The Obscuring of Production Relations by the Upgrading of Headphone Technology from a Political Economy of Communication Perspective

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Abstract. Against the background of the continuous development of digital media and the consumer electronics industry, headphones have gradually become everyday media devices that regulate individual perception, emotional states, and social relations. Taking the upgrading of headphone technology as the point of entry, and based on the perspective of the political economy of communication, this paper analyzes the technological logic, consumption logic, and industrial logic behind closed-back, semi-open-back, and open-back headphones. The study finds that functions such as noise reduction, transparency, and openness, while relieving sensory pressure and improving convenience of use, also gradually transform structural issues that originally belong to the levels of urban governance, labor rhythms, and public space into "private troubles" in which individuals rely on consumer technologies for self-regulation, and to a certain extent obscure the deep-seated contradictions in production relations.

Keywords: headphone technology, political economy, production relations, principal contradiction, mediatized society

1. Introduction

In contemporary urban life, headphones have gradually become a kind of media device that people carry with them in their daily lives. Whether during subway commuting, at office workstations, or in public scenes such as campuses and streets, people are increasingly accustomed to using headphones to maintain a certain distance from the external environment: some people use noise-cancelling headphones to isolate noise and interference from the outside; some use transparency mode to switch rapidly between being "online" and being "detached"; and some rely on open-back headphones to continue retaining their perception of the surrounding environment during work, exercise, and social interaction. From this perspective, what headphones change is not only the way people "listen"; they are also quietly adjusting the connection relationship between people and the environment, and between people and society. Behind this phenomenon, what is actually reflected is the relatively common sensory pressure and emotional anxiety in contemporary society. As the pace of urban operation continues to accelerate, information connection remains constantly online, and public space also becomes increasingly crowded, many problems that should originally belong to

the level of the public environment and social structure are continuously translated into consumption choices at the individual level. Against such a background, headphone technology continues to upgrade, seemingly providing people with a more comfortable, more efficient, and also freer life experience. At the same time, however, it also brings out a question worthy of further inquiry: why do more and more social pressures eventually need to be relieved through personal consumer technologies?

From the perspective of the political economy of communication, the formation, promotion, and use of technology are always embedded in specific capital logic and social relations. The development of headphone technology, on the one hand, reflects the progress of digital media and the consumer electronics industry; on the other hand, it also, to a certain extent, reflects the transformation mechanism of contradictions in contemporary society, namely that structural problems that originally belong to the public sphere and the institutional level are being continuously translated into consumption choices, self-management, and emotional regulation at the individual level.

Based on this, this paper takes the development process of headphone technology and its consumption practices as the point of entry, and, from the perspective of the political economy of communication, discusses the structural tension existing between the upgrading of headphone technology and production relations. The article will conduct analysis around technological logic, consumption logic, and industrial logic, and further explore the possible substitution relationship formed between technological remedy and public governance, thereby explaining how technological progress obscures, to a certain extent, the problems of production relations in contemporary society.

2. Literature review

In recent years, as intelligent media technologies have continuously penetrated daily life, research on the relationships between technology and human beings, and between technology and society, has also gradually presented more diversified theoretical perspectives. The existing literature related to the topic of this paper can generally be understood from several aspects: first, the reshaping of social relations and perceptual experience by technology; second, the power structures and governance logic implied behind technology; and third, the influence exerted by social conditions and social relations on technological development itself.

Some studies mainly approach the topic from the perspective of the interaction among technology, culture, and perception, focusing on how technology changes individual behavior and modes of social interaction. In their study on social bots, Shi Wen and Chen Changfeng, through an analysis of China-related topics on the Twitter platform, revealed how automated algorithms intervene in the dissemination of public opinion, change the original structure of information interaction, and further affect the process through which human users come into contact with information [1]. Yang Guang and Yu Jialing, starting from the interactive relationship between algorithms and users, discussed the influence of news recommendation mechanisms on information visibility and user initiative, pointing out that algorithms may, on the one hand, lead to a narrowing of the scope of information exposure, and, on the other hand, may also, under specific conditions, expand the paths through which individuals obtain information [2]. On this basis, related studies generally regard technology as an important "intermediary" mechanism connecting individuals and society [3], and emphasize that, against the background of the era of "algorithmic existence" [4], technology has already deeply participated in the reconstruction of the relationship between human beings and the world.

