



Ready Steady GO — How a Computer Playing a Board Game May Have Spurred on China's AI Frenzy

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Abstract

Chinese - 中文

本篇研究论文旨在探讨“AlphaGo”人工智能围棋软件在多大程度上影响了中国政府的政治决策。除了研究“五年计划”，年度预算以及其他正式文件和公开声明之外，本篇研究论文重点探讨“AlphaGo”对解放军的影响。尽管没有绝对确定的直接和可辨别的联系，但是有许多迹象表明“AlphaGo”产生了一定程度的影响。

Swedish - Svenska

Denna uppsats undersöker i vilken utsträckning AlphaGo, ett dataprogram som med hjälp av artificiell intelligens spelar brädspelen Go, har påverkat den kinesiska ledningens strategiska och politiska beslut. Utöver att granska femårsplaner, årliga budgetar och andra officiella dokument och offentliga uttalanden, analyseras även AlphaGos inflytande på den kinesiska försvarsmakten. Även om det inte går att belägga en direkt koppling, finns flera tecken på att AlphaGo haft en viss påverkan på den kinesiska ledningens beslut.

English

This essay explores the extent to which AlphaGo, an artificial intelligence Go-playing computer program, has affected the political and strategic decision-making of the Chinese government. Beyond analyzing Five-Year Plans, annual budgets, and other official documents and public statements, this essay assesses AlphaGo's influence on the Chinese People's Liberation Army. Although a direct and discernible connection can not be claimed with absolute certainty, there are multiple indices of "AlphaGo" having had a certain degree of impact.

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1 Introduction

Go is an ancient Chinese board game requiring great strategic complexity and depth.¹ In March of 2016 and May of 2017, two historic games of Go were played. Lee Sedol 이세돌² and Ke Jie 柯洁³ respectively, two of the world's greatest Go players, both played and lost against AlphaGo, a computer program powered by an artificial intelligence neural network.⁴ AlphaGo was created by DeepMind, a British firm which was bought by Google in 2014.⁵ These two matches clearly demonstrated the capabilities and potential of artificial intelligence (AI), in what was previously largely seen as a too complex field for computers to tackle.⁶ In China, these matches generated fascination, interest, and worry.

Just two months after Ke Jie lost against AlphaGo, the Chinese government publicly released an ambitious plan outlining their approach to AI in the near future, the 'New Generation Artificial Intelligence Development Plan'. This plan specifies China's ambition to achieve global AI supremacy by 2030, and is but one example of China's widespread investment into AI in the time period following the AlphaGo matches.

This essay aims to investigate the link between AlphaGo's victories and the Chinese government's perception of AI as a geopolitical tool, to the degree that this is manifested in public documents. As AI technologies are poised to revolutionize countless aspects of modern society, the nation which achieves AI supremacy first may come to dictate the terms of the new world order. In the wake of this scramble to achieve technological domination in this field, it is of academic interest to understand the context and background leading to such drastic investments, and to understand the degree to which technological advancements can impact government perceptions.

In order to determine whether AlphaGo influenced Chinese government policies toward AI, this essay aims to examine two primary channels of influence. The first of these refers to

¹ Shotwell, Peter. "The Game of Go: Speculations on Its Origins and Symbolism in Ancient China." 2008, p. 5., www.usgo.org/sites/default/files/bh_library/originsofgo.pdf. All web resources were visited on 25 May 2021.

² Borowiec, Steven. "AlphaGo Seals 4-1 Victory over Go Grandmaster Lee Sedol." *The Guardian*, Guardian News and Media, 15 Mar. 2016, www.theguardian.com/technology/2016/mar/15/googles-alphago-seals-4-1-victory-over-grandmaster-lee-sedol.

³ Mozur, Paul. "Google's AlphaGo Defeats Chinese Go Master in Win for A.I." *The New York Times*, The New York Times, 23 May 2017, www.nytimes.com/2017/05/23/business/google-deepmind-alphago-go-champion-defeat.html.

⁴ "AlphaGo: The Story so Far - The Matches." *Deepmind*, deepmind.com/research/case-studies/alphago-the-story-so-far#the_matches.

⁵ "Google Buys UK Artificial Intelligence Startup Deepmind for £400m." *The Guardian*, Guardian News and Media, 27 Jan. 2014, www.theguardian.com/technology/2014/jan/27/google-acquires-uk-artificial-intelligence-startup-deepmind.

⁶ "AlphaGo: The Story so Far - The Matches."

examining AlphaGo's influence on the political leadership of the Chinese Communist Party (or CCP). This would be reflected in documents such as Five-Year Plans, annual budgets, or speeches made by prominent officials of the Chinese Communist Party (CCP). Alongside investigating these political documents, this essay will further investigate AlphaGo's influence within the PLA.

1.1 Abbreviations and Concepts⁷

- CCP, Chinese Communist Party

The Chinese Communist Party (CCP) is the ruling party of the People's Republic of China (PRC), ruling with a monopoly on power. It is led by Xi Jinping 习近平, who has, since coming to power in 2012, consolidated control and pushed to end term limits.⁸

- PLA, People's Liberation Army

The People's Liberation Army (PLA) is the armed wing of the CCP, directly ensuring the party's continued rule and governance.⁹

- Go (Go, 围棋)

An ancient board game requiring skill and strategy, often considered the oldest continuously played board game, and of great cultural importance in China.¹⁰ Although the game is known as 围棋 *weiqi* in China, this essay will use the Japanese term "Go", as this is more commonly used in English-speaking and international settings.

- AlphaGo (AlphaGo, 阿尔法围棋, 阿尔法狗, 阿法狗, or 阿发狗)

A computer program playing Go, powered by artificial intelligence. Through a unique combination of highly advanced tree searches and deep neural networks, this program was able to defeat Lee Sedol, the winner of 18 world titles and considered the greatest player of the last decade, and Ke Jie, the best player in the world at the time.¹¹

⁷ As part of the research process of analyzing the New Generation Artificial Intelligence Development Plan and the Five-Year Plans, certain key words were searched for in these documents. These can be found underlined and in parentheses.

⁸ Albert, Eleanor, et al. "The Chinese Communist Party." *Council on Foreign Relations*, Council on Foreign Relations, 9 June 2020, www.cfr.org/backgrounder/chinese-communist-party.

⁹ Office of the Secretary of Defense. "Military and Security Developments Involving the People's Republic of China 2020." Annual Report to Congress, 2020, p. 26., media.defense.gov/2020/Sep/01/2002488689/-1/-1/1/2020-DOD-CHINA-MILITARY-POWER-REPORT-FINAL.PDF.

¹⁰ Shotwell, Peter. p.5

¹¹ "AlphaGo: The Story so Far - The Matches."

- DeepMind (**DeepMind**)

The company behind AlphaGo, founded in 2010 and bought by Google in 2014. Their stated long term aim is to “solve intelligence”, through “developing more general and capable problem-solving systems, known as artificial general intelligence (AGI).”¹²

- Google (**Google**, 谷歌)

From being founded in 1998 as a search engine company, Google has since expanded to encompass countless sectors and businesses, including acquiring Deepmind.¹³

- Artificial Intelligence, AI (人工智能)

Artificial Intelligence (AI) is a general term which can be defined in numerous ways, but is typically defined as the science of making intelligent machines or intelligent computer programs. The meaning of “intelligent” varies, and as computers’ computational power increase, so too is the bar of what constitutes “intelligent” raised.¹⁴

- Intelligentization (智能化)

A term rarely found outside a Chinese context, it appears to be used to refer to a possession of some degree of perception-, memory-, self-adapting , or learning-related abilities.¹⁵

- Machine learning (机器学习)

Machine learning is a branch of AI research which emphasises using algorithms and large quantities of data to imitate human learning capabilities, allowing algorithms to improve automatically, leading to more accurate predictions, classifications, or decisions over time.¹⁶

- Deep learning (深度学习)

¹² “Deepmind - Our Story.” *Deepmind*, www.deepmind.com/about#our_story.

¹³ Fitzpatrick, Alex. “Google Used to Be the Company That Did 'Nothing But Search'.” *Time*, Time, 4 Sept. 2014, www.time.com/3250807/google-anniversary/.

¹⁴ McCarthy, John. “WHAT IS ARTIFICIAL INTELLIGENCE?” Computer Science Department, Stanford University, 24 Nov. 2004, homes.di.unimi.it/borghese/Teaching/AdvancedIntelligentSystems/Old/IntelligentSystems_2008_2009/Old/IntelligentSystems_2005_2006/Documents/Symbolic/04_McCarthy_whatissai.pdf.

¹⁵ As used in the Five-Year Plans and New Generation Artificial Intelligence Development Plan, outlined below on pages 12-15 and pages 9-10 respectively.

¹⁶ IBM Cloud Education. “Machine Learning” *IBM*, 15 July 2020, www.ibm.com/cloud/learn/machine-learning.

Deep learning is a subset of machine learning, in which algorithms use big data (often unsorted, unstructured, and unprocessed) without direct instructions on how to process it. To achieve an outlined goal, algorithms thus develop hidden “layers”. In other words, while the inputs and outputs are known, the exact method the algorithm used may be unknown.¹⁷

- Wargaming (translated as 战争游戏, 兵棋推演, 指挥所演习, or 桌上演习)

The artificial simulation of warfare or combat scenarios,¹⁸ usually carried out either through computer simulations or table-top simulations (i.e board games).

1.2 Research Question

This essay aims to answer the following question - did AlphaGo’s victories against Lee Sedol and Ke Jie impact the Chinese government’s perception of AI as a tool for military development and geopolitical influence?

1.3 Method and Material

This essay's research methodology consists of **(1)** first, establishing a baseline of internal government documents. The sources for this step will be acquired primarily through reviewing (a) annual budgets, (b) Five-Year Plans, (c) public statements from the CCP leadership on AI or mentioning AI to a significant degree, or (d) other documents demonstrating the political prioritization of AI. More specifically, ties to AlphaGo will be highlighted and addressed.

The review of (a) annual budgets will be conducted through analyzing annual data compiled and published by the National Bureau of Statistics of China. Inspired by the methodology of quantitative content analysis¹⁹, the (b) Five-Year Plans were searched for specific keywords relating to either AlphaGo, or artificial intelligence as a concept, with the frequency and context of these keywords being taken into special consideration. These keywords can be found above on page 5, in the section entitled “Abbreviations and Concepts”, as the words within parentheses and underlined.

¹⁷ IBM Cloud Education. “Deep Learning.” *IBM*, 1 May 2020, www.ibm.com/cloud/learn/deep-learning; “Deep Learning.” *A Dictionary of Construction, Surveying and Civil Engineering*, Edited by Christopher Gorse et al., 2nd ed., Oxford University Press, 2020, www-oxfordreference-com.ezproxy.ub.gu.se/view/10.1093/acref/9780198832485.001.0001/acref-9780198832485-e-8332.

