# Analysis of VR Communication Imbalance from a 5G Perspective (Postprint)

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## Abstract

With 4G gradually being superseded by 5G, VR technology is undergoing continuous innovation across user experience, infrastructure configuration, and application domains. Within the mimetic macro-environment of 5G communication, issues attendant upon VR technology are increasingly commanding attention, encompassing communication predicaments such as cognitive deviation between physical and virtual spaces arising from technological mimesis, cognition of the ethical boundaries of technology, disequilibrium between emotional resonance and spatiotemporal judgment, and the conflation of personal and public spaces. Therefore, from a 5G perspective, it is imperative to correctly comprehend how to rationally employ VR technology for information dissemination within the 5G context.

## Full Text

## Preamble

**Title:** Analysis of VR Communication Imbalance Issues from a 5G Perspective
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**Abstract:** As 4G is gradually replaced by 5G, VR technology continues to innovate across audience experience, facility configuration, and application domains. Within the mimetic environment of 5G-enabled communication, problems arising from VR technology have attracted increasing attention, including cognitive biases between real and virtual spaces, ambiguity in the ethical boundaries of technology, imbalances between emotional resonance and spatiotemporal judgment, and confusion between personal and public spaces. Therefore, it is essential to approach VR technology from a 5G perspective to understand how to use it reasonably for information dissemination in this new context.

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In 2015, video platforms such as iQiyi and Youku began integrating VR technology into their content. That same year, *People' s Daily* incorporated VR into news reporting, allowing audiences to experience news scenes from a first-person perspective. The 2017 Chinese Volleyball Championships marked a historic first by employing VR live broadcasting, pioneering the use of VR in sports. By 2020, the CBA All-Star Game leveraged "8K+VR" technology to create an immersive experience that made viewers feel physically present. Indeed, VR technology has created a new form of communication medium through sensory intervention, fundamentally transforming traditional visual experiences and reshaping spatial perception. According to the China Academy of Information and Communications Technology, China' s current VR technology remains at the preliminary immersion stage, focusing on human-computer interaction and rendering processing. However, the arrival and widespread adoption of 5G could propel China' s VR technology toward full immersion.

McLuhan' s concept that "the medium is the message" suggests that a medium' s primary impact lies not in its transmitted content but in the environment it creates—an environment whose effects surpass the "messages" comprising its content [2]. The development of 5G validates McLuhan' s theory, as the communication environment facilitated by VR through 5G generates greater effects than the content itself. As Li Tengyue, President of Huawei' s AR/VR Division, stated, 5G development serves as a scaffold for the rapid advancement of the VR industry. From the perspective of Metcalfe' s Law, greater network size yields higher value, a principle that 5G amply demonstrates. In 2019, the Chinese government promoted the gigabit broadband initiative and designated the AI industry as a key priority. Economist Brian Arthur has also argued that the internet economy exhibits increasing returns, giving industry leaders greater advantages—making it crucial to integrate VR across all sectors.

## 1. 5G and VR: A Match Made in Heaven

### 1.1 The Origin of VR

VR (Virtual Reality), first coined by American Jaron Lanier, refers to a computer-generated virtual world that enables fully immersive, interactive simulation experiences. The emergence of computers in the mid-20th century

propelled VR development forward. Since the 1960s, institutions such as MIT, the University of North Carolina, and the University of Washington have conducted in-depth research. By the 1980s, NASA began using VR technology to study and explore cosmic environments, applying it to Mars exploration missions. In 2012, Google' s release of the futuristic smart device "Google Glass" sparked the first global wave of wearable smart devices, officially heralding the era of mass-market electronic wearables built on VR technology frameworks. Since then, VR has permeated diverse industries, including news reporting, game development, and medical equipment.

### 1.2 VR Development in China

Compared to foreign countries, China' s VR research began relatively late. According to the China Academy of Information and Communications Technology, China's current VR technology remains at the preliminary immersion stage, characterized by human-computer interaction and rendering processing. The arrival and comprehensive application of 5G may enable China' s VR technology to reach full immersion.