At the same time, some scholars have also examined technology within the framework of power structures and social governance from a critical perspective. Qi Cheng pointed out in his discussion of "auditory politics" that auditory perception can be coded and can further become an important tool of power discipline and modern governance; the distribution of sound and the control of "audibility" themselves constitute a kind of power practice [5]. Through analyzing the problem of the "black-boxing" of artificial intelligence technology, Qiu Yunqian and Chen Changfeng revealed how technological platforms and financial capital use algorithms to "counter-incorporate" professional media and form new centers of power [6]. Liu Riming, based on Marx's philosophy of technology, emphasized that technology itself and the social application of technology cannot be simply equated, thereby drawing a boundary between positivism and romanticism in technological criticism [7]. Chen Changfeng further pointed out that algorithms are not merely technical procedures, but complex sociotechnical systems [8]. These studies jointly show that technological development never occurs in isolation; it is always closely connected with specific power structures, social relations, and modes of governance.

In addition, some studies have reflected on the process of technological evolution from the perspective of the social logic of technological development. Xiao Feng systematically expounded the theory of the "social shaping of technology" (SST), arguing that technology does not advance independently and completely according to its own internal logic, but is continuously shaped under the combined effects of social needs, social choices, and social regulation [9]. Taking printing technology as an example, Liu Xiuxiu and Song Chenting proposed a "relational perspective," arguing that technological evolution is not a simply linear process of "progress," but the result of continuous "collision" and "negotiation" between internal iteration and external social structures [10]. Qi Chengshui, from the perspective of Marxist dialectics of human studies, emphasized that technological development needs to be understood within human subjectivity and social practice, and that the realization of the essence of technology also cannot be separated from specific fields of social life [11].

Overall, existing research has already formed relatively rich discussions on the cultural meaning of technology, the logic of technological operation, and the social power relations behind it, and has also provided important theoretical resources for analyzing contemporary digital technology. However, there remains a research space worthy of further advancement: at present, relatively few studies take specific consumer electronic products, especially highly personalized and everyday media devices such as headphones, as independent objects of analysis, and further place them within the framework of production relations for systematic examination.

3. Analysis

3.1. Technological logic: evolutionary characteristics of three types of headphone technology

The first type is closed-back headphones, whose technological orientation is mainly embodied in "high isolation." Represented by active noise-cancelling headphones such as AirPods Pro and the Sony WH-1000XM series, such products usually create a relatively private auditory space for users through the combined effect of physical sealing and electronic algorithms. In relatively noisy public environments such as subways, streets, and offices, closed-back headphones can effectively weaken external noise and satisfy individuals' needs for sensory privacy and a focused state. As "sensory overload" has gradually become a common experience in urban life, the popularization of closed-back headphones can also be regarded as a technological response made by people to high-pressure and noisy environments.

The second type is semi-open-back headphones, whose core characteristic lies in "switchable connection." Represented by in-ear wireless headphones such as Huawei FreeBuds and Samsung Galaxy Buds, the design focus of such products is not merely to isolate external sounds, but to provide a mechanism that can quickly switch between "isolation" and "connection." Users can flexibly switch between noise-cancelling mode and transparency mode according to different scenarios such as commuting, working, and communication, thereby completing state adjustment between "being online at any time" and "being detached at any time."