¹⁸ Hu, Xiaofeng 胡晓峰, et al. “AlphaGo di tupo yu bingqi tuiyan de tiaozhan, AlphaGo的突破与兵棋推演的挑战.” *科技导报*, vol. 35, no. 21, 2017, p. 1. *CNKI, China Academic Journals (CD Edition) Electronic Publishing House Co., Ltd.*, doi:10.3981/j.issn.1000-7857.2017.21.006.

¹⁹ Quantitative content analysis is the process of quantifying the frequency of certain concepts and words, in order to gain a greater understanding of a text.

Krippendorff, Klaus. *Content Analysis: an Introduction to Its Methodology*. SAGE, 2004, books.google.se/books?id=q657o3M3C8cC&.

(2) Second, the PLA will be analyzed, due both to the abundance of data, and to its intrinsic link to the CCP. This relationship is outlined in greater detail on page 18, in the section entitled “The PLA’s relationship with the CCP”. Furthermore, the extensive and numerous sources available outlining the PLA’s views not only on AI but on AlphaGo, grant a clear insight in contemporaneous military thought. These sources include (a) research articles published by PLA experts, (b) official summaries of seminars attended by high-ranked PLA officials, (c) articles published on the PLA’s official news website, or (d) official PLA events or competitions.

(3) Third, the above findings will be discussed and contextualized. Where applicable, an analysis of the PLA’s views on AlphaGo will be contextualized through applying Robert Jervis’ offense-defense theory, in order to gain a greater holistic understanding of how a factor such as AlphaGo may play into the greater context of the PLA’s views on AI and apprehension of US military and technological supremacy.

As the above documents are primarily in Chinese, the translations provided in this essay are the author’s own unless otherwise stated.

1.4 Considerations

There are multiple considerations to bear in mind with this chosen methodology.

- There may be a large amount of inaccessible or classified documents.²⁰
- The language barrier may lead to certain issues, as the translations were not carried out by a native Chinese speaker. Although great care has been taken to ensure correct translations, errors may be made and nuances may be lost.²¹
- The open nature of finding relevant mentions of AlphaGo by CCP officials creates difficulties of scope and scale.²² Therefore, relatively few CCP politicians were analyzed.
- The officially published funding data on AI research is unclear and largely aggregated. As it does not differentiate between AI and non-AI research, this results in rough estimates being made at best.
- Emphasizing the PLA offers insight into contemporary military thought, but ultimately only addresses one aspect, ignoring aspects such as the private sector’s role.

²⁰ Two potential factors may further exacerbate this - (1) the Chinese government being particularly opaque, and (2) the defense-related or military nature of certain documents, in combination with the cutting-edge nature of AI, may further prohibit open access.

²¹ To help mitigate this risk, certain quotes have been kept in their original language as a footnote.

²² In other words, what keywords should be used and how much searching should be carried out before concluding there is no relevant link?

2 AlphaGo and the CCP Leadership

2.1 The New Generation Artificial Intelligence Development Plan

The New Generation Artificial Intelligence Development Plan (新一代人工智能发展规划) (AIDP) was released in July 2017²³, two months after the AlphaGo - Ke Jie match (and 16 months after the AlphaGo - Lee Sedol match). Notably, the AIDP does not mention AlphaGo, Go, Deepmind, or Google.²⁴

The AIDP details China's ambitions for global supremacy in AI technologies by 2030, and the subsequent intelligent (智能) economy and intelligent society which will be achieved as a result.²⁵ Furthermore, AI is emphasized as being the "main driving force" for China's coming industrial and economic transformation.²⁶ The AIDP also highlights the military and national security-related aspects of AI, calling for an increased support of applying the new generation of AI technologies to "command and decision-making, military deduction, national defense equipment, and other applications."²⁷

Researchers from the University of Oxford, in their analysis of the AIDP, consider China's investment into AI technologies an attempt to reach parity with and leapfrog US military capabilities - "Rather than outspending the US in conventional weaponry, China considers investing in AI as an opportunity to make radical breakthroughs in military technologies and thus overtake the US."²⁸

Despite AlphaGo (or affiliated terms) being unmentioned in the AIDP, this does not preclude AlphaGo's victories from having had any influence on how the Chinese government views AI. In fact, the researchers from the University of Oxford claimed "the victory for AlphaGo contributed to an increase in focus, as indicated by the 2017 'New Generation

²³ "Guowuyuan guanyu yinfa xin yidai rengong zhineng fazhan guiha de tongzhi 国务院关于印发 新一代人工智能发展规划的通知.", 国务院, 20 July 2017. www.gov.cn/zhengce/content/2017-07/20/content_5211996.htm.

²⁴ See the "Abbreviations and Concepts" section for the Chinese translations of these terms used to search the AIDP.

²⁵ Original quote - "第三步, 到2030年人工智能理论、技术与应用总体达到世界领先水平, 成为世界主要人工智能创新中心, 智能经济、智能社会取得明显成效, 为跻身创新型国家前列和经济强国奠定重要基础。"

²⁶ Original quote - "第二步, 到2025年人工智能基础理论实现重大突破, 部分技术与应用达到世界领先水平, 人工智能成为带动我国产业升级和经济转型的主要动力, 智能社会建设取得积极进展。"

²⁷ "Guowuyuan guanyu yinfa xin yidai rengong zhineng fazhan guiha de tongzhi 国务院关于印发 新一代人工智能发展规划的通知。";

Original quote - "强化新一代人工智能技术对指挥决策、军事推演、国防装备等的有力支撑引导国防领域人工智能科技成果向民用领域转化应用。"

²⁸ Roberts, Huw, et al. "The Chinese Approach to Artificial Intelligence: an Analysis of Policy, Ethics, and Regulation." *AI & Society*, vol. 36, no. 1, 2020, p. 62., doi:10.1007/s00146-020-00992-2.

Artificial Intelligence Development Plan' (AIDP).” Seeking to further substantiate this claim, this essay will thus attempt to determine whether or to what extent the political leaders of the Chinese Communist Party (CCP) were aware of AlphaGo.

2.2 Mentions of AlphaGo by the CCP Leadership

There is precious little evidence that the top leadership of the CCP is aware of the existence of AlphaGo, as it does not seem to have been mentioned to any substantive degree. The three highest ranked government officials are (1) Xi Jinping, the General Secretary of the CCP, President of the People’s Republic of China (PRC), and Chairman of the Central Military Commission (CMC)²⁹, (2) Li Keqiang 李克强, the Premier of the State Council,³⁰ and (3) Li Zhanshu 栗战书, the chairman of the Standing Committee of the National People’s Congress.³¹ Due to the ties between the PLA and AlphaGo, outlined below, Xu Qiliang 许其亮, the Vice Chairman of the Central Military Commission and member of the Central Political Bureau³², was also looked into. In exploring connections between these officials and AlphaGo, very little of substance was found. Li Zhanshu does not seem to have mentioned AlphaGo at all, nor has Xu Qiliang.

2.2.1 Li Keqiang

Li Keqiang does not seem to have mentioned AlphaGo directly either, with the exception of a short interview held after the Fourth Session of the 12th National People’s Congress, held the day after Lee Sedol lost the final match against AlphaGo. Li Keqiang did not comment on the match specifically, saying “I don't want to comment on this win or loss, because regardless of the win or loss, this machine [i.e AlphaGo] is still man-made.”³³. This was interpreted by the State Council Information Office of the PRC as;

²⁹ “Xi Jinping tongzhi jianli 习近平同志简历.” 中央领导机构资料库, 中国共产党新闻网, Mar. 2018, cpc.people.com.cn/n1/2017/1025/c414940-29608803.html.

³⁰ “Li Keqiang tongzhi jianli 李克强同志简历.” 中央领导机构资料库, 中国共产党新闻网, Mar. 2018, cpc.people.com.cn/n1/2017/1025/c414940-29608804.html.

³¹ “Li Zhanshu tongzhi jianli 栗战书同志简历.” 中央领导机构资料库, 中国共产党新闻网, Mar. 2018, cpc.people.com.cn/n1/2017/1025/c414940-29608805.html ;

“Di shijiu jie zhonggong zhongyang zuzhi jiegou tu 第十九届中共中央组织结构图.” 中国共产党新闻网, cpc.people.com.cn/GB/64162/414940/index.html.

³² “Xu Qiliang 许其亮.” Edited by Zhang Hongzhou 张宏洲, 中华人民共和国国防部, 18 Mar. 2018, www.mod.gov.cn/leaders/2018-03/18/content_4807124.htm.

³³ “Li Keqiang tan AlphaGo: Ren ji dazhan buguan shuying jiqi haishi renzao de 李克强谈AlphaGo: 人机大战不管输赢 机器还是人造的.” Edited by Shang Yang 尚阳, 中国网, 16 Mar. 2016, www.china.com.cn/lianghui/news/2016-03/16/content_38039432.htm ;

Original quote - “我不想评论这个输赢，因为不管输赢如何，这个机器还是人造的。”

Premier Li has attached great importance to cutting-edge technologies. During the two sessions in 2016, he had mentioned the Go match between Lee Sedol and AlphaGo when he answered a question concerning relations among China, Japan and the Republic of Korea.³⁴

However, AI made its first appearance in Li Keqiang's annual work report covering the work of the government in 2016.³⁵ Media outlets including the New York Times,³⁶ China Daily,³⁷ and Reuters³⁸ speculated that this first mention of artificial intelligence was at least in part due to AlphaGo's victory over Lee Sedol, with an article from Reuters stating:

Since AlphaGo's defeat of Lee Sedol just over a year ago, AI has shot up the agenda for China's top policy makers, making its first appearance this year in Premier Li Keqiang's annual work report, a document laying out China's top policy priorities.³⁹

2.2.2 Xi Jinping

Similarly, AlphaGo does not seem to have been mentioned by Xi Jinping, with the only found exception being a single mentioning of AlphaGo while attending a symposium on cyber security and informatization. This symposium was held in April 2016⁴⁰, less than a month after AlphaGo's victory over Lee Sedol. Although there were no references to AlphaGo in the speech held by Xi⁴¹, Shen Yi 沈逸, an associate professor at Fudan University⁴², deputy director of the Cyberspace Governance Research Center of Fudan University⁴³, and attendee of the symposium, demonstrates otherwise. A People's Daily article on the symposium reported on Shen Yi's impression of Xi's speech.

³⁴ "Govt Work Report Turns 'Artificial Intelligence' into Buzzword." Edited by Zheng Chengqiong 郑成琼, 国务院新闻办公室网站, 13 Mar. 2017, www.scio.gov.cn/32618/Document/1544731/1544731.htm.

³⁵ Li, Keqiang. "Report on the Work of the Government." *The State Council of The People's Republic of China*, 16 Mar. 2017, english.www.gov.cn/premier/news/2017/03/16/content_281475597911192.htm.

