Published by :
https://www.ijert.org/
An International Peer-Reviewed Journal

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 15 Issue 11 , November - 2026

The Impact of Artificial Intelligence on Games: Challenges, And Future Directions

Jaib J. Shaikh, Rubul B. Gogoi, Mohamed Jishan Sheikh, Shlok A. Madri, Dr. Siddhantkumar V. Wadmare

Department of Animation, School of Design, Dr. D.Y. Patil Vidyapeeth, Pune, India

Abstract - There have been drastic changes within the gaming industry due to the development of new technologies. In particular the use of Artificial Intelligence (AI) within games. This study looks at how AI can be used throughout a game's development, including game design, character behaviour and player experience. It will also look at how AI is aiding developers to create more interactive and realistic games. Overall this research will look to understand how AI is currently being used in the gaming industry, what benefits it provides and any challenges that come with its usage. This will include looking at how AI can affect the future of game development. It discusses how the AI is used to create smart game characters, enhance game design , support animations, and adjust gameplay to match different players' behaviour. The paper also explores the advantages and challenges of using AI including challenges related to ethics and technology. Finally, it explores the future development of AI in the gaming and how it can be continue to improved gameplay quality, player experience and future development and innovation in the gaming industry

KEYWORDS - Artificial Intelligence, Gaming Industry, Game Development, Game Design, Player Experience, Machine Learning, Future of Gaming.

I. INTRODUCTION

Gaming is a entertainment form where people interact with digital environment such as characters and challenges through electronic devices such as computers, mobile phones and gaming consoles.the gaming industry has grown over the years,from a small form of digital entertainment into one of the Major parts of modern technology and media, in the beginning games were simple like basic graphics,a fewer interactive features and limited controls.most of the characters followed fixed movements and players had the limited ways to interact with the game world. as (AI) technology developing the gaming industry also started changing. like new softwares, powerful hardware advanced graphics,and better animation techniques which helped the developers to create more detailed environments and realistic characters etc. games slowly moved from a simple 2D design to the large 3D worlds where players where they could explore,interact and experience in different situations.gaming is not only about completing levels or winning challenges today. It also about creativity, storytelling, exploration and creating experience in the field and feel closer to the real life. Artificial intelligence had become another most important part of this development, helping game characters respond to players,making gameplay more dynamic,and bringing new possibilities to game design and the development.

Artificial intelligence (AI)

Artificial intelligence is commonly known AI, the technology that allows computers and machines to perform tasks that usually require human intelligence . Like we use in simple words, AI means making machines smart enough to learn the information,and understand situation, solving problems , and make decisions just like humans learn from their experiences, AI systems use data and computer algorithms to improve the Way of work they do. in the gaming industry AI is used to make characters behave more naturally, create challenges, react to player action, and improve the overall the gaming experience , As the technology continues to develop , AI is becoming An important Part of how modern games are designed developed and played.

Use Of Artificial Intelligence In Gaming

Artificial intelligence has become one of the important part of modern video games because it helps in make the gaming experience and more realistic,interactive and enjoyable. in the games AI works by following programmed instructions ,analysing the player actions, and deciding how the characters and other elements should respond. For an example,when a player moves or attacks, hides or changes direction (AI) - controlled characters can react according to the situation instead of repeating the same actions each and every time. Artificial intelligence is also used to control enemy movements , adjust game difficulty, improve character behaviour, and create more challenging for players in some modern games, it can help generate landscape,missions dialogues and the other game elements.

(This work is licensed under a Creative Commons Attribution 4.0 International License.)

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 15 Issue 11 , November - 2026

Changes brought by Ai in the gaming industry

Artificial intelligence has brought so many changes to the way modern video games like - look, work and feel earlier, and game characters followed limited movements and repeated the same actions but now artificial intelligence helps them react to a different situation and behave more naturally. It has also improved character movements enemy behaviour, and the interactions within the game . With the help of AI and other advanced technologies, developers can create more detailed in the environments , realistic animation, and the visual impressive game worlds. Another major change is the player experience,as games can now adjust challenges respond to the player decisions, add offer different types of experiences based on how someone plays. This all improves to make games more interactive and enjoyable, giving players a strong feelings of being a part of the virtual world.