### 1.3 5G Applications for VR

With the advent of 5G, both fixed and mobile broadband have undergone gigabit upgrades, ushering in transformation and upgrading of media technology. First, growing mobile user demand aligns with 5G' s distinctive features of ultra-low latency and ultra-dense networking, which are well-suited for VR' s 360-degree panoramic viewing functions. In terms of immersive interaction, 5G provides comprehensive, precise matching and scene delivery for audiences' senses while improving image resolution to approach human eye discrimination capabilities. Spatiotemporally, 5G' s high-speed, low-latency technology enables multi-perspective input, multi-base station construction, and wide terminal connectivity, breaking through temporal and spatial limitations. In application domains, 5G successfully enables the Internet of Everything, providing an excellent foundation for VR to connect all things—such as VR real estate, dining and entertainment, and beauty and fitness. Regarding facilities, 5G meets VR' s hardware requirements for massive data transmission and storage through distributed core network models, meeting corresponding traffic demands and offering new opportunities for online video streaming and infrastructure equipment.

As McLuhan observed, people endow new technology with functions akin to sensory extensions, creating a new media environment in which the demarcation of boundaries becomes unconscious.

## 2. Communication Imbalance Phenomena

If virtual reality has captured people' s imagination before fully proving itself, it is because it surpasses all other technologies as a model of technological integra-

tion. The birth of new technology represents not only external morphological transformation but also fundamental changes to its core essence. With the rapid development of 5G, VR' s intervention has upgraded an increasing number of media forms. However, as a new technology industry, certain communication deviations and imbalances exist in this integration.

### 2.1 Cognitive Imbalance of Real-Virtual Boundaries

VR technology breaks the limitations of real space, enabling audiences to experience three-dimensional effects while transforming media transmission forms and methods. Riding the wave of 5G, VR technology can transcend previous limitations, delivering superior audio-visual experiences. For instance, in 2019, CCTV launched a VR channel that allowed users to experience VR realism simply by placing their phones in a VR headset box. The same year, the Second Youth Games also employed VR technology to enable athletes to appreciate China's magnificent landscapes. In recent years, VR technology has been trialed across various scenarios—VR film viewing, VR shopping convenience, and VR tour experiences—gradually eroding the boundary between reality and virtuality. In the movie *Doctor Strange*, the sorcerer can switch between real and virtual spaces; similarly, VR technology, aided by 5G, presents a world where reality and virtuality coexist. When people lack sufficient analytical capabilities, they can easily be influenced by immersive environments, mistaking them for reality and causing cognitive imbalance between objective reality and virtual reality.

### 2.2 Cognitive Bias in the Good-Evil Boundary of Technology

Technology itself is a neutral tool without inherent good or evil distinctions. Just as water can carry a boat or overturn it, technology can facilitate convenience while also creating unexpected situations—everything depends on the user' s intentions. VR technology significantly enhances audio-visual sensory experiences, creating more intelligent spaces for human-computer interaction and adapting to different scenarios and architectures. However, we must remain vigilant: although 5G can help VR technology apply more widely across fields and make information easier for audiences to comprehend, malicious actors may exploit VR technology for illegal profits. From the developer perspective, VR technology may conflict with domestic media behavior norms when designing information transmission methods, causing clashes with mainstream social values. From the user perspective, unfamiliarity with VR technology often leads users to gravitate toward VR content that aligns with their interests, making them unable to resist negative influences—VR gaming being a prime example. Users immersed in interactive virtual worlds become unable to distinguish between reality and the virtual gaming environment.

### 2.3 Empathy Experience and Spatiotemporal Judgment Imbalance

The popularization of 5G has enhanced VR technology' s immersive and imaginative features. VR constructs virtual space through subjective perspectives,

providing users with realistic human-computer interaction and sensory fusion. However, VR devices require high-speed, low-latency performance to ensure smooth and realistic transmitted content; otherwise, excessive duration leads to poor user experiences such as dizziness. 5G has enabled a qualitative leap for VR technology, achieving the goal that "China' s virtual reality industry will rank among the world' s top players, with significantly enhanced innovation capabilities, substantially improved application service supply levels, markedly elevated VR application capabilities, and notably increased development quality and efficiency across economic and social fields." For example, due to the pandemic in 2021, many exhibitors could not attend trade shows, facing temporal and spatial restrictions. Organizers could use VR technology for panoramic broadcasting to enable online participation. Similarly, in real estate, VR technology allows prospective buyers to view completed properties before construction finishes, saving time and energy costs for both parties while meticulously displaying housing structures to buyers and greatly improving sales conversion rates.

