

Art and digital: synchrony and tangibility

A study on the immersive experience effect of digital red culture venues for young children

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Abstract: To implement the important directives on protecting and utilizing revolutionary heritage, and in alignment with national cultural digitization strategies, children and youth should be prioritized as vital demographic for disseminating revolutionary culture. The conventional, singular approach to disseminating traditional revolutionary culture is no longer sufficient to meet the current needs of this demographic. To address this issue, this study employs questionnaire surveys grounded in Piaget's cognitive development theory and concrete operational theory. This study employs data analysis of collected samples to investigate the relationships among immersive form, content concretization, and technological adaptability in digital revolutionary cultural venues, and their collective impact on immersive experience outcomes. Results demonstrate a positive correlation between these factors and immersive experience outcomes within digital venues. Based on these findings, this paper proposes relevant recommendations to provide theoretical and practical guidance for the digital dissemination and immersive experiences within red culture digital venues.

Keywords: children and young people; digital venues for revolutionary culture; cognitive development; concrete cognition

1 Introduction

The world is currently undergoing a once-in-a-century transformation, with profound shifts occurring in international relations. As 2025 marks the 80th anniversary of the victory in the Chinese People's War of Resistance Against Japanese Aggression and the World Anti-Fascist War, it is imperative to fully implement General Secretary Xi Jinping's important directive delivered during the 31st collective study session of the Political Bureau of the CPC Central Committee: We must devote our hearts, emotions and efforts to safeguarding, managing and utilizing our revolutionary heritage effectively [1]. The Ministry of Culture and Tourism, the Ministry of Education, the Communist Youth League Central Committee, the All-China Women's Federation, and the China Working Committee for Caring for the Next Generation have jointly issued the notice entitled *Action Plan for Utilizing Red Resources to Cultivate New Generations for the New Era: Red Tourism Boosting the Initiative to Forge Character and Nurture Talent (2023–2025)* [2]. This initiative aims to fully leverage red resources, promote and disseminate red culture, and cultivate a deep sense of patriotism among young people. Exposing young people to the power of revolutionary culture through digital venues represents a vital avenue to preserve its legacy. Presently, children's engagement with revolutionary culture predominantly involves visiting historical museums, attending educational lectures, and viewing revolutionary films – approaches that tend towards one-way dissemination. Consequently, young audiences offer limited feedback on their experiences, as their lack of direct wartime experience makes it difficult to fully appreciate the heroic deeds of China's revolutionary forebears.

Compared to traditional methods of learning about revolutionary heritage, digital venues dedicated to revolutionary culture serve as immersive, all-encompassing digital experience centers. Employing virtual interaction, holographic imaging, and live performances, they offer children a novel immersive experience, enabling them to genuinely appreciate the hardships and challenges of China's revolutionary struggle. This fosters a deeper appreciation for the present era of prosperity and happiness, helping young people inherit and promote the spirit of revolutionary culture while strengthening their cultural confidence. The establishment of digital venues for revolutionary heritage actively responds to the national strategy of building a cultural powerhouse. By harnessing digital technology to empower cultural development, these venues creatively transform revolutionary resources, fostering greater confidence in revolutionary culture and advancing it to a higher level. With the rapid advancement of digital technology, China's digital society has entered an era of intelligence. Currently, dozens of such digital venues for revolutionary heritage exist nationwide, many of which have been designated as National Patriotic Education Bases and Revolutionary Cultural Teaching Bases. Research integrating concrete object theory with Piaget's cognitive development theory to explore children's red culture education remains scarce both domestically and internationally. Through this investigative study, the author aims to uncover the strengths and shortcomings of immersive experiences within digital red culture venues for young audiences. This endeavour seeks to chart new developmental pathways for enhancing such immersive experiences in digital red culture venues catering to children.

2 Research hypotheses

On 22 May 2022, the General Office of the Central Committee of the Communist Party of China and the General Office of the State Council issued the *Opinion on Advancing the National Cultural Digitization Strategy*. It states that by the end of the 14th Five-Year Plan period, the cultural digitization infrastructure and service platform should be largely established. By 2035, a national cultural big data system will be built, presenting a comprehensive panorama of Chinese culture, with the nation's cultural digitization achievements shared by all citizens [3]. As a vital component of Chinese culture, the digital presentation of revolutionary heritage to the public must transcend the limitations of traditional dissemination methods. Issues such as dogmatic delivery and lack of engagement have become particularly evident among younger audiences. Enhancing the immersive experience within digital revolutionary cultural venues will foster the sustainable development of innovative approaches to disseminating this heritage.