1. OBJECTIVE OF RESEARCH

This research is about the influence of gaming through artificial intelligence and the development of the gaming field and players. This research is based on previous studies on the advantages, disadvantages, and future development of AI. [1]

1. Impact on Game Design

To understand the influence of AI in game design, character development, and auto-generating content. Researchers Summerville et al. [4] and Lai et al. [2] have studied these changes.

2. Effects on Gaming Experience

To investigate the impact of AI on player interactions with each other, game difficulty, and player experience in general. [11] Hunicke: The case for using adaptive game difficulty to match player skills.

3. Problems and Limitations

To discuss challenges of AI implementation in gaming technical challenges, copyright, and ethical issues. Melhart, S., et al. Game AI Ethics. Copyright Protection for Works of Artificial Intelligence, U.S. Copyright Office, 2020.

4. Future Direction

To explore the future of artificial intelligence (AI) technologies and the potential advantages they may bring to games, game design, players, and the industry. Farrokhhi Maleki and Zhao [16] review recent advances in automatic game content generation and suggest possible future research directions.

II. LITERATURE REVIEW

Multiple researchers have looked at the impact of AI within the gaming industry. Togelius and Yannakakis showed how AI is becoming an increasingly useful tool for game design, player models, and NPC's. This helps games to become more realistic and engaging through implementing intelligent characters into their games.Risi and multiple other researchers have shown how AI can be used to design game content automatically. These studies demonstrated how AI can be used to generate new game levels, maps, characters and environments automatically. This cuts down the amount of time spent designing but provides more varied content.

Karaca, Derias, and Sarsar looked at how AI can be used with procedural content generation to improve NPC's. Their research concluded that using methods like reinforcement learning, neural networks, and Natural Language Processing have made NPC's more adaptable, interactive and provide a more immersive experience.Recent studies have looked at using Large Language Models (LLMs) within Video Games. Researchers have shown that LLM's can be used to create dynamic dialogue, interactive stories and adaptive NPC conversation. However, challenges have been encountered such as computational costs, accurate responses and narrative consistency.

Overall it has been shown from previous research that AI has had a huge impact on improving games. However, researchers agree that challenges need to be overcome such as ethical concerns, copyright issues, computational needs and responsible use of AI.

What is Artificial Intelligence?

Artificial Intelligence (AI) refers to the ability of computer systems to perform tasks that normally require human intelligence. These tasks include learning from data, recognising patterns, solving problems, making decisions, and adapting to new situations. AI systems use algorithms and large amounts of data to analyse information, improve their performance over time, and provide accurate

(This work is licensed under a Creative Commons Attribution 4.0 International License.)

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 15 Issue 11 , November - 2026

responses based on different scenarios.

Today, AI is widely used in various fields, including healthcare, education, finance, transportation, entertainment, and gaming. In the gaming industry, AI plays a significant role in creating intelligent game systems that enhance the overall gaming experience. It enables game characters to respond naturally to player actions, make decisions based on changing situations, and provide more realistic interactions within the game environment.

Use of Artificial Intelligence in Gaming

Artificial Intelligence has become an essential part of modern game development by improving the quality, realism, and interactivity of video games. It enables game systems to analyse player actions and respond intelligently, making gameplay more dynamic and engaging. Unlike traditional games that rely on fixed patterns and repetitive behaviours, AI-powered systems allow game characters to adapt to different situations and react according to the player's decisions.

One of the most common applications of AI in gaming is controlling the behaviour of non-player characters (NPCs). AI enables NPCs to make decisions, navigate complex environments, respond to player movements, and perform actions that create a more realistic gaming experience. As a result, players encounter less predictable and more challenging gameplay.

III. RESEARCH METHODOLOGY

This is qualitative research. The research is based on reviewing literature concerning issues of AI in gaming and gaming in the future. The objective of the research is to review previous studies on the usage of AI in gaming and its pros and cons as well as future perspectives. As Snyder [19] notes, literature review can represent a method of research in which existing literature is reviewed.

1. Methods of Research

In this case, qualitative research based on literature review is adopted instead of performing some kind of experiments. As it is noted by Snyder (1999), the research based on the literature review can provide an opportunity to enhance the existing body of knowledge.