The third type is open-back headphones, whose technological orientation places more emphasis on "continuous connection." Represented by open-back devices such as Shokz bone-conduction headphones and Sony LinkBuds, such products no longer rely completely on the traditional ear-canal sealing design, but allow users to retain their perception of sounds in the surrounding environment while listening through bone conduction or an open-back structure. Compared with closed-back headphones, open-back headphones, to a certain extent, reduce the discomfort that may be caused by long-term wearing, and also lower safety risks in scenarios such as outdoor exercise and commuting. Their technological logic is more inclined to maintain the basic connection between individuals and the external environment, so that users can still be situated in a relatively open social context when using the device.

Overall, these three technological paths correspond respectively to different auditory needs and usage scenarios in daily life. Headphones have evolved from simple acoustic tools into perceptual switches that regulate the relationship between individuals and the external world. As McLuhan said, "the medium is the extension of man," and any medium will rearrange the sensory ratios of human beings [12]. Media extend human sensory abilities and also reshape the relational structure between people and the environment. For users, choosing headphones is essentially choosing a posture for interacting with the surrounding world.

3.2. Consumption logic: buying solutions or buying anxiety

Technology provides users with diversified choices, but the core that drives consumption often comes from individuals' need to respond to social anxiety. In the context of consumer society, technological progress and commercial marketing interact with each other, transforming originally abstract social pressure into concrete commodity demands that can be consumed. As Baudrillard said, "consumption is no longer the use of objects, but the consumption of signs" [13].

First is the purchase of "tranquility." In crowded and noisy public spaces, users need to pay an additional cost to cope with sensory overload, and the demand for "quietness" even surpasses, to a certain extent, attention to sound quality itself. Taking Sony's flagship noise-cancelling headphones, the XM series, as an example, a large part of their price of several thousand yuan is reflected in paying for the experience of "blocking external interference." In the advertising visual presentation of "put them on and it becomes quiet immediately," consumers are actually purchasing a "firewall" for their own mental boundary that is difficult to maintain.

Second is the purchase of "control." The core selling point of highly integrated semi-open-back headphones lies in improving efficiency and a sense of control. Taking the seamless linkage between Apple AirPods and the iPhone ecosystem as an example, users can complete functions such as answering calls and voice activation through simple operations, and this convenience is packaged as an effective tool for coping with information overload. Just as Schönberger described "the Internet of Everything" in Big Data [14], this technological experience enables users to obtain a feeling of efficient movement through fragmented time, but at the same time, it also deepens, to a certain extent, dependence on being continuously online, making "offline" more difficult.

Third is the purchase of "safety." The popularity of open-back headphones, to a certain extent, reflects consumers' concern and anxiety about health and safety. The advertising narratives of related products often point to the potential risks of in-ear headphones, such as hearing damage, ear-canal discomfort, and safety hazards during outdoor use, and bind themselves to a "healthier" and "safer" lifestyle. In this process, consumption behavior is endowed with rationality and legitimacy.

Neil Postman once pointed out in Amusing Ourselves to Death that media forms profoundly affect the ways in which people understand the world and organize experience [15]. In this sense, headphones imperceptibly transform typical problems: originally structural social problems such as urban noise and work pressure are translated into "private troubles" that can be relieved through individual consumption, and technological products are thus expanded into a buffer zone connecting individuals and society.

3.3. Industrial logic: the capital drive behind the upgrading of headphone technology

Behind technological differentiation and consumer desire is the internal logic through which industrial capital continuously seeks valorization. Judging from the current market structure, the headphone industry is mainly driven by the dual forces of brands and platforms, jointly promoting the continuous progress of technological iteration and consumption upgrading.

At the brand level, constructing a "closed" or "semi-closed" technological ecosystem has become a core strategy. Taking Apple AirPods as an example, they have become a key component of Apple's ecosystem, and the exclusive functions brought by H-series chips have formed stable technological barriers, locking users into the existing system to a certain extent. In the competitive environment driven by capital, the headphone market presents the characteristics of high-frequency iteration and refined price stratification. Even among noise-cancelling headphones, different brands and models can still form a price range of thousands of yuan due to differences in functional configurations, thereby constructing a consumption structure that covers different levels of payment ability, and on this basis guiding users to continue upgrading. As Chen Changfeng pointed out, differences in technological application will bring about new social divisions, and the technological levels and price differences of headphones are also shaping new identity symbols and a "digital divide" in auditory experience [8].