³⁶ Mozur, Paul. "Beijing Wants A.I. to Be Made in China by 2030." *The New York Times*, The New York Times, 20 July 2017, www.nytimes.com/2017/07/20/business/china-artificial-intelligence.html.

³⁷ "China's AI Business Ready to Lead the World." *China Daily*, 1 June 2017, www.chinadaily.com.cn/business/tech/2017-06/01/content_29576692.htm.

³⁸ Cadell, Cate. "Google's AlphaGo Clinches Series Win over Chinese Go Master." Reuters, Thomson Reuters, 25 May 2017, www.reuters.com/article/us-science-intelligence-go-idUSKBN18L0LH.

³⁹ Ibid

⁴⁰ Shen, Yaxin, and Cheng Yao. "Can hui zhe tan ganshou: Xi Jinping jianghua goule wang xin gongzuo da zhanlue." *People's Daily*, politics.people.com.cn/n1/2016/0420/c1001-28291806.html.

⁴¹ Xi, Jinping 习近平. "Xi Jinping zong shuji zai wangluo anquan he xinxi hua gongzuo zuotan hui shang de jianghua 习近平总书记在网络安全和信息化工作座谈会上的讲话." 国家互联网信息办公室, 25 Apr. 2016, www.cac.gov.cn/2016-04/25/c_1118731366.htm.

⁴² "Shen Yi 沈逸." 复旦大学 教师个人主页, faculty.fudan.edu.cn/shenyi/.

⁴³ Shen, Yaxin, and Cheng Yao.

Shen Yi was deeply impressed by Xi Jinping's thorough understanding and accurate grasp of cutting-edge information on the Internet. 'When communicating with the speakers, the general secretary also mentioned the popular Google artificial intelligence AlphaGo.'⁴⁴

In the research conducted for this essay, this is the sole found example of AlphaGo having been mentioned by Xi Jinping.

2.3 The Five-Year Plans

China's five-year plans can be regarded as a window into the Chinese government's coming prioritizations in the near future. These plans outline goals and ambitions for the modern Chinese society, including economic production, growth-rate targets, encouraging green energy and improving air quality, and maintaining social stability, to name just a few aspects.⁴⁵

Thus, in order to glean insight into China's political decision-making, the five-year plans are undoubtedly an essential resource to analyze. In the sections below, the analyses of three separate five-year plans; the 12th (covering the period 2011-2015)⁴⁶, the 13th (2016-2020)⁴⁷, and the 14th (2021-2025)⁴⁸, are presented.

Despite none of these five-year plans directly referencing AlphaGo, DeepMind, or Go,⁴⁹ they showcase a clear increase in interest in AI over time. As the AlphaGo - Lee Sedol match occurred in March 2016 (with the AlphaGo - Ke Jie match taking place in May 2017) neither the 12th five-year plan nor the 13th could have been influenced by these events, as they were released in 2011 and March 2016, respectively.

2.3.1 The 12th Five-Year Plan (2011–2015)

The 12th five-year plan does not mention any of the significant five-year plan keywords (see "method and material" section on page 7), with the exception of 智能化, intelligentization,

⁴⁴ Ibid

⁴⁵ "What Is China's Five-Year Plan?" *The Economist*, The Economist Newspaper, 4 Mar. 2021, www.economist.com/the-economist-explains/2021/03/04/what-is-chinas-five-year-plan ; "Zhonghua renmin gongheguo guomin jingji he shehui fazhan di shisi ge wu nian guihua he 2035 nian yuanjing mubiao gangyao 中华人民共和国国民经济和社会发展第十四个五年规划和2035年远景目标纲要." Edited by Liu Chang, 中华人民共和国中央人民政府, 13 Mar. 2021, www.gov.cn/xinwen/2021-03/13/content_5592681.htm.

⁴⁶ "Guomin jingji he shehui fazhan di shi'er ge wu nian guihua gangyao (quanwen) 国民经济和社会发展第十二个五年规划纲要(全文)." 中国政府网, 16 Mar. 2011, www.gov.cn/2011lh/content_1825838.htm.

⁴⁷ "Zhonghua renmin gongheguo guomin jingji he shehui fazhan di shisan ge wu nian guihua gangyao 中华人民共和国国民经济和社会发展第十三个五年规划纲要" Edited by Wen Ya 温雅, 中国政府网, 17 Mar. 2016, www.gov.cn/xinwen/2016-03/17/content_5054992.htm.

⁴⁸ "Zhonghua renmin gongheguo guomin jingji he shehui fazhan di shisi ge wu nian guihua he 2035 nian yuanjing mubiao gangyao 中华人民共和国国民经济和社会发展第十四个五年规划和2035年远景目标纲要."

⁴⁹ See the "Abbreviations and Concepts" section for the Chinese translations of these terms used to search the Five-Year Plans.

mentioned twice. Although this general term is often associated with AI and the process of creating “smart” software capable of intelligent decision-making, it is just as likely to refer to connecting previously “dumb” hardware to the internet, such as tractors. The latter appears to be the case in the 12th five-year plan, with intelligentization mentioned in relation to promoting intelligentization and standardization in logistics management,⁵⁰ as well as promoting intelligentization of products developed by the “equipment manufacturing industry”.⁵¹

Although artificial intelligence is not mentioned at all, there is however an urge to “gradually establish a military-civilian integrated development system with Chinese characteristics” which “meets the needs of winning local wars under the conditions of informatization” (信息化). Beyond this, there is a highlighted need to “promote innovation in military technology”.⁵² Although this is not directly tied to AI, they are emblematic of a desire to modernize the PLA with innovative and cutting-edge technologies within the coming years, which would indicate a willingness to adopt new technologies (such as AI) at the requirement or request of the PLA.

2.3.2 The 13th Five-Year Plan (2016–2020)

The 13th five-year plan was released just two days after the AlphaGo - Lee Sedol match ended (the final AlphaGo - Lee Sedol game ended on March 15th, while the five-year plan was released on March 17th, 2016).⁵³ Although theoretically possible that the effects of this match may be seen in the five-year plan, the comprehensive and extensive nature of these plans all but guarantee that they are outlined, drafted, and written long before their release date, thus making any possible influence negligible.

In contrast to the previous 12th five-year plan, this plan does mention artificial intelligence. However, it is only mentioned once, as is listed in passing alongside numerous other “key technologies” which China aims to achieve breakthroughs in.⁵⁴

Similarly, intelligentization is mentioned twice as often as in the previous five-year plan. However, just as in the previous plan, it is used to refer to concepts and projects largely unrelated to AI, and more specifically, largely unrelated to AI as it relates to AlphaGo. For

⁵⁰ “Guomin jingji he shehui fazhan di shi'er ge wu nian guihua gangyao (quanwen) 国民经济和社会发展第十二个五年规划纲要(全文).” p. 4.

⁵¹ Ibid p. 5.

⁵² Ibid p. 16.

⁵³ “Zhonghua renmin gongheguo guomin jingji he shehui fazhan di shisan ge wu nian guihua gangyao.”

⁵⁴ Ibid

Original quote - “重点突破大数据和云计算关键技术、自主可控操作系统、高端工业和大型管理软件、新兴领域人工智能技术。”

example, the 13th five-year plan emphasizes the intelligentization of agricultural equipment, public transportation systems, and national cable television networks.⁵⁵

2.3.3 The 14th Five-Year Plan (2021–2025)

Although the 14th five-year plan doesn't mention AlphaGo by name, artificial intelligence is undoubtedly more prioritized than in the plans of the past. AI is mentioned six times, while intelligentization 智能化 is mentioned twelve times. Artificial intelligence is considered a “frontier field”, in which China is looking to “implement a batch of forward-looking and strategic national major scientific and technological projects.”⁵⁶

There is also a push to “Strengthen the research and development of key cyber security technologies, accelerate the innovation of artificial intelligence security technologies”.⁵⁷ Of note is that AlphaGo has been mentioned within the context of cyber security by Xi Jinping.⁵⁸

Militarily, the Chinese government is looking to “Deepen the military-civilian scientific and technological collaboration innovation,” as well as strengthen coordination of joint military-civilian development of technologies such as artificial intelligence.⁵⁹

Intelligentization seems largely to refer to concepts such as creating intelligent agricultural and manufacturing processes, or accelerating the creation of an intelligentized grid infrastructure, in similar fashion to previous plans. However, there is also a highlighted push for the intelligentization of government operations, which includes a call to “Accelerate the establishment of a digital technology-assisted government decision-making mechanism”.⁶⁰ This is likely to include investment into AI-assisted decision-making, which is reminiscent of the PLA's views on AlphaGo as a breakthrough in AI decision-making capabilities, covered in greater detail in the section entitled “The PLA's Relationship with AlphaGo” on page 21.

2.3.4 The Five-Year Plans Relationship with AlphaGo

Although none of these plans mention AlphaGo, they demonstrate a clear increase in interest in AI over time. The term “AI” (人工智能) goes from not being mentioned at all in the 12th five-year plan, to being once, without much further elaboration, to being mentioned six times in the most recent five-year plan. The term “intelligentization” (智能化) follows a similar trend,

⁵⁵ Ibid

⁵⁶ “Zhonghua renmin gongheguo guomin jingji he shehui fazhan di shisi ge wu nian guihua he 2035 nian yuanjing mubiao gangyao 中华人民共和国国民经济和社会发展第十四个五年规划和2035年远景目标纲要。”

⁵⁷ Ibid

⁵⁸ See page 11.

⁵⁹ Ibid

⁶⁰ Ibid

going from being mentioned twice in the 12th plan, to four times, to finally being mentioned twelve times in the most recent plan. The use of the term also shifted from largely irrelevant (in relation to AlphaGo) aspects of intelligentization, such as connecting agricultural equipment to the internet, to concepts far more relevant to AlphaGo such as intelligent decision-making. Had AlphaGo had an impact on the CCP's views on AI to the extent that it led to a greater emphasis on AI in the five-year plans, this would have been reflected in the 14th five-year plan at the earliest.

2.4 The Annual Budgets and Investment into AI Research

This increasing interest in AI technologies, demonstrated in the Five-Year Plans, coincides with a rising investment in AI from the Chinese government over time. This is reflected in the increasing investments in R&D year by year, as well as the growing sizes of “High-technology Industrial Development Zones”, sometimes referred to as ‘science parks’. However, there are difficulties in estimating Chinese public investments specifically into AI research, as spending information is not detailed to that degree of specificity, and especially so in regards to defence-related research.⁶¹

A study by the “Center for Security and Emerging Technology” tentatively estimated that between 1 and 3 percent of Chinese investment into “Basic Research”⁶² and somewhere between 3 and 10 percent of Chinese investment into “applied research and experimental development” went to AI-related research in 2018. However, these are “crude assumption[s]”, and difficult to ascertain with any significant degree of certainty.⁶³

R&D expenditures in “Basic Research”, “Applied Research”, and “Experimental Development”, are all outlined in the “China Statistical Yearbook”, an annual report published by the National Bureau of Statistics of China. These reports demonstrate a clear increase in investment in R&D, with investments into Basic Research increasing from 71 billion CNY in 2015⁶⁴ to 134 billion CNY in 2019⁶⁵, investments into Applied Research increasing from 153 billion CNY in 2015⁶⁶ to 250 billion CNY in 2019⁶⁷, and investments into Experimental

⁶¹ Acharya, Ashwin, and Zachary Arnold. “Chinese Public AI R&D Spending: Provisional Findings.” *Center for Security and Emerging Technology*, Dec. 2019, p. 3. doi:10.51593/20190053.