2. Collection of Data

This research relies on journals, conference papers, books, and other materials related to AI and game development. The research regarding AI in games as conducted by Yannakakis and Togelius [1] and by Summerville et al. [4] is of great use for the purposes of this research.

3. Review of Literature

The literature review is made to present the contribution of AI to game development, players, and the gaming industry in general.

4. Choice of Research Documents

Research documents will be selected based on their relevance, reliability, and value. As in this context, Grant and Booth mention different kinds of literature reviews and the essentiality of choosing the right type of literature review.

5. Results of Research

This part presents the results that have been obtained from readings concerning the influence of AI on the gaming sphere. It also highlights the difficulties and perspectives gained from what was investigated earlier on this issue.

IV. ROLE OF ARTIFICIAL INTELLIGENCE IN GAMING

1. Game development

AI has become useful in the game development as it helps developers with different tasks such as designing levels and creating game content. It can reduce the amount of repetitive work and allow the developers to spend more time on creative ideas. Lai et al [2] have discussed how AI based tools can assist human designers in creating game content and supporting the development process.

2. Non-player character (NPCs)

Non-player characters (NPCs) are characters in the game that are not controlled by the players. AI have helped these characters to make decisions, react to player actions and behave according to different situations in the game. For example, enemy characters may follow the player’s take cover or change their actions during combat. Yannakakis and Togelius [1] discussed how AI techniques are used to improve the behaviour of NPCs and make the gameplay more interactive.

(This work is licensed under a Creative Commons Attribution 4.0 International License.)

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 15 Issue 11 , November - 2026

3. Game Design and Animation.

AI has also been used in game design and character animation. I can help developers create the character movements that look more natural and realistic. This is especially useful in games where characters need to walk, run, turn, or react to different situations. As Holden et al. [3] has developed a neural network method for generating the character movements showing how machines learning can be useful to improve animation and make character motion smoother.

4. Automatic Content Creation

Creating the game levels maps and environment manually can take a long time . AI can also help the developers by generating some of their content automatically. This process is called procedural content generation. It also allows developers to create different types of game content without having to create every detail manually. Summerville et al [4] studied how machine learning can be used in procedural content generation and explained how AI can learn from existing game content to create new levels and environments.

5. Game Testing

Game testing is an important part of game development because it helps developers to find problems before a game is released. AI can be used to test different gameplay situations such as identifying possible issues and examining how a game performs. It can also help to reduce the need for repeating the same testing task manually . Bergdahl et al [5] explored how deep reinforcement learning can use for AI based game testing, especially for finding problems in gameplay and checking how difficult the game maps are.

V. IMPACT OF ARTIFICIAL INTELLIGENCE IN GAMING

1. Player Experience

AI has helped to make games more interactive and enjoyable for players. It allows the game character and gameplay to change based on their actions of the players. Yannakakis and Togelius [1] have already discussed how AI can be used to study player behaviour and understand how different players play the game. This helps the developers to create the game that suits different playing styles.

2. Realistic Gameplay

AI helps to make gameplay feel more natural by improving how the game characters interact with the players. For example AI controlled the characters can respond to player actions and take part in the conversation. Peng el at. [6] studied how the Large Language Models (LLMs) can be used in game stores and character conversations. Their research showed how the AI can help to create the different conversations and make the interactions with the game characters more interesting.

3. Impact on E-sports

AI had also been used in the study of e-sports and competitive gaming. It can also help to analyse the player's performance and understand the skills needed in competitive games. Jing et al. [7] used machine learning to study how professional Counter-Strike (CS) players and found the important factors that affect their performance. Researchers have also studied how AI can help detect cheating in online multiplayer games [8]. This can help the developers to improve fair play in competitive games.

4. Impact on game developers

AI is changing the way game developers work. It can also help with tasks such as writing code , creating game assets and designing the games. Heslinga et al. [9] have studied how the game studios are using generative AI and discussed its benefits and challenges. Xing et al. [10] also discussed how AI may change the work of game developers and why learning new technical and creative skills may become important in the future.

VI. BENEFITS OF ARTIFICIAL INTELLIGENCE IN GAMING

1. Faster Game Development

AI helps the game developers to complete the task in less time. It can be used to create the game levels, maps, and other game content. Summerville et al. [4] have studied how the machine learning fan creates new game content by learning from existing examples. This can help the developers to save time and focus on other parts of the game development .