The term "concrete" may function both as a noun, denoting a tangible form or image, and as an adjective, signifying something specific or non-abstract [4]. In Wang Fuzhi's *Commentary on the Book of Documents: The Three Moulds from the late Ming Dynasty*, it is stated: "Observing reveals form; examining reveals pattern." The eye directly perceives the shape of things, while through the analysis and induction of these forms, one may discern underlying principles (that is, the pattern). Scholar Chang Zhiguo's couplet reads: "Diligence and benevolence shape the form of the heart's office; clouds embody simplicity, radiating literary brilliance." Through the body, abstract qualities are transformed into concrete, visible forms; through the environment, the senses are internalized into the spirit, thus forming a cognitive loop. Traditional approaches to disseminating revolutionary culture have predominantly employed a "scattergun" strategy, focusing primarily on "what we can offer" while frequently overlooking "what the audience desires". This has resulted in revolutionary cultural dissemination failing to accurately align with the specific preferences of its intended recipients [5]. The immersive experience of revolutionary culture for young children can be enhanced through tangible, audible, visible, perceptible, and experiential digital venues. These serve as platforms for learning about revolutionary heritage, thereby fostering cultural confidence and patriotic sentiment among the younger generation.

Swiss psychologist Jean Piaget's theory of cognitive development divides children's cognitive growth into four stages,

emphasizing how youngsters gradually understand the world through active exploration and interaction with their surroundings. This paper primarily examines the cognitive development of children aged 2 to 11 regarding red culture. Following Piaget's framework, this group is categorized into the preoperational stage (2-7 years) and the concrete operational stage (7-11 years). Children in the former stage can express themselves and understand objects through language and images, yet lack logical reasoning abilities. Those in the latter stage possess some logical reasoning capacity, but they often learn from others through concrete experiences or by observing behaviour. They find it difficult to confidently and independently solve abstract problems. Children in these two age groups have yet to develop a fully formed understanding of revolutionary culture. Lacking direct experience of revolutionary history, their primary exposure to such culture comes through history textbooks or revolutionary films and television programmes, with occasional visits to revolutionary history museums. However, the content of revolutionary culture learned through these traditional methods is difficult for them to comprehend accurately and comprehensively at their current cognitive level. Embodiment theory in cognitive science suggests that the interaction between the body and the environment inherently constitutes the primary source of meaning[6]. Beyond the brain, the physical structures of limbs, facial features, and torso also constitute significant experiential components in the formation of mental processes through their interactions with the surrounding environment [7]. The Red Culture Digital Exhibition Hall employs digital audio-visual technology, three-dimensional modelling, augmented reality (AR) and virtual reality (VR) techniques to present revolutionary heritage in a digital, immersive format for young audiences. Unlike the static narratives of textbooks or conventional films, visitors here can physically experience the sensation of "goose-feather snow", feel the "biting cold wind", and witness the sudden detonation of a "bomb"- the deafening explosion and pungent smell of gunpowder forcing them to cover their noses as they proceed. They raise the crimson Five-Starred Red Flag high above their heads with both hands. The digital venue for revolutionary culture constructs a virtual reality world for young audiences, enabling authentic environmental sensations and experiences across sight, sound, taste, smell and touch. The effectiveness of this immersive experience hinges upon the comprehensiveness of information input. The transition from traditional audiovisual sensory engagement to multi-sensory immersion significantly enhances knowledge and information acquisition [8]. Therefore, this paper proposes the following hypothesis.

Hypothesis 1: The immersive experience and heightened sense of identification that all artistic and technological forms within the Red Culture Digital Venue provide to young audiences can significantly enhance their immersion in Red Culture. That is to say, the superior the artistic and technological forms employed by the Red Culture Digital Venue, the stronger the immersion created, the more focused the young audience's attention becomes, the greater their sense of identification, and the more effective the immersive experience of Red Culture proves to be. The two factors are positively correlated.