⁶² Ibid p. 7

⁶³ Ibid p. 10

⁶⁴ *China Statistical Yearbook 2016*. National Bureau of Statistics of China, www.stats.gov.cn/tjsj/ndsj/2016/indexeh.htm. [note: section 20-1]

⁶⁵ *China Statistical Yearbook 2020*. National Bureau of Statistics of China, www.stats.gov.cn/tjsj/ndsj/2020/indexeh.htm. [note: section 20-1]

⁶⁶ *China Statistical Yearbook 2016*. [note: section 20-1]

⁶⁷ *China Statistical Yearbook 2020*. [note: section 20-1]

Development increasing from 1190 billion CNY in 2015⁶⁸ to 1830 billion CNY in 2019⁶⁹. The figures of 1 to 3 percent and 3 to 10 percent are likely to have further increased since 2018, as AI continues to be of growing interest to the Chinese government.

Similarly, “High-technology Industrial Development Zones” are growing at a fast rate, with the total number of enterprises located within these science parks around China rising from 82,712 to 141,147 enterprises between 2015⁷⁰ and 2019.⁷¹ Although these science parks are undoubtedly not entirely focused on AI, their explosive growth occurring in parallel with China’s aspiration for AI supremacy is certainly of note. The largest of these zones, Zhongguancun Science Park, is described as “China's Silicon Valley”⁷², and has grown from 16,693 enterprises in 2015⁷³, to 24,892 in 2019.⁷⁴ Kai-Fu Lee 李开复, the CEO of Sinovation Ventures, a Zhongguancun-based technology-focused venture capital firm, and President of Sinovation Venture’s Artificial Intelligence Institute⁷⁵ describes Zhongguancun as the “beating heart of China’s AI movement”.⁷⁶ Referring to Zhongguancun, Lee later writes “To people here, AlphaGo’s victories were both a challenge and an inspiration.”⁷⁷

Zhongguancun, as a leading hub for AI technologies, has recently launched China’s first “National New Generation Artificial Intelligence Innovation Development Pilot Zone” (国家新一代人工智能创新发展试验区)⁷⁸, and has quickly been followed by similar AI-focused hubs being launched in Shanghai, Hefei, Hangzhou, Shenzhen, Tianjin, Jinan, Xi’an, Chengdu, Chongqing, Guangzhou, Wuhan, and Suzhou.⁷⁹

⁶⁸ *China Statistical Yearbook 2016*. [note: section 20-1]

⁶⁹ *China Statistical Yearbook 2020*. [note: section 20-1]

⁷⁰ *China Statistical Yearbook 2016*. [note: section 20-19]

⁷¹ *China Statistical Yearbook 2020*. [note: section 20-25]

⁷² Lee, Kai-Fu. *AI SUPERPOWERS: China, Silicon Valley, and the New World Order*. MARINER Books, 2019. p. 3. ;

“Zhongguancun, China's Silicon Valley.” 中国网, 12 Dec. 2002, www.china.org.cn/english/travel/51023.htm.

⁷³ *China Statistical Yearbook 2016*. [note: section 20-19]

⁷⁴ *China Statistical Yearbook 2020*. [note: section 20-25]

⁷⁵ “Investment Team.” Sinovation Ventures, www.sinovationventures.com/index.php/home/teams/index.html#Investment.;

Before founding Sinovation Ventures, Kai-Fu Lee former accolades include working as the President of Google China, more than 30 years of artificial intelligence research, founding the Microsoft Research Asia institute which has trained Chinese AI leaders including CTO’s and heads of AI at firms including Baidu, Tencent, Alibaba, Lenovo, and Huawei, and being the author of 10 US patents and over 100 journal and conference papers. “Kai-Fu Lee.” TED, www.ted.com/speakers/kai_fu_lee.

⁷⁶ Lee, Kai-Fu. p. 3

⁷⁷ Ibid p. 3

⁷⁸ “Beijing Officially Unveils Artificial Intelligence Industry Alliance in Zhongguancun.” *China Banking News*, 1 Sept. 2020, www.chinabankingnews.com/2020/09/01/beijing-officially-unveils-artificial-intelligence-alliance-in-zhongguancun

⁷⁹ “Guojia xin yidai rengong zhineng chuangxin fazhan shiyan qu guo wei 国家新一代人工智能创新发展试验区扩围.” Edited by Ling Jiwei 凌纪伟, 新华网, 25 Mar. 2021, www.xinhuanet.com/tech/2021-03/25/c_1127252336.htm.

Although specific figures are hard to come by, there is clear evidence that AI is highly prioritized, not only on paper but through the establishment of numerous research hubs around the country. However, to what degree this increase in investment relates to AlphaGo remains unknown and an area of speculation.

2.5 Investment into AI Research - South Korea

However, although there is precious little information from China regarding direct investments into AI research explicitly due to AlphaGo, this does not apply to the same degree to its neighbor, South Korea, Lee Sedol's homeland. In 2016, the then-president Park Geun-hye 박근혜, pledged 3.5 trillion won (3 billion USD) in direct AI funding, announcing this in a meeting with the country's tech industry leaders and senior government officials. Speaking to local reporters assembled for the meeting, the business tech news website *zdnet.com* quotes her acknowledgement of AlphaGo's influence;

'Above all, Korean society is ironically lucky, that thanks to the 'AlphaGo shock' we have learned the importance of AI before it is too late,' the president told local reporters assembled for the meeting, describing the game as a watershed moment of an imminent 'fourth industrial revolution'.⁸⁰

The scientific journal *Nature* reported on a 1 trillion won (\$863 million USD) investment in AI research by the South Korean government, announced two days after AlphaGo's victory over Lee Sedol. "Scrambling to respond to the success of Google DeepMind's world-beating Go program AlphaGo," this investment equated to a 55% increase in annual funding for AI. As part of this investment, a "high-profile, public-private research centre" would be founded;⁸¹

Korean scientists told *Nature* that the AI research institute was already in the planning stages, and was originally intended to open in 2017. The science ministry, however, says it was on track to open by this June. However, AlphaGo's success has prompted the government to accelerate plans for the institute.⁸²

⁸⁰ Iglauer, Philip. "South Korea Promises \$3b for AI R&D after AlphaGo 'Shock'." *ZDNet*, 22 Mar. 2016, www.zdnet.com/article/south-korea-promises-3b-for-ai-r-d-after-alphago-shock/.

⁸¹ Zastrow, Mark. "South Korea Trumpets \$860-Million AI Fund after AlphaGo 'Shock'." *Nature*, Nature Publishing Group, 18 Mar. 2016, www.nature.com/news/south-korea-trumpets-860-million-ai-fund-after-alphago-shock-1.19595.

⁸² *Ibid*

3 The PLA - AlphaGo Relationship

AlphaGo appears to be of considerable interest to the People's Liberation Army (PLA), the armed wing of the CCP, and the military force generally regarded to be the national armed forces of the PRC. Before examining the PLA's interest in AlphaGo, it is first necessary to understand the PLA's relationship with the Chinese government, as well as their relationship with artificial intelligence at large.

3.1 The PLA's relationship with the CCP

The PLA is foundationally an extension of the Communist Party, and although serving the role of a national armed forces, does not belong to the state as is the norm outside the PRC, making the PLA an inherently political organization. It responds directly to two political bodies - the Communist Party Central Committee, of which Xi Jinping is the general secretary, and the Central Military Commission (CMC), of which Xi Jinping is the chairman, as mentioned above. The CCP therefore claims absolute leadership over the PLA, referring to this as the “fundamental principle” of their relationship.⁸³

Xi Jinping has also increasingly propagated his status as the sole and primary commander-in-chief of the PLA. Within the past few years, two newly established political decision-making organizations have been established, the “CCP Central National Security Commission”, and the “Leading Group for Deepening National Defense and Military Reform of the CMC”, both of which are chaired by Xi Jinping and which tighten his grip on the PLA. Xi has combined this political maneuvering and consolidation of political power with an increased number of (publicized) visits to military installations,⁸⁴ and a new title as the PLA's “Commander in Chief”.⁸⁵

⁸³ “Jiefangjun bao pinglun yuan: Gongzuo zhidu yao jinyibu yan qilai shi qilai 解放军报评论员：工作制度要进一步严起来实起来。”中国共产党新闻网, 28 Jan. 2015, cpc.people.com.cn/pinglun/n/2015/0128/c78779-26464541.html. ;

“Guomin jingji he shehui fazhan di shi'er ge wu nian guihua gangyao (quanwen) 国民经济和社会发展第十二个五年规划纲要(全文).”

⁸⁴ Kou, Chien-Wen. “Xi Jinping in Command: Solving the Principal-Agent Problem in CCP-PLA Relations?” *The China Quarterly*, vol. 232, 2017, p. 873., doi:10.1017/s0305741017001321.

⁸⁵ Ramzy, Austin. “China's President, Xi Jinping, Gains a New Title: Commander in Chief.” *The New York Times*, *The New York Times*, 21 Apr. 2016, www.nytimes.com/2016/04/22/world/asia/china-xi-jinping-military-commander.html. ;

“Xi Jinping's New Title [sic] Announced: the ‘Commander in Chief of the Central Military Commission Joint Battle Command Center.’” Edited by Ren Jianmin 任建民, *People's Daily*, 21 Apr. 2016, en.people.cn/n3/2016/0421/c90000-9047469.html.

As such, the PLA is referred to as a “political actor” in the Military and Security Developments Involving the People's Republic of China 2020, drafted by the US Department of Defense, and thus the PLA’s goals for the adoption of and investment into AI technologies can be regarded as an extension of the CCP’s AI ambitions.⁸⁶ Due to this intertwined relationship, larger decisions seemingly made by the PLA leadership may likely stem from a political will of the CCP to maintain or pursue a certain strategy, rather than stemming from the PLA itself.

