mistakes and be curious about AI.

Unlike other playful AI tools, like photo filters on smartphones, games are a two-way immersive interactive entertainment experience resulting in players interacting with an AI and seeing the results. They are, therefore, a great medium for people to learn how to interact and engage with AI systems, which is an important area of research for AI, especially in enabling greater safety of systems. There is already a wide range of games driven by their AI¹⁷, such as *Black And White* (in which players train a machine learning system, under the guise of training an animal) or *Alien: Isolation* (in which players must understand the strengths and weaknesses of an AI, represented as a dangerous alien). Both of these milestone AI-based games were developed by UK game developers.

¹⁷ <http://julian.togelius.com/Treanor2015AIBased.pdf>

Games also serve as an effective medium to capture the public' imagination and drive enthusiasm for the creative potential and uses of AI. *No Man's Sky*, for examples, offers a vivid depiction of the artistic possibilities opened up by AI, by providing players the opportunity to marvel and explore beautiful and expansive planets, in which every rock, flower, tree, creature and scene is generated by an AI algorithm.

Moreover, by acting as an example for the ways AI can empower and fuel human creativity, the games industry can be used to help develop the public's understanding of the various opportunities that exist for society in the development and use of AI. AI presents huge potential to unlock individual creativity in areas that traditionally have a high barrier to entry. The creation of videogames is a good example of this, as it requires many artistic and technical skills to create even a simple game. Over the next decade, academics predict that we will see the emergence of 'computationally creative' AI systems that can tackle highly creative problems, which historically have been problematic for AI. Dr. Michael Cook at Falmouth University has done work in this area that vividly demonstrate this.- His ANGELINA¹⁸ system has created videogames on its own as well as in conjunction with humans, and is designed to be able to explain its actions, understand cultural references and common knowledge, and be inventive and novel.

Creative AI that can work with people and converse with them about creative tasks could change everyday creative expression, making it easier and increasing everyone's potential for creating and sharing things like videogames. Increasing the public's understanding of the creative opportunities presented by the development of AI is important to foster an informed and balanced perspective on how AI will impact society.

Impact on society and the role of the Government

The development and widespread uses of AI across all sectors of the UK economy will continue to significantly increase demand for individuals with critical, creative,

¹⁸ <http://www.gamesbyangelina.org/>

computational, and problem-solving skills. There is a significant role for the government to invest in the digital and creative skills needed to support a strong UK economy, especially in light of the well documented digital skills gap.¹⁹ This can best be achieved by focusing on the education curriculum, teacher training and digital inclusion. For example, whilst a renewed focus on coding in the curriculum is very welcome, it is important that teachers are fully trained in how to deliver it, and that government supports their training.

Students need to be prepared for a future where robotics and AI are commonplace, and our education system should be developing the cognitive skills that are not easy to automate. By way of illustration, if AI is widely used in games development as a tool to create personalised content and experiences for players, as described above, the skills required of certain games developers could evolve; they will need new skills to successfully design sets of rules and instructions from which an AI can help create a game.

This inevitably calls for a deeper understanding of computational and systems thinking, as games designers would in essence be designing sets of rules through which creativity can arise. Therefore, to prepare the future workforce for the widespread use of AI, they need to be equipped with the computational thinking skills necessary to conceive and design systems, as well as the creative skills to manipulate technology to deliver an innovative outcome. Supporting the development of creative skills alongside technical ones is crucial as innovation inherently relies on artistic and creative thinking.

In recent years Ukie has been at the forefront of advocating for changes to the UK's educational system to ensure that the creative, computational and critical thinking skills needed for the future growth of the UK's economy are properly embedded in schools and classrooms.²⁰ The Ukie-led teach training program Digital Schoolhouse empowers, supports and trains teachers in their delivery of the computer science curriculum by providing creative workshops where both teachers and pupils learn about computing fundamentals through

¹⁹ We're Just Not Doing Enough - Working Together to meet the Digital Skills Challenge, Tech UK 2015

²⁰ <http://ukie.org.uk/content/next-gen-skills-campaign-launched>

play-based learning techniques. Our national programme has established over 20 Digital Schoolhouses across the UK, which collectively supports almost 2000 teachers and over 10,000 pupils each year.

Conclusion

To conclude, we hope our response has highlighted to the Committee: (i) the important role the games industry is playing in the development of artificial intelligence, (ii) the creative ways AI is being harnessed by our sector to create innovative and engaging interactive entertainment, and (iii) how games can be used as a tool to increase the public's understanding and engagement with AI. Whilst, the games industry stands to benefit from the continued development and use of AI, we believe that there is a clear role for government to further support the development of the critical, creative and computation skills that will be vital to developing and using AI as well as equipping our workforce with the skills needed for the future growth of the UK economy.

Point of contact

We remain at the Committee's disposal to answer any questions or elaborate on the points made in our response. In this regard please feel free to contact Marianna Drake at marianna@ukie.org.uk or 0207 534 0584.