Within the virtual experiential space, the presentation of red culture is three-dimensional and vivid, effectively achieving an overlap between the virtual and the real, history and the present. This renders "the individual themselves a medium, the boundaries of time and space dissolved, with the interaction between body and technology, senses and medium, enduring perpetually" [9]. The Guizhou Long March Cultural Digital Art Museum (hereinafter referred to as the "Red Ribbon") employs AI technology to simulate the voices of Red Army soldiers. Utilizing three-dimensional Dolby Atmos sound systems, it recreates the explosions, flames and gunfire of battle. When depicting the heroic sacrifice of Red Army soldiers, solemn music is played to immerse visitors in an authentic wartime environment. Throughout the venue, visitors encounter screens shaped like stone stalagmites sloping downward from above, while others resemble rock formations. Holographic projections immerse visitors in the harsh conditions of revolutionary warfare, creating a vividly

three-dimensional visual experience. When young visitors embark on the "Red Army's Long March" journey, the venue delivers such an audiovisual impact that they become "young Red Army soldiers" themselves, traversing time to immerse themselves in the revolutionary history found in textbooks. The Digital Red Culture Exhibition Hall employs digital technology to creatively transform traditional revolutionary heritage. It simplifies and visualizes the profound, often dull textual knowledge found in textbooks, into forms accessible to young minds. By simplifying and visualizing activities, it enables children to engage in cross-temporal "dialogue" and interaction with historical figures and narratives from textbooks. This significantly reduces cognitive barriers, helping them learn the spirit of sacrifice and dedication embodied by revolutionary forebears, truly grasp the essence of red culture, and strengthen their memory of it. Therefore, this paper proposes Hypothesis 2:

Hypothesis 2: There exists a positive correlation between the concretisation of content within digital red culture venues and the immersive experience of such venues for young children. That is to say, by rendering abstract and obscure red culture knowledge tangible, these digital venues facilitate children's comprehension and retention of red culture.

The embodiment of red culture primarily refers to presenting the information that carries the ideological, conceptual, and spiritual essence of red culture through diverse, concrete, and visualized forms [10]. Hubei Provincial Library has established the Hubei Red History and Culture Database to preserve revolutionary heritage and perpetuate revolutionary spirit. This database integrates local revolutionary historical facts, revolutionary figures, red landmarks, historical photographs, revolutionary documents, literary and artistic works, and relevant red-themed videos. Utilizing computer technology, multimedia, photography, and videography, it brings together these content sections into a comprehensive repository [11]. Given the current cognitive capacity of children to comprehend external matters, they are not yet equipped to properly grasp the essence of revolutionary culture. The digital revolutionary culture venue presents the specific content of such culture—such as historical events—through live performances or digital imagery, rendering it visually accessible in a manner comprehensible to young audiences. This generation of young people lacks direct experience of revolutionary history. Through immersive experiences in digital venues, they have, to a certain extent, transcended the limitations of their own understanding of revolutionary culture, compensating for their lack of imagination regarding it. For instance, the moment children enter the "Red Ribbon" venue, they become "young Red Army soldiers". Guided by Red Army actors, they climb snow-capped mountains and traverse grasslands alongside "Red Army warriors". Within this venue, they "time-travel" to the 1934 Battle of the Xiang River and experience the pivotal Zunyi Conference—a turning point in the Chinese Revolution—in a fully immersive, three-dimensional manner. Compared to textbook learning or oral history, children genuinely "experience" revolutionary history within these digital venues. This approach effectively captures their attention and interest, aiding their comprehension and retention of abstract concepts within revolutionary culture. Hence, this paper proposes Hypothesis 3:

Hypothesis 3: When utilizing technological equipment within the Red Culture Digital Venue, the technical adaptability of such equipment exhibits a positive correlation with the immersive experience outcomes for the young audience. That is to say, straightforward equipment operation can reduce distractions among the young audience during usage, thereby enhancing the immersive experience of Red Culture.

The technological equipment within the Red Culture Digital Experience Centre typically includes AR glasses, digital avatar video guides, gesture-input data controllers, three-dimensional sound systems, and head-mounted displays. The simpler and more intuitive the operation of such devices is, the more conducive they are to enabling children to immerse themselves fully in the digital venue's immersive experience of red culture. Through the implementation of the "Red Army Meeting at Shangqing Exhibition" project, Jiangxi Province has adopted advanced display technologies including

multimedia electronic sand tables, interactive multimedia sculptures, virtual reality exhibition booths, and three-dimensional immersive cinemas. These innovations transport visitors through time and space, placing them within authentic historical settings [12].