At the platform level, more attention is paid to the closed-loop operation of content production and consumption conversion. On the one hand, streaming media platforms continuously strengthen users' attention to sound quality and device performance by providing high-resolution audio content, thereby stimulating their demand for higher-end headphone products. On the other hand, content platforms such as Douyin, Bilibili, and Xiaohongshu have gradually become important arenas for headphone "grass-planting" and product reviews. In this process, KOLs (Key Opinion Leaders) transform originally relatively abstract technical parameters into experiential narratives that are easier for users to perceive and accept; algorithmic recommendation accurately pushes relevant content and purchase links to potential consumers; and live-streaming e-commerce further completes the connection from the arousal of interest and the stimulation of desire to actual purchase. The marketing chain driven by the content ecosystem enables market demand to be continuously manufactured and converted and satisfied within a relatively short time.

Overall, industrial logic shows that each upgrade of headphone technology often does not merely point to the improvement of product performance, but also simultaneously opens up new consumption scenarios and higher profit space. Driven by capital logic, technological progress not only serves the optimization of product functions, but also gradually becomes an important way to stimulate consumption and create demand. Marx once pointed out that "production not only

produces an object for the subject, but also a subject for the object" [16]. In this sense, technology and commodities do not merely passively satisfy existing needs; they are also continuously shaping new consuming subjects and consumer desires.

4. Discussion

4.1. The substitution relationship between "self-regulation" and "public regulation"

The convenience brought by headphones is, in essence, an efficient form of individualized technological regulation. It can allow individuals to obtain an immediate and autonomous opportunity to "exit" in complex environments, or complete rapid switching between different states. However, when this seemingly free personal choice is placed at a more macro social level, it may also produce a certain substitution effect, namely replacing the collective governance of public issues with individualized technological solutions.

When more and more people choose to cope with urban noise through noise-cancelling headphones, the practical urgency of issues such as noise control and acoustic design of public spaces in urban planning may be weakened to a certain extent. McLuhan's proposition that "the medium is the message" still has relatively strong explanatory power here: as a medium, the core message transmitted by headphones is not merely "hearing more clearly" or "hearing more quietly," but a turn in lifestyle, that is, people no longer prioritize attempts to transform the external environment, but instead turn more toward the optimization of personal internal experience [12]. In this process, public space presents a trend of fragmentation because of individuals' technological "withdrawal." Habermas pointed out in The Structural Transformation of the Public Sphere that the public sphere depends on "rational discussion among private individuals on public affairs" [17]. Once this communicative space is replaced by privatized media, publicness will face structural weakening. While individuals obtain sensory comfort, they also gradually reduce their opportunities to share space and interact with others.

4.2. Production relations problems obscured under the progress of productive forces

From the perspective of Marxist political economy, the progress of headphone technology undoubtedly reflects the development of productive forces. However, when the improvement of productive forces fails to match the corresponding adjustment of production relations, technological progress may instead, to a certain extent, conceal or even displace deep structural problems.

For example, noise-cancelling headphones can alleviate fatigue and discomfort during commuting to a certain extent, but they cannot shorten commuting distances, nor can they change structural realities such as "extreme commuting." Although the seamless connection and multi-device collaboration of TWS headphones improve operational efficiency, they also blur, to a certain extent, the boundary between work and life, strengthening the working state of "being online at any time" and "being on standby at any time." In this sense, what headphones perform is closer to a "buffering" or "pain-relieving" function similar to a "plaster," that is, under the premise of not changing existing structural conditions, they carry out local regulation of the pressure borne by individuals, but find it difficult to touch the root of the problem. DeNora distinguished two mechanisms, "removal" and "refurnishing," in Music Asylums [18]. The former refers to individuals withdrawing from the real environment through music and obtaining temporary relief; the latter refers to improving the overall state by changing the environment itself. In comparison, headphones

belong more to the former path, namely realizing "withdrawal" from reality through individualized technology, rather than changing structural conditions.