2. Personalised Gameplay

Ai can also change the difficulty level of a game based on how well a player is performing. For example, if a player finds a game

(This work is licensed under a Creative Commons Attribution 4.0 International License.)

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 15 Issue 11 , November - 2026

too difficult, the difficulty can be reduced. If the game becomes too easy it can become more challenging. Hunicke [11] studied a method called dynamic difficulty adjustment where the game changes its difficulty during the gameplay. This helps to keep the game challenging and enjoyable for different players.

3. Improved game Design

AI dan also help the game designer to create levels, maps, and other game content. It gives the developers more ways to explore the different designs and ideas. Lai et al. [2] reviewed how AI tools can work together with human designers to create game content. These methods can make the design process easier while allowing developers to make their own creative decisions.

VI. CHALLENGES OF ARTIFICIAL INTELLIGENCE IN GAMING

1. High Development Costs

Using the advanced AI in the games can also be expensive, but especially for the small game development companies. AI systems may also need powerful computers and other resources, which can cost more money . Dablander[12] has discussed how the deep learning models required expensive hardware and computing power. This can make it difficult for smaller game studios to use advanced AI technology.

2. Copyright Issues

The use of AI-generated content in games can create copyright problems. For example, when AI is used to create the game characters. Images, or environmental questions may raise questions about who owns the content. In India, the Copyright Act, 1957 explains that the person who causes a computer-generated work to be credited to its author. However deciding ownership of AI generated content can still be difficult. the game develop also need to be careful when using copyright materials in their games [13].

3. Impact on Job Opportunities

AI may change the job opportunities in the gaming industry. Some tasks in animation , game art, programming, and testing can now be supported by AI tools. This may reduce the need for certain types of work while creating a demand for new skills. Xing et al. [10] have discussed how AI is changing the responsibilities of the game developers and why learning new technical skills is becoming important. However, it is still unclear how AI will affect the jobs in the gaming industry in the future.

4. Lack of human creativity

AI can also help to create game characters, environments, and stories but it may not always produce the results that developers want. Sometimes AI-generated content may not also match the original ideas or style of a game. Lau et al. [2] discussed how the AI tools can work together with human designers in the game development. Their research shows why human creativity and decision-making are still important when designing games.

5. Ethical Issues

The use of AI in the gaming industry also raises concerns about player privacy and fairness. Some of the AI systems collect information about how the players behave in the games, which may create privacy concerns . Developers also need to make sure AI is used fairly and does not affect the players. Melhart et al. [14] studied ethical issues related to AI in games including players' data, fairness, and how AI systems can influence the gaming experience.

VII. FUTURE DIRECTIONS OF ARTIFICIAL INTELLIGENCE IN GAMING

1. Advanced AI characters

In the future, The AI may also help the non-player characters (NPCs) to have more natural conversations and respond better to players. These characters may also be able to remember the previous interactions and change their behaviour based on what happens in the game. Mian et al. [15] studied how the Large Language Models (LLMs) can be used to improve NPCs. Their research may discuss how AI could help the game characters communicate better and behave more naturally.

2. Generative AI in Game Development

Generative AI may also become more common in the game development. It can also help the developers to create the game environment, characters, and stories in less time. Farrokhi Maleki and Zhao [16] studied how the AI can be used to create the game content automatically. Their research discussed how the newer AI technologies including LLMs may help to improve the game development in the future.

(This work is licensed under a Creative Commons Attribution 4.0 International License.)

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 15 Issue 11 , November - 2026

3. AI and Virtual Reality (VR)

Ai and Virtual Reality (VR) may also work together to make the games more realistic and interactive. The AI could also help the virtual characters to communicate with the players and to react to their actions. This may also allow the players to have a more natural experience in the virtual environments. Ozkaya et al. [17] studied how the LLMs can also be used in the VR and discussed their possible use in the character interactions, storytelling and improving the gaming experience.

4. Future of E-sports

AI may also become more useful in e-sports by helping the players improve their skills and understand their performance. It could also help the developers to find cheating in online competitive games. Jing et al. [7] studied how the machine learning can be used to analyse professional Counter-Strike players and also understand their performance. In the future improvements in the AI may also help with player training, performance analysis and fair gameplay [8].