3 Research design

3.1 Research methodology

Employing a questionnaire survey methodology, this study investigates the factors influencing the immersive experience outcomes for young children within digital venues dedicated to revolutionary culture.

3.2 Questionnaire design

A questionnaire comprising 24 questions was designed using a five-point Likert scale to test the three proposed hypotheses, as shown in Table 1.

Table 1. Measurement table of variables influencing the immersive experience effect in digital red culture venues for children and young people

Variable	Measurement issues
Form Immersion	I felt as though the scenes within the venue were lifelike, as if I were right there inside them.
	I heard the sounds and music within the venue, making me feel as though I had stepped into a red story.
	I find the lighting, colours and animations inside the venue particularly captivating, making me want to keep watching.
	When I watch actors perform, I become utterly absorbed, feeling as though I've entered another world.
	I enjoy learning about these stories through animation, role-playing, dance, singing, and acrobatics.
Content concretisation	I think the story of the venue is told very clearly; I understood it perfectly.
	The animations and live performances within the venue helped me understand the heroic tales of history, and I have remembered this hero.
	The exhibits at this venue have taught me a great deal about revolutionary history that I hadn't learnt before.
	I shall learn from the heroes in the story and strive to become a worthy Chinese citizen.
Technical compatibility	I cannot understand the instruction manual for the technological equipment in the venue.
	I find the technological equipment in the venue far too heavy; I can only manage to lift it with Mum and Dad's help.
	When using the equipment within the venue, I do not experience any lag.
	I don't think these technological devices are suitable for us children to use.

This questionnaire survey yielded a total of 150 completed responses. After excluding 27 questionnaires from respondents who had not visited a digital venue for revolutionary culture or had provided incomplete information, 123 valid responses were retained.

4 Empirical analysis

4.1 An investigation into factors influencing the immersive experience effect of digital red culture venues for young children

4.1.1 Descriptive statistics

Following screening and collation, this study selected 123 valid sample datasets. Descriptive statistical analysis was conducted using SPSS 26.0, yielding the results presented in Table 2. The variables ranged from a minimum value of 1 to a maximum value of 5, with mean values distributed between 2.9 and 4.4 and standard deviations between 1.1 and 1.5. This indicates low data dispersion, rendering it unnecessary to discuss individual cases separately.

Table 2. Descriptive statistics of variables

Variable	Sample size	Minimum	Maximum	Mean	Standard deviation	Median
Authentic visuals	123	1.000	5.000	3.840	1.275	4.000
Authentic sound and music	123	1.000	5.000	3.873	1.244	4.000
Authentic lighting and colour	123	1.000	5.000	3.800	1.336	4.000
Authentic performance	123	1.000	5.000	3.887	1.277	4.000
Engaging methods such as dance and singing	123	1.000	5.000	4.073	1.153	4.500
Easy to memorize	123	1.000	5.000	3.567	1.184	4.000
Learning new knowledge	123	1.000	5.000	3.693	1.164	4.000
Highly infectious	123	1.000	5.000	3.707	1.196	4.000
Easy to understand	123	1.000	5.000	4.060	1.166	4.500
Difficult to operate	123	1.000	5.000	2.980	1.499	3.000
Cannot be mastered independently	123	1.000	5.000	3.107	1.559	3.000
Equipment unsuitability	123	1.000	5.000	3.293	1.369	3.000

4.1.2 Reliability and validity analysis

Reliability analysis of questionnaire data concerning factors influencing the immersive experience of digital red culture venues for children and adolescents yielded the following results.

Table 3. Reliability table for factors influencing the immersive experience effectiveness of digital red culture venues for children and young people

Number of items	Cronbach's alpha coefficient
13	0.933

As shown in Table 3, the Cronbach's alpha value for the factors influencing the immersive experience of digital red culture venues among the youth demographic was 0.933, exceeding 0.9. This indicates that the data quality in this study is exceptionally high.

The author conducted validity analysis on the recovered data using Bartlett's sphericity test and KMO test, yielding the results presented in Table 4.