3.2 The PLA’s AI Ambitions

The PLA has grand ambitions for its modernization and development in the near future. The white paper entitled “China’s National Defense in the New Era” released by the State Council Information Office of the People’s Republic of China, describes the Chinese government's view on their national defense policy and military ambitions. The PLA is described as aiming to “comprehensively enhance combat capabilities for the new era”.⁸⁷ The “New Generation Artificial Intelligence Development Plan”, clearly demonstrates the PLA’s AI ambitions. The plan outlines aims to “Promote all kinds of AI technology to become quickly embedded in the field of national defense innovation.” as well as “Strengthen a new generation of AI technology as a strong support to command and decision-making, military deduction, defense equipment, and other applications”.⁸⁸ Alongside this, extensive research has been done by the PLA and leading military universities on the military applications of AI. This is demonstrated by such articles as “Will artificial intelligence command future wars?” (人工智能将指挥未来战争?)⁸⁹ or “Artificial Intelligence: Subversively changing the ‘rules of the game’”(人工智能:颠覆性改变“游戏规则”)⁹⁰, both of which can be found on the PLA’s official news website. The latter of these articles demonstrates the need for military AI in its opening paragraph;

Whoever can process information faster, understand the operating environment, implement decisions and execute strikes will win the initiative. Compared with the human brain, the biggest advantage of artificial intelligence is that it has faster response speed, greater capacity, and is not

⁸⁶ Office of the Secretary of Defense, p. 26.

⁸⁷ “China’s National Defense in the New Era.” *The State Council Information Office of the People’s Republic of China*, July 2019, http://english.www.gov.cn/archive/whitepaper/201907/24/content_WS5d3941ddc6d08408f502283d.html. p. 9

⁸⁸ “Guowuyuan guanyu yinfa xin yidai rengong zhineng fazhan guiha de tongzhi 国务院关于印发 新一代人工智能发展规划的通知.”

⁸⁹ Yuan, Yi 袁艺. “Rengong zhineng jiang zhihui weilai zhanzheng? 人工智能将指挥未来战争? .” Edited by Li Chen 李晨, 中国军网, 12 Jan. 2017, www.81.cn/jmywyl/2017-01/12/content_7448385.htm.

⁹⁰ Chen, Hanghui 陈航辉. “Rengong zhineng: Dianfu xing gaibian ‘youxi guize’ 人工智能:颠覆性改变‘游戏规则.’” Edited by Zhang Shuo 张硕, 中国军网, 18 Mar. 2016, www.81.cn/jskj/2016-03/18/content_6966873_2.htm.

limited by time, space or physical strength. Therefore, in order to speed up their own decision-making cycle and enter the enemy's decision-making cycle, the militaries of various countries will increasingly rely on artificial intelligence to win this decision-making cycle battle.

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There have been multiple high-level workshops and symposiums with leading experts and thinkers both within and outside the PLA⁹², allowing for a clear insight in contemporary military thought. From these leading military experts, two conclusions can be drawn. **(1)** First, AI technologies will come to play an important auxiliary role in supporting military capabilities, through generating military action plans, running simulations and evaluations, and assisting commanders in the decision-making process. AI entering the “field of command and decision-making” is described as “inevitable”.⁹³ Facing increasingly complex battlefield environments, the processing and analysis of big data is seen to provide an important technological advantage for the PLA. Top experts within the PLA believe that the integration of man and machine “will become the basic mode of military command and decision-making in the future” and that they must therefore “accelerate the development of intelligent command and decision-making in our army”.⁹⁴ **(2)** Second, there is a prevailing emphasis on catching up to the United States militarily, and the PLA sees AI as a tool to not only catch up, but leapfrog past the US.⁹⁵

⁹¹ Ibid ;

Original quote - “信息时代的战争，交战双方的核心竞争发生在认知领域，谁能够更快地处理信息、理解行动环境、实施决策并执行打击，谁就能赢得主动。与人脑相比，人工智能的最大优势是反应速度更快、容量更大且不受时空或体力限制。因此，为加快己方决策周期，并进入敌方决策周期，各国军队都会越来越多地依靠人工智能赢得这场决策周期之争。”

⁹² Zhang, Xiaohai 张晓海, et al. “Research on Intelligence of Military Auxiliary Decision Making System Based on Deep Learning.” 兵器装备工程学报, vol. 39, no. 10, 2018, p. 1., doi:10.11809/bqzbgcxb2018.10.033. ;

“Weiqi ren ji dazhan yu junshi zhihui juece zhineng hua yantao hui guandian zongshu 围棋人机大战与军事指挥决策智能化研讨会观点综述” 中国军事科学, Feb. 2016.

<https://oversea-cnki-net.resources.asiaportal.info/KCMS/detail/detail.aspx?dbcode=CJFD&dbname=CJFDLAST2017&filename=XKSJ201602019&v=4yvUOZYFIYOhZsndpbIYXkBzF9DK%25mmd2FFmWIHQEdh1%25mmd2FgRx9C%25mmd2Fvc1vl6FJbQFCBjNTxl>

⁹³ Guo, Ruobing 郭若冰, et al. “Meet New Challenges to Military Command in the Intelligence Era——A Summary of the PLA Symposium on ‘The Complexity of War and the Simulation of Informationized Warfare.’” 中国军事科学, 2016, p. 151.

<https://oversea-cnki-net.resources.asiaportal.info/KCMS/detail/detail.aspx?dbcode=CJFD&dbname=CJFDLAST2017&filename=XKSJ201605020&v=4yvUOZYFIYP3SNBSP5b7ml2bWSTPxsrkuQu%25mmd2BnjlAa1rEhYRF9Gft8AC8Hs6nLnDh>

⁹⁴ “Weiqi ren ji dazhan yu junshi zhihui juece zhineng hua yantao hui guandian zongshu 围棋人机大战与军事指挥决策智能化研讨会观点综述.” p. 151.

⁹⁵ “China’s National Defense in the New Era.” ; Zhang, Xiaohai 张晓海, et al.

The PLA's view on AI appears to have shifted from the hypothetical to practical application in recent years. An example of this is PLA AI wargame competitions,⁹⁶ such as the “Stratagem at Heart, Joint Victory by Intelligence” (谋略方寸 联合智胜), hosted in 2020 by the Equipment Development Department of the Central Military Commission (中央军委装备发展部). This competition was partnered with China Electronics Technology Group Corporation (中国电子科技集团), PLA National University of Defense Science and Technology (中国人民解放军国防科技大学), and China Aerospace Science and Industry Corporation (中国航天科工集团有限公司). The competition had participants submit AI algorithms which would militarily resolve an island dispute, wherein the “blue side” has possession of two islands, while the “red side” tries to recover these occupied islands.⁹⁷ The comprehensive and advanced nature of these AI algorithms is demonstrated by the competition description, as it states that the submitted AI programs can “control hundreds of combat units in 15 categories, including early warning aircraft, fighters, bombers, electronic warfare aircraft, ground radars, air defense missiles, shore-based anti-ship missiles, and destroyers.” and “issue more than 40 mission instructions such as route maneuvering, area reconnaissance, fire distribution, electronic countermeasures, etc., highlighting the hierarchical, coordination and complexity of AI command and decision-making.” The initial description of the competition also highlights that this kind of intelligent wargaming AI technology has reached a “key breakthrough”, and refers specifically to AlphaGo's victory of Lee Sedol as an example of this.⁹⁸ That such a recent event still refers to AlphaGo is emblematic of its continued relevance.

3.3 The PLA's Relationship with AlphaGo

As the PLA considers intelligent warfare to be on the horizon⁹⁹, it appears to have been partially led to this conclusion by the existence of AlphaGo and its successes against some of the worlds best Go players. The week after AlphaGo defeated 18-time Go world champion Lee Sedol, a top-level workshop/seminar was hosted by “China Military Science” (中国军事科学),

⁹⁶ Beyond the “谋略方寸 联合制胜” competition mentioned in this essay, the PLA Rocket Force (PLARF) also held an AI challenge entitled “智箭·火眼” “Intelligent Rocket, Fire Eyes” aimed at using AI to increase rocket precision strike capabilities. See “Dongfeng kuaidi, yao ni zhuli--huojian jun ‘zhi jian·huoyan’ rengong zhineng tiaozhan sai deng ni lai zhan.” Edited by Ye Mengyuan, 中国军网, 9 Sept. 2020, www.81.cn/hjj/2020-09/09/content_9900420.htm.

⁹⁷ This scenario is clearly meant to be representative of a PLA invasion of Taiwan. The scenario is further described as “The Red side has organized sea and air forces to vigorously defend their rights. The red side intends to attack the blue side's two island command posts, paralyzing its command system.”

⁹⁸ “DC jingsai-da shuju jingsai pingtai DC竞赛-大数据竞赛平台.” 中央军委装备发展部, encourage.dcyjingsai.com/WarGame.html.

⁹⁹ “China's National Defense in the New Era.” p. 6

a journal administered by the PLA Academy of Military Science. This seminar was specifically held to discuss the “the Game between AlphaGo and Lee Sedol and the Intelligentization of Military Command and Decision - Making”.¹⁰⁰ Numerous leading PLA thinkers and experts within both AI and military matters were invited, including:

- He Lei 何雷, the vice-president of the PLA Academy Military of Science.
- Zhang Zhenjiang 张振江, the deputy minister of the Scientific Research Guidance Department of the PLA Academy of Military Sciences and a Major General in the PLA.¹⁰¹
- Wang Chengwei 汪成为, a leading expert in China's computer industry and former permanent consultant of the PLA General Armament Department and the Ministry of Science and Technology.¹⁰²
- Li Deyi 李德毅, an expert in command automation and artificial intelligence, researcher for the 61st Research Institute of the General Staff of the PLA, chairman of the Chinese Artificial Intelligence Society, and honorary chairman of the Chinese Command and Control Society.¹⁰³
- Lin Jianchao 林建超, the chairman of the Chinese Go Association (vice chairman at the time of the seminar), former director of the PLA General Staff Office, member of the Military Strategic Planning Advisory Committee, and a Major General in the PLA.¹⁰⁴

The workshop concluded that the match between AlphaGo and Lee Sedol was “a landmark event with important influence”¹⁰⁵ which had a “great impact on people's thinking, especially

¹⁰⁰ “Weiqi ren ji dazhan yu junshi zhihui juece zhineng hua yantao hui guandian zongshu 围棋人机大战与军事指挥决策智能化研讨会观点综述.” p. 147.

¹⁰¹ Zhang, Zhenjiang 张振江, et al. “Theoretical Connotation and Practical Requirement of ‘Scientific Military Theories Are Warfighting Capabilities.’” 中国军事科学, p. 1., <https://oversea-cnki-net.resources.asiaportal.info/kcms/detail/detail.aspx?filename=XKSJ201602008&dbcode=CJFD&dbname=CJFD2016&v=>

¹⁰² Mo, Xiao 莫晓. “‘863’ Jihua: Gaibian zhongguo de keji zhanlue ‘863’计划:改变中国的科技战略.” no. 9, 2016, oversea-cnki-net.resources.asiaportal.info/KCMS/detail/detail.aspx?dbcode=CJFD&dbname=CJFDLAST2016&filename=FLWS201609003&v=vjjPtDF4etz%mmmd2Bx5pjuivj%mmmd2B1E%mmmd2BpHyPxxvZpX14QIyffUu%mmmd2B1SMXSw3omBfZeiZTK0Avh ;

“Academician Wang Chengwei Was Invited as Adjunct Professor of DCST.” Department of Computer Science and Technology, Tsinghua University, www.cs.tsinghua.edu.cn/publish/csen/4894/2012/20120326090342254914779/20120326090342254914779_.html.