5. Human and AI Collaboration

AI may also help the game developers with tasks such as designing the characters, creating the environments, and the developing the game content. However, the human ideas and creativity will still be important in the game development. Lai et al. [2] discussed how the AI tools can help human designers with their work. Alharthi [18] also explained why human creativity and control are important when using generative AI in game design.

VIII. RESULTS AND DISCUSSION

1. Findings from the Previous Research

Previous studies show that how AI can support game design, content creation, and the player interactions. Yannakakis and the Togelius [1] discussed how AI can be is used in different types of areas of gaming, including the game-playing agents, player modelling, and the game content generation.

2. Changes in the Game Development

Research suggests that how AI can assist developers in creating the game levels, environments, and the other content. Summerville et al. 4- studied how machine learning can generate the game content, while Bergdahl et al. 5-explored that how AI can support automated game testing.

3. Comparison of the Previous Studies

Different researchers that have been focused on a different types uses of AI in the gaming. Summerville et al. [4]- explored automatic content creation, while the Lai et al. 2 - studied how AI tools can work on the alongside human designers. These studies show that AI can support both of the automated and human-guided development.

4. Limitations and Research Gaps

Although AI offers a new opportunities, existing research also can identifies limitations. AI generated content still requires the quality evaluation, and automated systems may not always produce the results developers expect. Further research is needed to understand that how these technologies perform across different types of games and development environments [2], [4].

5. Overall Findings and Future Implications

The reviewed studies suggest that AI can support a game development and create a new possibilities for the gameplay. However, human involvement remains important for the maintaining game quality and the creative direction. Future research should focus on improving [Artificial intelligence] reliability, evaluating its effects on the players, and supporting responsible development. [1], [2].

IX. CONCLUSION

Artificial Intelligence (AI) has become an important part of the gaming industry, influencing how games are developed and experienced. Based on the previous research, AI has been created new opportunities in the game development while also introducing the challenges that need further attentions.

1. Summary of the Research Findings

Previous studies that have been shown in that AI supports different areas of gaming, including game design, character behaviour,

(This work is licensed under a Creative Commons Attribution 4.0 International License.)

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 15 Issue 11 , November - 2026

and content creation. Yannakakis and Togelius [1]- discussed how AI technologies are used to improve the game systems and support to the player experiences.

2. Benefits and Challenges

AI offers several benefits, such as supporting the game developments, improving the gameplay, and reducing certain manual tasks. However, the challenges related to the technical limitations, development costs, and the ethical issues still needs to be addressed [14].

3. Future Development of AI

AI is expected to continue of improving the game developments and the player interactions. Future developments may include smarter game characters, better gameplay systems, and more advanced tools for creating games contents. However, further research is needed to understand their effectiveness and the limitations.

4. Final Research Conclusion

Overall, the reviewed research suggests that AI has the potential to improve the different types of aspects of the gaming industry. However, its successful development depends on the balancing of technological progress with the human creativity, fairness, and the responsible use.