Table 4 KMO and Bartlett's test table

KMO value		0.913
Bartlett's Test for Sphericity	Approximate chi-squared	1878.962
	df	78
	p-value	0.000

As shown in Table 4, the KMO value is 0.913, exceeding 0.8, and the P-value is 0, which is below 0.005. This indicates that the questionnaire research data is highly suitable for information extraction (reflecting excellent validity), confirming the questionnaire's validity.

4.1.3 Correlation analysis

This study employed principal component analysis to extract factor analysis variables. Analysis of the extracted values revealed that commonality (shared variance) ranged between 0.448 and 0.892, with all values exceeding 0.4. This indicates a strong correlation between the listed factor variables and the principal components, confirming that the principal components effectively capture the underlying information. The cumulative variance explained reached 72.455%, exceeding the 50% threshold, confirming the validity of the factor analysis results.

The author analyzed the correlation between three factors and the immersive experience outcomes of the Red Culture Digital Venue, with results presented in Table 5.

Table 5 Correlation coefficients for immersive experience effects and influencing factors in Red Culture Digital Venues

		Immersive experience effect	Form immersion	Content concretisation	Technical compatibility
Pearson	Immersive experience effect	1	—	—	—
	Form immersion	0.901**	1	—	—
	Content concretisation	0.862**	0.869**	1	—
	Technical compatibility	0.500**	0.471**	0.374**	1

* $p < 0.05$ ** $p < 0.01$ (The p-value represents the probability value in hypothesis testing; **indicates that the correlation between variables is statistically significant at the 0.01 significance level.)

As evidenced by the data in Table 5, the Pearson correlation coefficient between formal immersion and the immersive experience effect of digital venues for red culture (hereafter referred to as "immersive experience effect") is 0.901**. This

indicates a highly significant positive correlation between the two variables, with statistical significance at the $p < 0.01$ level. It demonstrates that stronger formal immersion in digital venues for red culture yields a more effective immersive experience for the youth demographic. The Pearson correlation coefficient between content figurativeness and immersive experience effect is 0.862^{**} , indicating a strong positive correlation between the two that is statistically significant at the $p < 0.01$ level. This suggests that a higher degree of content figurativeness in red culture digital venues markedly enhances the immersive experience effect for children. The Pearson correlation coefficient between technological adaptability and immersive experience effectiveness is 0.500^{**} , indicating a moderate positive correlation that is statistically significant at the $p < 0.01$ level. This suggests that technological adaptability in digital venues for revolutionary culture has a certain promotional effect on the immersive experience effectiveness for children.

5 Conclusions and recommendations

This paper investigates the factors influencing the immersive experience of digital venues featuring revolutionary cultural content for children. Through empirical research employing questionnaire surveys, the following conclusions were drawn: (1) Hypothesis 1, positing a positive correlation between the immersive experience of digital red culture venues for children and the formal immersion within such venues, holds true. The diverse sensory elements within digital red culture venues—such as sound, light, and electricity—can deliver richer immersive experiences for young audiences. By synchronising auditory, visual, olfactory, tactile, and perceptual stimuli, these spaces breathe life into otherwise abstruse or tedious knowledge. This approach creatively transforms traditional red culture, fostering innovative development through methods that resonate with children. It enables them to learn through play, and "play while learning", significantly reducing cognitive barriers. This approach genuinely aids their learning and comprehension of red culture, positively enhancing children's immersive engagement with this heritage. (2) Hypothesis 2, positing a positive correlation between the immersive experience of digital red culture venues for children and the concrete representation of content within such venues, holds true. Given that children's cognitive abilities currently cannot fully grasp the red culture, this often abstruse subject matter can be presented in a more intuitive and tangible manner within digital red culture venues—where they become "young Red Army soldiers" retracing the Long March alongside "Red Army fighters". Immersed in near-authentic settings and interacting with Red Army actors, this deepens their comprehension and retention of red culture, thereby positively influencing their immersive experience. (3) Hypothesis 3, positing a positive correlation between the immersive experience of digital red culture venues for children and the technical accessibility within such venues, holds true. Presently, the technological equipment within these digital red culture venues requires operations such as wearing goggles, holding controllers, and consulting electronic manuals. For children, the machinery is often too cumbersome for them to lift and operate independently, necessitating assistance from accompanying adults. Given the current educational attainment of the young audience, they lack the capacity to comprehend instruction manuals. If parents or guardians possess insufficient literacy, professional demonstrations and operational guidance may become necessary, requiring additional time for children to learn the operational procedures. Furthermore, disruptions such as equipment configuration issues, network problems, or operational errors by children during use can interrupt their learning process, hindering the continuity of their learning mindset. Consequently, technical adaptability shows no correlation with the immersive experience of children within digital venues dedicated to revolutionary culture. Based on these conclusions, the following recommendations are proposed.