However, after upgrading sensory experiences through 5G, VR technology can also monopolize users' sensory experiences and information reception in real space. Although traditional media channels occupy users' audio-visual senses, other sensory systems remain semi-idle, allowing users to think objectively about what they see and hear. VR technology, however, causes users to become fully immersed, preventing all sensory systems from receiving real-space information in real time. This comprehensive immersion easily triggers emotional resonance, causing them to conflate virtual and real spaces [4]. Additionally, 5G networks enable higher-definition image quality for VR video, providing a solid foundation for VR live streaming. "Live + VR" offers users a beyond-virtual experience, easily confusing real and virtual spaces and generating cognitive imbalance and emotional resonance.

### 2.4 Confusion Between Personal and Public Space

As science and technology develop, media forms change accordingly, with the user perspective becoming mainstream. After 5G' s emergence, VR has undergone qualitative transformation. First is the change in location attributes: 5G endows VR-transmitted content with three-dimensional spatial perception, providing both stereoscopic and immersive sensations. For example, VR panoramic immersion uses scene construction, eye-tracking instruments, and depth-of-field lens perspectives to transmit and reproduce information. Despite its advantages, VR technology' s disadvantages are also notable—for instance, its excessive reliance on wearable all-in-one devices that cannot be carried conveniently. Second is customization: leveraging 5G' s high-efficiency, low-latency attributes, VR can reduce device dependency while obtaining high-definition image quality to optimize visual experiences and reduce dizziness. Consequently, 5G+VR focuses more on personal user experiences and enhances interpersonal interaction. Finally is the unity of sharing and practicality: because 5G+VR can connect

objects to people, objects to objects, and people to people, constructing a data-common virtual space for content sharing within this scope, it breaks traditional cognition. No longer is VR information defined simply by human terminals; instead, it is defined based on objects' input and output terminals. Every object becomes a VR carrier during secondary information transmission, fusing its characteristic attributes with VR. Thus, people encounter different VR presentations when contacting different objects, forming an invisible 5G+VR network that permeates every corner of society [5].

However, problems emerge: when 5G provides VR with personalized, private, and customized services, users may become overly immersed in the virtual world created by VR technology, unable to extricate themselves—much like how today's "short video personalized recommendations" distract and addict many users. If this continues, users may end up living exclusively within the "pseudo-environment" tailored for them by VR, losing critical thinking and initiative, ultimately trapped in "information cocoons." This could lead to social public topics gradually fading from attention, with the public sphere dissolving in individuals' minds and becoming difficult to reconstruct. Both industry and academia should carefully consider the issue of personalized customization.

As China's economy transforms and its middle class expands, the VR market will enjoy broad development space in the coming decade, providing infinite possibilities for VR technology and market development. Currently, after leveraging 5G, VR has undergone qualitative changes both internally and externally: internal changes refer to increasingly smooth data content transmission, while external changes involve all-in-one devices being replaced by mobile personal devices applied across various fields. The emergence of 5G has driven improvements in VR device R&D, technological innovation, and user experience. However, 5G's high-efficiency, low-latency application to VR technology has also caused problems such as blurred boundaries between real and virtual space, cognitive bias in technological good-evil boundaries, empathy experience and spatiotemporal judgment imbalance, and confusion between personal and public spaces—concerns shared by both academia and industry [6]. Therefore, regardless of how communication channels and content innovate, we must adhere to selecting virtual symbol content suitable for mainstream society, cultivate users' media literacy to familiarize them with VR devices without causing addiction, enable them to distinguish scene authenticity, and enhance VR information objectivity while constructing real and virtual spaces. Both academia and industry must comprehensively understand VR technology's new development possibilities from a 5G perspective and use VR reasonably and appropriately to grasp its connotations.

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*Note: Figure translations are in progress. See original paper for figures.*