REFERENCE

[1] G. N. Yannakakis and J. Togelius, Artificial Intelligence and Games. Springer, 2018. https://doi.org/10.1007/978-3-319-63519-4
[2] G. Lai, F. F. Leymarie, and W. Latham, “On Mixed-Initiative Content Creation for Video Games,” IEEE Transactions on Games, vol. 14, no. 4, pp. 543–557, 2022. https://doi.org/10.1109/TG.2022.3176215
[3] D. Holden, T. Komura, and J. Saito, “Phase-Functioned Neural Networks for Character Control,” ACM Transactions on Graphics, vol. 36, no. 4, 2017. https://doi.org/10.1145/3072959.3073663
[4] A. Summerville et al., “Procedural Content Generation via Machine Learning (PCGML),” IEEE Transactions on Games, vol. 10, no. 3, pp. 257–270, 2018. https://doi.org/10.1109/TG.2018.2846639
[5] J. Bergdahl, C. Gordillo, K. Tollmar, and L. Gisslén, “Augmenting Automated Game Testing with Deep Reinforcement Learning,” 2020 IEEE Conference on Games (CoG), 2020. https://doi.org/10.1109/CoG47356.2020.9231552
[6] Peng, X. et al. Player-Driven Emergence in LLM-Driven Game Narrative. 2024 IEEE Conference on Games (CoG). 2024. DOI: 10.1109/CoG60054.2024.10645607.
[7] Jing, S. et al. Interpretable Machine Learning with SHAP for Esports Performance Analysis of Professional Counter-Strike Players from 2012 to 2025. International Journal of Sports Science & Coaching, 21(5): 3298-3314. 2026. DOI: 10.1177/17479541251388864.
[8] Operacz, K., Zembrowski, H., Kłopotek, R. Server-Side Machine Learning for Cheat Detection in Massively Multiplayer Online Role-Playing Games. In: Proceedings of the 21st Conference on Computer Science and Intelligence Systems, pp. 215-220. 2026. DOI: 10.15439/2026F1905.
[9] Heslinga, A., Chiesa, C.D. and Loots, E., 2025. The Adoption of Generative AI in Video Game Production: Firm and Industry-level Dynamics. In Artificial Intelligence in the Cultural and Creative Sectors (pp. 251-266). Routledge. DOI: 10.4324/9781003509738-24.
[10] Xing, Y. et al. The Impact of AI on Game Development: A Scoping Review of Transformations, Career Implications, and Emerging Challenges. Computers, 15(10), p. 693. 2026. DOI: 10.3390/computers15100693.
[11] R. Hunicke, “The Case for Dynamic Difficulty Adjustment in Games,” Proceedings of the 2005 ACM SIGCHI International Conference on Advances in Computer Entertainment Technology, pp. 429–433, 2005. https://doi.org/10.1145/1178477.117857
[12] M. Dablander, “Five Emerging Research Opportunities for Deep Learning in Video Games: A Curated Overview,” Entertainment Computing, vol. 57, article 101092, 2026. https://doi.org/10.1016/j.entcom.2026.101092
[13] U.S. Copyright Office, Copyright and Artificial Intelligence, Part 2: Copyrightability, January 2025. https://www.copyright.gov/ai/
[14] D. Melhart, J. Togelius, B. Mikkelsen, C. Holmgård, and G. N. Yannakakis, “The Ethics of AI in Games,” IEEE Transactions on Affective Computing, vol. 15, no. 1, pp. 79–92, 2024. https://doi.org/10.1109/TAFFC.2023.3276425
[15] D. Mian, J. Bradbury, Y. G. Gueheneuc, F. Petrillo, and C. Politowski, “LLM-Based NPCs in Video Games: A Systematic Mapping Study,” IEEE Transactions on Games, in press, 2026. https://doi.org/10.1109/TG.2026.3733302
[16] M. Farrokhi Maleki and R. Zhao, “Procedural Content Generation in Games: A Survey with Insights on Emerging LLM Integration,” Proceedings of the AAAI Conference on Artificial Intelligence and Interactive Digital Entertainment, vol. 20, no. 1, pp. 167–178, 2024. https://doi.org/10.1609/aiide.v20i1.31877
[17] S. Ozkaya, S. Berrezueta-Guzman, and S. Wagner, “How LLMs Are Shaping the Future of Virtual Reality,” IEEE Access, vol. 13, pp. 193335–193355, 2025. https://doi.org/10.1109/ACCESS.2025.3631594
[18] S. A. Alharthi, “Generative AI in Game Design: Enhancing Creativity or Constraining Innovation?” Journal of Intelligence, vol. 13, no. 6, article 60, 2025. https://doi.org/10.3390/jintelligence13060060
[19] H. Snyder, “Literature Review as a Research Methodology: An Overview and Guidelines,” *Journal of Business Research*, vol. 104, pp. 333–339, 2019. doi: 10.1016/j.jbusres.2019.07.039.
[20] M. J. Grant and A. Booth, “A Typology of Reviews: An Analysis of 14 Review Types and Associated Methodologies,” *Health Information & Libraries Journal*, vol. 26, no. 2, pp. 91–108, 2009. doi: 10.1111/j.1471-1842.2009.00848.x.

(This work is licensed under a Creative Commons Attribution 4.0 International License.)