¹⁰³ “Li Deyi 李德毅” 北京邮电大学, www.bupt.edu.cn/info/1070/13996.htm ;

Li Deyi 李德毅. “Yuanchuang gun lideyi: Zhi chuang weilai weilai yi lai 原创 | 李德毅: 智创未来 未来已来” 中国人工智能学会通讯, no. 1, 2017, www.caai.cn/index.php?s=/home/article/qikandetail/year/2017/month/01.html.

¹⁰⁴ Lin, Jianchao 林建超, and He Yunbo 何云波. “Xinren wei xie zhuxi Lin Jianchao zhuanfang (shang) jiangjun de weiqi moulue 新任围协主席林建超专访(上) 将军的围棋谋略.” 手机新浪网, 30 Dec. 2017, sports.sina.cn/others/qipai/2017-12-30/detail-ifyqefvw2411961.d.html.

¹⁰⁵ “Weiqi ren ji dazhan yu junshi zhihui juece zhineng hua yantao hui guandian zongshu 围棋人机大战与军事指挥决策智能化研讨会观点综述.” p. 147. ;

Original quote - “一、围棋人机大战是一个具有重要影响的标志性事件”

military command and decision-making thinking”¹⁰⁶. AlphaGo was clearly seen as impressive in its own right, and its significance was explored in detail. (AlphaGo was also clearly seen as a representation of the forefront of American AI technology, and a cog in the greater machinery of the US ambition for AI supremacy, and this will be covered in more detail on page 28, in the section entitled “AlphaGo’s Place Within the Greater US AI Framework”)

The match was considered by Wang Chengwei to have a “profound strategic background”¹⁰⁷, and was described by Lin Jianchao as being “a landmark event in the development and practical application of artificial intelligence technology, the scientific principles revealed by it have universal significance and value, and the shocking radiation effect produced by it is also worthy of deep vigilance in military theory circles.”¹⁰⁸

Lin Jianchao elaborated on four primary ways that the AlphaGo victory over Lee Sedol may directly affect perceptions and thinking on AI, “especially military command and decision-making thinking”. These were: (1) The perception that AI does not possess the capacity to think may change, through the development of modern science and technology. (2) The idea that AI can only play an auxiliary role in the decision-making process may change. Although the currently prevailing mainstream view of AI is that it can only serve to aid human decision-making, the idea of machines and humans working in parallel, or AI cognition playing the primary role in the decision-making process, has emerged. Furthermore, (3) the idea that AI cannot surpass human thinking may change. Both humans and machines have their cognitive advantages, and the notion that humans will remain the primary decision-makers while intelligent machines will remain in an auxiliary role is challenged. Here, Lin Jianchao claims the artificial intelligence community predicts that by 2045, the cognitive abilities of AI will in some respects reach or surpass the human brain. Finally (4) the idea that AI can only imitate humans, and that humans can not learn from AI, may change. While modern AI mainly imitates humans, the development of technology shows signs of this changing, and humans and machines have begun learning and improving together.¹⁰⁹

A few months after this first seminar, in June 2016, another academic seminar was held focusing on "Complex Military Systems in the Era of Big Data" which included a panel discussion specifically on AlphaGo. This seminar was held by the PLA National Defense

¹⁰⁶ Ibid p. 149.

¹⁰⁷ Ibid p. 147

¹⁰⁸ Ibid p. 149

¹⁰⁹ Ibid p. 149

University¹¹⁰ (another one of the PLA's top academic institutes alongside the PLA Academy of Military Science¹¹¹). Invited to speak were such notable experts as:

- He You 何友, an expert in the informatization of the military, director of the Institute of Information Integration at the PLA Naval Aviation University, director and doctoral supervisor of the Military Key Laboratory of Naval Information Perception and Integration Technology, and the vice chairman of the Chinese Command and Control Society.¹¹²
- Hu Xiaofeng 胡晓峰, a leading expert in wargame computer simulations and professor at the Joint Operations College of the PLA National Defense University, and a Major General in the PLA.¹¹³
- Tan Yuejin 谭跃进, professor at the College of Systems Engineering at the PLA National Defense University, former Vice Chairman of the Chinese Society of Systems Engineering, member of a professional group of the PLA Equipment Development Department.¹¹⁴
- Cao Yimin 曹益民, Chief of Staff of the PLA Western Theatre Command, former commander of the 21st Group Army and 47th Group Army, and a Major General in the PLA.¹¹⁵
- Guo Ruobing 郭若冰, an expert in information warfare, Director of the Department of Information Operations and Command Training at the PLA National Defense University, former dean of the Defense Academy of the PLA National Defense University,

¹¹⁰ Guo, Ruobing 郭若冰, et al. p. 149.

¹¹¹ Office of the Secretary of Defense, p. 141.

¹¹² “He You 何友.” *Chinese Academy of Engineering*, www.cae.cn/cae/html/main/colys/42602659.html. ; “Zhongguo gongchengyuan yuanshi haijun hangkong daxue He You jiaoshou xueshu baogao 中国工程院院士 海军航空大学何友教授学术报告.” *Faculty of Electronic Information and Electrical Engineering, Datian University of Technology*, 12 July 2018, ee.dlut.edu.cn/info/1123/9113.htm.

¹¹³ Luo, Jinmu 罗金沐. “Guofang daxue lianhe zuozhan xueyuan jiaoshou Hu Xiaofeng: Ba ‘qi lu’ yanshen dao budui zhandouli shengcheng zui qianyan “国防大学联合作战学院教授胡晓峰：把‘棋路’延伸到部队战斗力生成最前沿.” Edited by Li Jing 李晶, *Ministry of National Defense of the People's Republic of China*, 1 Sept. 2020, www.mod.gov.cn/education/2020-09/01/content_4870451.htm. ;

Zhang, Xiaonan 张笑男, and Guo Youjun 郭友军. “Shoujie xin shidai guofang wenhua chuangxin luntan zai xibei gongye daxue yuanman wancheng 首届新时代国防文化创新论坛在西北工业大学圆满完成.” *Northwestern Polytechnical University*, 19 Nov. 2020, news.nwpu.edu.cn/info/1002/73843.htm.

¹¹⁴ “Xitong gongcheng xueyuan Tan Yuejin jiaoshou wei nin jiedu xitong gongcheng chuangxin jiaoyu ji rencai peiyang 系统工程学院谭跃进教授为您解读系统工程创新教育及人才培养.” *National University of Defense Technology*, 23 July 2020, www.nudt.edu.cn/jy/jx/jxd/59c6bcc2897b427c80bb3e06de58f721.htm. ;

Ge, Tongtong 葛彤彤. “Guofang keji daxue xitong gongcheng xueyuan Tan Yuejin jiaoshou zuoke shang xueyuan xueshu luntan 国防科技大学系统工程学院谭跃进教授做客商学院学术论坛.” *Shandong University*, 3 Nov. 2020, shxy.wh.sdu.edu.cn/info/1006/8064.htm.

¹¹⁵ Yue Huairang 岳怀让, and Jiang Ziwen 蒋子文. “Di 21 jituanjun yuan jun zhang Cao Yimin diao ren xibu zhanqu lujun canmou zhang 第21集团军原军长曹益民调任西部战区陆军参谋长.” *澎湃新闻*, 15 Mar. 2017, www.thepaper.cn/newsDetail_forward_1639342.

Commandant of the National Security College at the PLA National Defense University, and a Major General in the PLA.¹¹⁶

- Lin Jianchao 林建超, mentioned above.¹¹⁷

Furthermore, more than 200 representatives, experts, and scholars from relevant agencies of the Military Commission and related fields inside and outside the military attended.

This panel discussion echoed many of the points raised in the previously mentioned seminar hosted by “China Military Science”, and covered not only AlphaGo’s groundbreaking significance as AI software, and what this may mean for AI technologies in the future, but also closely linked AlphaGo to the US race for AI supremacy.¹¹⁸ AlphaGo was described as “a huge breakthrough in artificial intelligence”¹¹⁹ by Lin Jianchao, and by Hu Xiaofeng as “an important milestone in the progress of machine intelligence”¹²⁰. Hu Xiaofeng continued to explain that the primary reason AlphaGo is seen as such a groundbreaking AI is due to its machine learning methodology. He elaborates with four reasons for why AlphaGo is of such note. These were: (1) Firstly, AlphaGo’s game knowledge was not coded into the program, but it was instead mastered through deep learning, demonstrating that it is “possible to solve the artificial intelligence self-learning problem that has [puzzled/plagued] us for a long time.” (2) Secondly, the ability to balance both the micro and macro aspects of the board, which Hu Xiaofeng referred to as the “intuition of Go”. Hu continues, this balancing “intuition” ability was in the past considered “unique to humans, and difficult for computers to achieve”. (3) Thirdly, the ability to discover Go moves that humans would not have thought of. This ability “gives us a preliminary demonstration of the ‘creativity’ of machines”. Finally, as AlphaGo was not explicitly taught the rules of Go or how to best approach the game, (but instead relied heavily on machine learning and teaching itself), its underlying algorithms can be seen as more general-purpose. This was described by Hu Xiaofeng as (4) having a “certain degree of ‘versatility’”, and its algorithms went beyond being a “cheat-sheet only applicable in the field of Go” to instead being “of great value as a reference for solving other problems, and therefore has broad application prospects.”

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¹¹⁶ “Feature: Overview of 1st China-Africa Peace and Security Forum.” Edited by Xu Yi, *China Military*, 17 July 2019, eng.chinamil.com.cn/view/2019-07/17/content_9560795.htm. ;

Yue Huairang 岳怀让. “Guo Ruobing shaojiang ren guofang daxue xinxi zuozhan yu zhihui xunlian jiaoyan bu zhuren 郭若冰少将任国防大学信息作战与指挥训练教研部主任.” 澎湃新闻, 22 Mar. 2016, www.thepaper.cn/newsDetail_forward_1447169.

¹¹⁷ See page 22.

¹¹⁸ Guo, Ruobing 郭若冰, et al. p. 149.

¹¹⁹ Ibid p. 151.

¹²⁰ Ibid p. 149.