Firstly, optimize the age-appropriate design of equipment to reduce the complexity of operating technical devices. Children's cognitive abilities are still developing, and their acceptance of and learning speed regarding technical equipment varies significantly between individuals. Particularly for younger children or accompanying adults with lower educational

attainment, an inability to use technical devices can substantially diminish their immersive experience of revolutionary culture. To address this, venue technicians may devise simplified solutions, streamlining operational steps. For instance, developing a children's version of AR glasses, with a weight controlled under 80g, enables young visitors to operate them independently. Additionally, providing pinyin annotations for textual content facilitates reading and learning for young visitors. By equipping children with more intelligent, user-friendly, and age-appropriate technological devices, their learning processes and cognitive engagement become more fluid. This approach enhances the immersive experience of red culture within digital venues for young audiences.

Secondly, upgrading equipment installations to enhance the immersive experience of young visitors. The current technical apparatus within the red culture digital venue is rather cumbersome; children's physical strength makes independent operation difficult, and prolonged use can cause dizziness and eye strain. Consequently, the comfort level of the venue's technical equipment requires further improvement. Moreover, these venues impose stringent technical requirements on equipment. During children's use, issues such as playback stuttering and signal loss may occur due to configuration problems, abruptly interrupting their immersive experience. Consequently, the technical departments of these venues must optimize and upgrade equipment installations to minimize such occurrences, thereby delivering a smoother and more comfortable immersive experience for young visitors.

Thirdly, establish age-specific design standards for venues. According to Piaget's theory of cognitive development, children of different age groups are at distinct stages of cognitive development, meaning their capacity to comprehend revolutionary culture also varies. Consequently, digital venues dedicated to revolutionary culture must be designed to deliver content tailored to the cognitive abilities of each age cohort. For instance, children under seven may benefit from "red fairy tales" narrated through vividly coloured animated picture books combined with projections, simplifying complex knowledge for easier comprehension. For those aged seven to eleven, a "historical simulation" module could be developed, allowing them to independently choose military routes to foster critical and creative thinking based on their understanding and learning. For children aged 11 and above, a "Decision Simulation" system is introduced. This enables them to analyse historical events using big data, drawing upon classroom learning and their cognitive abilities. It cultivates their critical historical awareness and deepens patriotic sentiment, thereby enhancing the immersive experience of the digital red culture venue. This approach aids children in comprehending red culture and reinforces their memory of its significance.

6 Conclusion

Today, the preservation and promotion of revolutionary heritage are of pressing importance. Establishing digital venues for revolutionary culture has become an inevitable choice that aligns with contemporary developments and meets audience demands, particularly for those born and raised in the digital age—the "digital natives". This generation of young people, having never experienced war, possesses significantly altered cognitive abilities and reception habits. Traditional, didactic methods of disseminating red culture—such as children independently visiting historical museums, attending campus or community lectures, or watching red-themed films and television programmes—rely on one-way information delivery. Such approaches struggle to spark genuine interest or enthusiasm among young audiences, resulting in low participation rates and limited dissemination of red culture. Conversely, the digital red culture venue employs advanced audiovisual and lighting technologies, alongside holographic imaging, virtual interaction, and live performances, to create an immersive environment tailored to children's preferences. This approach aligns closely with their cognitive habits in the digital age, encouraging them to engage more proactively with red culture and thereby reducing cultural discounting. Digital venues for revolutionary culture must continually innovate their formats and refine their content to cater to the diverse needs of children across different age groups. This enables them to deliver more targeted revolutionary cultural

content and superior immersive experiences, thereby effectively perpetuating the revolutionary legacy and promoting outstanding revolutionary culture. Such efforts will revitalize revolutionary culture in the new era, fostering a new generation of citizens imbued with profound patriotism and cultural confidence for our nation.

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Conflicts of interest

The author declares no conflicts of interest regarding the publication of this paper.

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