Marx once pointed out that "the power of capital over labor, and the degree of labor's dependence on capital, also increase accordingly" [19]. While machinery improves production efficiency, it also strengthens domination and control over workers. In the digital age, personal technological devices such as headphones assume similar functions to a certain extent: by providing immediate sensory comfort and psychological adjustment, they help individuals better adapt to existing work rhythms and social environments, thereby objectively maintaining the operation of existing production relations. However, a question worthy of further inquiry is: who determines the direction of technological development? How are technological dividends distributed? And why, while society as a whole continues to develop, do individuals increasingly rely on technological devices for self-regulation and emotional buffering? Together, these questions constitute an important point of entry for understanding contemporary technological society.

4.3. Implications

Taking headphones, an everyday technological device, as a case can provide implications for understanding several important issues in contemporary society.

First, attention should be paid to the transformation mechanism of the principal social contradiction in the new era within daily life. The people's aspiration for a better life is often refined in concrete practice into the pursuit of technological functions, such as the demand for higher-performance noise-cancelling headphones. In this process, macro-level social contradictions are translated into micro-level consumption behavior, and technological consumption becomes, to a certain extent, a "buffer mechanism" for easing social tension, while concealing the risk of dissolving public issues. Second, public governance needs to form a clearer ordering of values. When individuals cope with environmental problems by purchasing devices, their costs and effects often show obvious differences, and it is difficult for them to cover broader groups of people. By contrast, the overall improvement of the public environment has stronger inclusiveness and long-term benefits. Therefore, it is necessary for governance thinking to gradually shift from "promoting individuals' adaptation to the environment" to "optimizing public environmental conditions," and to invest more effort at the level of public regulation, such as urban planning and labor laws. Third, the technology and media industries should strengthen a responsible development orientation. In market competition and marketing communication, they should avoid excessively using social anxiety to stimulate consumer demand, and should instead pay more attention to the practical value of technological innovation and reasonable pricing mechanisms, so as to reduce "hierarchical consumption" and "anxiety consumption" caused by technological differences.

Finally, it is necessary to return to the basic Marxist principle concerning the dialectical unity of productive forces and production relations. Technological progress is not an end in itself. How to make innovation serve fairer social distribution, more reasonable working models, more livable living environments, and freer and more comprehensive human development is the ultimate question in the face of technological progress. As Marx once said, "the philosophers have only interpreted the world in various ways; the point, however, is to change it" [19]. The meaning of technological development should ultimately return to the improvement of social relations.

5. Conclusion

Headphones may be one of the most ordinary and also most easily overlooked technological products in contemporary society, but precisely because they are sufficiently everyday, they can better reflect the real changes in the relationship between technology and society. While headphones provide individuals with convenience and comfort, they also, to a certain extent, help people "adapt" to the existing environment, thereby weakening further inquiry into structural problems. Technological progress therefore presents a kind of complexity: it truly improves human experience, but it may also invisibly obscure the root causes of problems. In many cases, what people truly need is a living environment in which they do not have to rely on headphones in order to obtain quietness, dignity, and a sense of relaxation. This is perhaps also a question that is more worthy of being reconsidered beyond technological development.

Of course, this paper still has certain limitations. Since the research is mainly based on theoretical analysis and case observation, it lacks support from more systematic user surveys and industrial data. Future research can combine specific user interviews, platform communication mechanisms, and the development trends of smart wearable devices to continue discussing the relationship between "individual self-regulation" and "changes in social structure" in the digital age.

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