¹²¹ Ibid p. 149-150. ;

Lin Jianchao believes, “The development process and methods [i.e. the AI algorithms used] of AlphaGo will have exemplary significance for the development of artificial intelligence in the field of command and decision-making,” and continues by claiming it “will bring revolutionary impact and influence on command and decision-making.”¹²²

He goes on to outline why AlphaGo is particularly groundbreaking (stating nearly identical reasons to those previously stated in the above mentioned workshop, covered on page 23).¹²³ Lin Jianchao then highlights the need for intelligent decision-making on the battlefield, calling “intelligent warfare” an “important tool and means to ensure timely, efficient, and correct command and decision-making.” AlphaGo, although obviously inefficient if directly applied in a military capacity, is seen as a starting point, as Lin highlights the need to leap from a “Go brain” (referring to AlphaGo, as a Go-playing AI-powered software) to a “command brain” (referring to a decision-making intelligent combat platform). This transition will include a leap “from flat battlefields [i.e the Go board] to three-dimensional battlefields, from complete information games to incomplete information games, from enclosed spaces to open space operations, from single force application to compound force application, from single goal decisions to comprehensive goal decisions...”.¹²⁴ The AlphaGo model of AI is evidently considered an important stepping stone on the pathway to incorporating AI technologies into the military.

Tan Yuejin continues to laud AlphaGo’s technological innovation, claiming that “From the perspective of artificial intelligence and military systems engineering, AlphaGo has achieved remarkable results in the development of artificial intelligence technology and the human-machine collaborative environment in terms of the rapid formation of decisions from big data and the verification of the correctness of the proposed decisions.”¹²⁵ Here, particular praise is directed at AlphaGo’s ability to form rapid decisions from big data, and then verify to ensure these decisions are the best possible at any given moment. Tan goes on to state that “AlphaGo provides us with a successful case of implementing a information-led and system-building strategy supported by big data.”¹²⁶

Original quote for Hu Xiaofengs third and fourth points - “三是能发现人类没有的围棋着法，这种发现“新事物”的能力为我们初步展示了机器的“创造性”；四是这种方法有一定“通用性”，而不仅仅是围棋领域的独门秘籍，对解决其他问题极具参考价值，因而具有广阔的应用前景。”

¹²² Ibid p. 152.

¹²³ Ibid p. 152.

¹²⁴ Ibid p. 152.

¹²⁵ Ibid p. 153.

¹²⁶ Ibid p. 153. ;

Original quote - “可以说，阿尔法围棋为我们提供了一个贯彻大数据支撑下信息主导、体系建设战略的成功案例。”

3.3.1 AlphaGo's Relevance to Wargaming Simulations

AlphaGo's groundbreaking ability to handle complex situations and form actionable decisions from big data clearly interests the PLA, as they look to apply these technologies to assist in military decision-making. Beyond this, AlphaGo's technological breakthroughs were seen as applicable in war-gaming (ie, the artificial simulation of warfare or combat scenarios¹²⁷). This is explored in greater detail in a paper entitled "AlphaGo的突破与兵棋推演的挑战" (AlphaGo's breakthrough and challenges of wargaming), authored by Hu Xiaofeng, mentioned above, and two colleagues also from the Department of Information Operation & Command Training of the PLA National Defense University.¹²⁸

Hu and his colleagues claim "Combat situation intelligence cognition technology is a key technology that urgently needs breakthroughs in the research and development of wargame systems" and that its importance lies in its ability to "improve combat command effectiveness through 'cognitive speed', which can significantly improve combat effectiveness"¹²⁹. In other words, breakthroughs in battlefield cognition technologies will allow for faster decision making (i.e greater "cognitive speed") and thus improve combat effectiveness. Referring to the problem of achieving "intelligent cognition of combat situations", the paper goes on to state:

"AlphaGo's breakthrough has demonstrated the possibility of solving this problem, teaching the computer to understand the combat situation, judge the situation and make correct decisions, that is, "perceived understanding" and "autonomous decision-making", which together constitute the most important "cognition" of the combat situation aspect."¹³⁰

The decision-making process of AlphaGo is evidently held in such high regard that it demonstrates the capacity for simulating the complexity of war games. Or, as the Hu and his colleagues put it;

What AlphaGo finds is not a 'win-in-chess' solution [i.e. some infallible, silver bullet-like solution], but more accurate calculations, more accurate judgments and more comprehensive analysis to achieve a better understanding of how to win in Go than a 'human'. From this point of view, it is foundationally the same as war game deduction.¹³¹

¹²⁷ Hu, Xiaofeng 胡晓峰, et al. p. 53.

¹²⁸ Ibid p. 49, 60.

¹²⁹ Ibid p. 58.

¹³⁰ Ibid p. 54.

¹³¹ Ibid p. 54. ;

Original quote - "AlphaGo找到的并非是一种“下棋必胜”的方案，而是更精确的计算、更准确的判断以及更全面的分析，达到比“人类”更好的围棋如何取胜的理解。从这一点来看，它与兵棋推演是基本一致的。”

AlphaGo's abilities to parse big data, and (through AI powered self-learning algorithms) make more accurate calculations and better decisions than any human, has clearly demonstrated the potential power of artificial intelligence, and its possible applications on the battlefield. The "Summary of the Workshop on the Game between AlphaGo and Lee Sedol and the Intelligentization of Military Command and Decision — Making" is summarized with six conclusions to be drawn from the AlphaGo - Lee Sedol match. These include (1) strengthening "collaborative innovation", (2) making "artificial intelligence technology the core and focus of our military's scientific and technological research", and (3) a need to "vigorously strengthen the construction of information resources" (i.e emphasizing the accumulation of big data). The fourth conclusion drawn is (4) a call for an increase in investment in AI. The need for further investment is justified by highlighting how much money has been spent on AlphaGo. "In 2013, Google spending 400 million US dollars to buy the British company DeepMind is a very far-sighted decision" and continues by detailing how Google has spent more than 100 million US dollars just in the electricity costs alone, "This strategic approach is very much worth learning from."¹³²

3.4 AlphaGo's Place Within the Greater US AI Framework

As mentioned previously, the PLA considers the ability to have AI understand and analyze military big data integral to modernizing its military capabilities, and to ensure parity with the US armed forces.

He You considers military big data "a strategic resource which supports national security and army building" and believes the application of military big data has an "important strategic significance" which "cannot be underestimated". Furthermore, he claims it will change the nature of cyberspace warfare, trigger new types of warfare, and spark a transition from information-based warfare to 'intelligent' warfare. However, research in multiple key areas is needed for these breakthroughs to occur. This research, He states, should be carried out on a national level.¹³³ It is clear from this that the understanding of big data, and thus the implementation of AI to parse and analyze big data, is considered of vital importance to the PLA, and that the ideal means of achieving AI supremacy is to invest on a national level.

¹³² "Weiqi ren ji dazhan yu junshi zhihui juece zhineng hua yantao hui guandian zongshu 围棋人机大战与军事指挥决策智能化研讨会观点综述." p. 152.

¹³³ Guo, Ruobing 郭若冰, et al. p. 153.

This position is clearly reflected in the “Military-Civil Fusion”, or MCF, national strategy adopted by the CCP. In order to achieve military dominance (through AI supremacy), the CCP aims to integrate civilian research and commercial sectors with its public sector.¹³⁴ A US Department of Defense document on the MCF summarizes its importance thusly:

The CCP sees MCF as critical to advancing its regional and global ambitions. It believes that artificial intelligence (AI) will drive the next revolution in military affairs, and that the first country to apply AI to next generation warfare will achieve military dominance.¹³⁵

This centralized, top-down, unified approach to AI research appears to be projected on to the US as well.

AlphaGo is repeatedly referred to in the context of a greater US investment into AI, and its ties to the US has led to its achievements therefore being seen with an increased level of alarm and interest. Lin Jianchao, speaking in the June 2016 seminar on "Complex Military Systems in the Era of Big Data" makes this link abundantly clear. Lin claims that “what deserves great attention and vigilance is that this project [i.e AlphaGo] is closely related to two ongoing US national strategies.”¹³⁶

The first of these two strategies is “the strategy that the United States is vigorously promoting from big data to intelligent decision-making”. Elaborating, Lin mentions the U.S Presidents Office of Science and Technology Policy releasing the first big data policy document in 2012 (which specifically includes the intelligentization of military decision-making systems), DARPA’s 2012 report on using big data to support decision-making, and the US Department of Defense establishing both the Digital Defense Service and the Defense Innovation Advisory Board. Lin continues by stating that the chairman of this board is Eric Schmidt, the executive chairman of Google’s parent company, Alphabet Inc.¹³⁷

The second national strategy is the “third offset strategy”,¹³⁸ an initiative launched in 2014 by the Department of Defense to develop innovative and advanced technologies to sustain and advance US military dominance.¹³⁹ Lin claims that on December 8, 2015, the Department of Defense announced it would invest between US\$12 billion and US\$15 billion in the fiscal year

¹³⁴ Office of the Secretary of Defense, p. 19.

¹³⁵ “Military-Civil Fusion and the People's Republic of China.” *U.S. Department of State*, May 2020, www.state.gov/wp-content/uploads/2020/05/What-is-MCF-One-Pager.pdf.

¹³⁶ Guo, Ruobing 郭若冰, et al. p. 151.

¹³⁷ *Ibid* p. 151.

¹³⁸ *Ibid* p. 151.

¹³⁹ Hagel, Chuck. “Reagan National Defense Forum Keynote.” U.S. Department of Defense. www.defense.gov/Newsroom/Speeches/Speech/Article/606635/.

of 2017 to support the "third offset strategy", and follows this by saying "The timing of the announcement is just before the official announcement of the Google AlphaGo team."¹⁴⁰ Lin Jianchao evidently sees a clear link between the timing of "the official announcement of the Google AlphaGo team" and the US government investment in AI. Lin Jianchao then continues,

Based on this, it is reasonable to judge that human intelligence is an important technological entry point for the United States to implement the 'third offset strategy.' AlphaGo is definitely not just a game for playing, behind it is a holistic strategic plan, and the impact is fundamentally not in the technical level, but in the strategic deterrence and challenge. The AlphaGo man-machine battle is a highlight of the 'soft power' of the United States. It is a test measure of the capabilities of the in-depth learning system and the effect of intelligent decision-making. It is a typical American version of 'military-civilian integration.'¹⁴¹

In the "Workshop on the Game between AlphaGo and Lee Sedol and the Intelligentization of Military Command and Decision - Making", Lin Jianchao lists three examples of the US being "extremely keen" and attaching great importance to technological innovation, "with artificial intelligence as its core". These are the Obama administration's BRAIN Initiative, the establishment of the Department of Defense Defense Innovation Advisory Board, and thirdly, Google's "huge investment" in the research and development of AlphaGo.¹⁴²

The connections between AlphaGo and US government interest in AI are found throughout multiple high-level PLA documents, as AlphaGo is mentioned in close relation to multiple high level US government officials, agencies and organs, such as DARPA¹⁴³, Secretary of Defense Ashton Carter¹⁴⁴, and President Obama and the Obama administration's Office of Science and Technology Policy¹⁴⁵.

¹⁴⁰ Guo, Ruobing 郭若冰, et al. p. 151.

¹⁴¹ Guo, Ruobing 郭若冰, et al. p. 151-152.

¹⁴² "Weiqi ren ji dazhan yu junshi zhihui juece zhineng hua yantao hui guandian zongshu 围棋人机大战与军事指挥决策智能化研讨会观点综述." p. 150.

¹⁴³ Guo, Ruobing 郭若冰, et al. p. 151.

¹⁴⁴ Ibid p. 154.

¹⁴⁵ Ibid p. 151. ;

"Weiqi ren ji dazhan yu junshi zhihui juece zhineng hua yantao hui guandian zongshu 围棋人机大战与军事指挥决策智能化研讨会观点综述." p. 150.

4 Conclusions

The question this essay has aimed to answer is whether AlphaGo's victories against Lee Sedol and Ke Jie impacted the Chinese government's perception of AI as a tool for military development and geopolitical influence.

In summary, there are numerous indices suggesting a changed attitude toward AI due at least in part to AlphaGo, however, this relationship can not be claimed with full confidence as the links between AlphaGo and a changed perception of AI from the Chinese government are hard to find explicitly stated.

The South Korean government's investment into AI due to AlphaGo's victory of Lee Sedol demonstrates AlphaGo's potential to change perceptions on AI. Similarly, the PLA clearly saw their perceptions on AI challenged by the success of AlphaGo.¹⁴⁶ Whether or not AlphaGo had a similar effect on China's top senior officials can not be stated with equal certainty.

There are, however, certain potential correlations of note. The Five-Year Plans underscore the need to "promote innovation in military technology"¹⁴⁷ and strengthen coordination of joint military-civilian development of technologies such as artificial intelligence,¹⁴⁸ while the white paper entitled "China's National Defense in the New Era" released by the Chinese State Council Information Office, as well as the AIDP, further demonstrate the Chinese government's ambitions to strengthen, modernize and intelligentize the PLA. Although it is impossible to say for certain the degree to which this is true, these ambitions indicate a willingness from the CCP to adopt new and innovative technologies at the requirement or request of PLA experts.

The PLA experts who attended the "Workshop on the Game between AlphaGo and Lee Sedol and the Intelligentization of Military Command and Decision - Making" were clear in their key takeaways from AlphaGo's victory, as their conclusions included making "artificial intelligence technology the core and focus of our military's scientific and technological research", and highlighted the need for an increased investment in AI, emphasizing how much money had been spent on AlphaGo and highlighting that "This strategic approach is very much worth learning from."¹⁴⁹

¹⁴⁶ For two examples of this, see Lin Jianchao's four primary ways that the AlphaGo victory over Lee Sedol directly affected perceptions and thinking on AI on page 23 or Hu Xiaofeng's four reasons for why AlphaGo is such a groundbreaking AI on page 25.

¹⁴⁷ Quote from The 12th Five-Year Plan (2011–2015), see page 13.

¹⁴⁸ Found in the 14th Five-Year Plan (2021-2025), see page 14.

¹⁴⁹ This is discussed in further detail on page 28.

This essay has been unable to demonstrate whether this call for making “artificial intelligence technology the core and focus of our military's scientific and technological research” has been put into practice. However, the increased funding for AI research, combined with the increased interest in AI technologies evidenced by the AIDP and the Five-Year Plans, do speak in favor of this. The call for increased investment in AI, has been seen through, however.¹⁵⁰

Although this essay could not definitively tie AlphaGo to increases in funding, certain indices of AlphaGo being a contributing factor exist, such as Kai-Fu Lee describing the science park Zhongguancun as the “beating heart of China’s AI movement” and following this up by claiming “To people here, AlphaGo’s victories were both a challenge and an inspiration.”¹⁵¹. Although this may be considered mere anecdotal evidence, credibility is lent to these statements through Kai-Fu Lee’s own company being headquartered in Zhongguancun and his 30+ years of AI research and close ties to the industry-leading companies at the forefront of AI research. Furthermore, Zhongguancun was selected as the location of the first “National New Generation Artificial Intelligence Innovation Development Pilot Zone”, and has seen enormous growth in the years since AlphaGo’s victories.¹⁵²

AlphaGo being viewed as intrinsically linked with US investment into AI may also have played a role in how its victories were perceived by the PLA.

4.1 AlphaGo Within the Greater US AI Framework: Application of Jervis'

Offense-Defense Theory

The PLA’s views on AlphaGo as an integral part of the US’ investment into and showcasing of AI technologies can be further understood through the application of Robert Jervis’ Offense-Defense theory, explained in further detail below. This theory is a further elaboration of the Security Dilemma theory originally coined by John Herz.¹⁵³ The Security Dilemma theory, as described by Herz, is explained as follows: As groups and individuals (or indeed countries) are concerned about their security, seeking not to be attacked, subjugated, or annihilated, they are driven to acquire more and more power. This subsequently increases the insecurity of other

¹⁵⁰ See the section entitled “The Annual Budgets and Investment into AI Research” on page 15

¹⁵¹ See page 16.

¹⁵² See the section entitled “The Annual Budgets and Investment into AI Research” on page 15

¹⁵³ Tang, Shiping. “The Security Dilemma: A Conceptual Analysis.” *Security Studies*, vol. 18, no. 3, 2009, p. 590., doi:10.1080/09636410903133050.

parties, encouraging them to respond by acquiring more power. As no entity or state can ever feel fully secure in such an environment of increasing power and heightened competition, a vicious cycle is formed; the Security Dilemma.¹⁵⁴

Robert Jervis' theory states that when an offensive posture is indistinguishable from a defensive posture, and the offensive has a military advantage over the defensive, then the security dilemma is "doubly dangerous", and the risk of war increases significantly.¹⁵⁵ This theory may help contextualize some of the PLA's actions regarding AI, in particular how they view AlphaGo as a part of American AI innovation.

As "Decision makers act in terms of the vulnerability they feel, which can differ from the actual situation"¹⁵⁶, whether this theory *objectively* applies to the AlphaGo/AI situation is largely irrelevant. What is more applicable is whether the two proposed postulates - (1) that offensive behavior is indistinguishable from defensive, and (2) that the offensive has a military advantage over the defensive - is *considered* true by the CCP and PLA leadership.

(1) Offensive behavior being indistinguishable from defensive

The PLA clearly finds AI technologies to be revolutionary in enhancing military capabilities. However, the PLA remains unknowing as to the full extent of US AI capabilities. This is evidenced by Lin Jianchao's claim that not only is China "lagging behind the world's powers [i.e the US] in the field of artificial intelligence" but that "the United States had deliberately caused the world to misjudge the level of its artificial intelligence technology" and thus "Lee Sedol's complete defeat was the result of [this] misjudgment."¹⁵⁷ This uncertainty of US capabilities naturally lends itself to increased unease and mistrust. Jervis writes that when "one state gains invulnerability by being more powerful than most others", then "Others who are more vulnerable will grow apprehensive, which will lead them to acquire more arms".¹⁵⁸ As AI can be applied in either an offensive or defensive capacity, through its broad application potential, if the CCP and PLA leadership thus feel vulnerable and apprehensive they are likely to interpret rapid AI investment as potentially offensive. This is in line with Jervis' claim that

¹⁵⁴ Ibid

¹⁵⁵ Jervis, Robert. "Cooperation under the Security Dilemma." *World Politics*, vol. 30, no. 2, 1978, p. 211., doi:10.2307/2009958.

¹⁵⁶ Ibid p. 174.

¹⁵⁷ Guo, Ruobing 郭若冰, et al. p. 155.

¹⁵⁸ Jervis, Robert. p. 173.

states which are predisposed to see each other as adversaries will react with greater speed and intensity than if they do not consider each other threats.¹⁵⁹

(2) The offensive having a military advantage over the defensive

Alongside offensive behavior being indistinguishable from defensive, the security dilemma is “doubly dangerous” when the offensive has a military advantage over the defensive. Jervis states that “Technology and geography are the two main factors that determine whether the offense or the defense has the advantage”.¹⁶⁰ The PLA clearly acknowledges that AI technologies are a crucial tool to achieve military supremacy. It also clearly finds AI to have great offensive capacity. This is exemplified in the PLA AI wargame competition mentioned above on pages 20 and 21, in which AI programmes competed to best assault politically disputed islands in realistic wargame simulations. The widespread application opportunities of AI technologies allow for potentially devastating applications in an offensive manner, and coupled with the PLA’s uncertainty surrounding US AI capabilities, this results in a “doubly dangerous” security dilemma and an apprehensive PLA.

Thus, there are multiple factors which exacerbate the PLA’s perceived noteworthiness or “severity” of AlphaGo’s victories.

- AlphaGo is considered a “huge breakthrough” and “an important milestone in the progress of machine intelligence”¹⁶¹, the groundbreaking technology behind it being applicable in an offensive fashion¹⁶² and a tool to bolster military strength.¹⁶³
- AlphaGo is regarded as a part of the US national investment into AI.
- The US is considered adversarial, at least in regards to military technology advancements. Thus, technological breakthroughs are perceived as a greater threat and thus warrant a stronger reaction.
- The potentially offensive nature of a military application of AI technologies, in combination with the above mentioned invulnerability stemming from a power imbalance between two states, leads to feelings of apprehension and vulnerability within the state with lesser power.

¹⁵⁹ Ibid p. 175.

¹⁶⁰ Ibid p. 194

¹⁶¹ See page 25.

¹⁶² For an example of this, see the discussion on PLA-hosted AI wargames on pages 20 and 21.

¹⁶³ For an example of this, see the section entitled “AlphaGo’s Relevance to Wargaming Simulations” on page 27.

AlphaGo, being perceived as emblematic of the technological capabilities of US military power, may therefore be considered a catalyst for increased spending in AI technologies from the Chinese side.

5 Future Research

As this essay focused largely on the PLA and its perception of AI, there remains many interesting aspects for future studies exploring the relationship between AlphaGo and the Chinese government. Two such relevant aspects to research would be how (1) AlphaGo's influence on the Chinese private sector, and (2) AlphaGo's influence on the Chinese public, as reflected in both social and traditional media, subsequently affected the Chinese government.

- (1) The preliminary research for this essay found indices of major Chinese technology companies being influenced by the success of AlphaGo. An interesting area of further research would be whether, and if so to what extent, an increased interest in AI from the private sector has influenced the Chinese government and encouraged the drafting of a national plan for AI development, such as the AIDP.
- (2) The Chinese public may have played a role in establishing a mainstream popular appeal in AI technologies. This may have encouraged actors such as the government, or indeed the private sector, to act upon this increased interest and invest in AI. Guided by such questions as “was there a significant shift in public perceptions of AI following the AlphaGo matches?” and “is there a precedent in widespread public opinion influencing Chinese political decision making?” further studies could explore the extent to which the AlphaGo matches shaped and influenced public perception on AI.

The abundance of information on the PLA's views on AlphaGo also begs the question of why such a significant amount of information is available, and whether or not the PLA has made the above mentioned documents public to intentionally foster a certain perception of AlphaGo or artificial intelligence.

Furthermore, as the relationship between AlphaGo and governments beyond the Chinese regime remains outside the scope of this essay, this may be a relevant basis for future research.

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