

## Augmented Reality in Sports Event Videos: A Qualitative Study on Viewer Experience

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### Abstract

*Augmented reality (AR) has been widely used in sports broadcasting. However, little is known about viewer experience with AR in sports event videos. To identify key AR features as well as its advantages and drawbacks in sports event videos, this research conducted a qualitative study through a semi-structured interview with 30 participants. Content analysis on the interview transcript identified four salient features of AR in the sports event video context, i.e., informativeness, novelty, vividness, and telepresence. It also revealed three key advantages of AR to sports audiences, including game comprehension, enjoyment, and fan socialization, as well as two drawbacks, including distraction and inauthenticity. The qualitative study provides a theory-building process and results in a conceptual model, which, based on the net valence approach, postulates the relationships between AR features and viewers' behavioral intentions through the mediation of perceived advantages and drawbacks.*

**Keywords:** augmented reality, sports event, audience experience, sportscasts, qualitative research

### 1. Introduction

Augmented reality (AR) has been widely applied in sports event videos to enhance the viewer experience. An increasing number of sports fans are now watching sports events on online broadcasting platforms. Specifically, about 50% of sports fans watch sports events on social media, and 45% of fans pay for streaming services (Toni, 2021). To improve sports fans' viewing experiences, emerging digital technologies such as AR, artificial intelligence, big data, and edge computing (Capgemini Research Institute, 2019) have been adopted. Particularly, AR can be now easily applied and provide a transforming viewing experience to sports audiences.

AR is a cutting-edge technology that enhances user perceptions by augmenting or superimposing digital content onto a live view of physical objects and environments in real-time (Du et al., 2022). Because of its unique advantages and relative ease of application, AR has been used in many customer service domains, such as retailing, tourism, and real estate (Daassi & Debbabi, 2021; Javornik, 2016; Poushneh, 2018), but not in the context of sports event videos. Research on AR applications in these domains has aggregated a long list of AR features, including interactivity, presence, augmentation, informativeness, control, novelty, aesthetics, immersion, vividness, and personalization, with notable variations across application contexts (Du et al., 2022; Poushneh, 2018). The different findings across AR application domains implicate the context-specific nature of AR effects and user experiences. This, coupled with the scant research on AR in sports event videos, warrant the need of studying viewer experience with AR in sports event videos. Understanding key AR features in sports event videos and their effects on viewers is important for designing and developing better AR for sports event videos.

This research conducts a qualitative study to understand viewer experience with AR in sports event videos and build a conceptual model through a net valence approach (Breward et al., 2017). Specifically, we inquire on three research questions:

- What are key, salient features of AR in sports event videos?
- What are the advantages and drawbacks of AR that viewers perceive in watching sports event videos?
- How can AR in sports event videos develop in the future?

To answer these research questions, we conducted a semi-structured interview. Through content analysis on the interview transcript, we identified four salient AR

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features, including informativeness, novelty, vividness, and telepresence. Three key advantages, including game comprehension, enjoyment, and fan socialization, as well as two potential drawbacks, including distraction and inauthenticity, are identified. The overall feedback is positive, with most interviewees commented on AR advantages and only a few mentioned drawbacks. A conceptual model, following a net valence approach (Breward et al., 2017), is proposed. It postulates the relationships between AR features and viewers' behavioral intentions (to continuously watch, to recommend, and to pay) through the mediation of perceived advantages and drawbacks. The interviewees point to the future development of AR in sports event videos in the areas of: (1) interactivity and user autonomy; (2) a multi-view of the game; and (3) a further developed immersion experience.

## 2. Literature review

### 2.1 AR Development

The history of AR can be traced back to the 1950s when Morton Heilig proposed an innovative idea that cinema needed to draw viewers into the onscreen activities by effectively taking in all senses (Carmigniani et al., 2011). Afterward, AR technologies have been gradually developed and various AR applications tested. The explosive popularity of Pokémon GO in 2016 showcased a grand success of an AR application (Rauschnabel et al., 2017).

AR is now a cutting-edge technology for human-computer interaction that superimposes digital content onto a live view of the physical objects and environments in real-time. It enhances users' visual, auditory, tactile, and olfactory perceptions with digital text, geolocation information, graphics, audios, and videos (Du et al., 2022). AR is regarded as a breakthrough technology and its applications have been developed in many fields such as marketing (Rauschnabel et al., 2019), tourism (tom Dieck & Jung, 2017), healthcare (Ferrari et al., 2019), and sport (Goebert & Greenhalgh, 2020) to attract, impress, and transform user experiences.

With the ultracompetitive nature of sports, sports organizations and athletes constantly seek opportunities for gaining competitive advantages (Goebert & Greenhalgh, 2020). Thus, they are often early adopters of technological innovations and actively employ new technologies to improve athlete training (Soltani & Morice, 2020) and fan engagement (Goebert & Greenhalgh, 2020). AR has been used to add digital information to help viewers understand sports events and provide enhanced viewer experiences in online sportscasts (Enomoto & Saito, 2009). As shown in

Figures 1(a) and 1(b), AR has been used to present players and game information (Impey, 2019; DFL, 2020). Figures 1(c) and 1(d) provide instances where AR is used to create an engaging and entertaining atmosphere by producing team names, star players, or the mascots of an event and a team (Immersiv.io, 2020; Peters, 2021).



Figure 1. AR instances in sports event videos.

### 2.2 AR features and effects

As AR applications have been developed for and adopted into an increasing range of business contexts, research on user experience with AR is fast growing. Research questions center around understanding key AR features in various applications and their effects on user experience (Du et al., 2022). Major contexts of study include retailing (Tan et al., 2022), tourism (Lacka, 2020), and advertising (Yang et al., 2020).

Depending on the AR application contexts, extant research has suggested various AR features and effect mechanisms. In retailing, existing literature has focused on AR characteristics such as interactivity, vividness, augmentation, informativeness, novelty, quality, reality congruence, anthropomorphism, and sensory control modality, and studied their effects on consumers' product attitude, brand attitude, product purchase intention, willingness to pay a price premium, and WOM intention (Heller et al., 2019b; Hilken et al., 2017; Javornik, 2016; Kowalczyk et al., 2021; Nikhashemi et al., 2021; Rauschnabel et al., 2019; Yim et al., 2017; van Esch et al., 2019). In tourism, prior studies gained insights into how AR empowerment features, technology embodiment, anthropomorphism, self-representation, and intimacy affect tourists' enjoyment, experience, willingness to pay, and the brand love of tourism destinations (Huang, 2021; Huang & Liu, 2021; Tussyadiah et al., 2018). In advertising, research suggests that the content features of AR advertisements including informativeness, novelty, entertainment, and complexity, affect consumers' attitudes toward AR

advertisements (Feng & Xie, 2018). The differences across the domains of studies implicate that key AR features and their effects can be context-specific and may vary across various AR application contexts.

However, user experiences with AR in sports event videos have not been studied. As AR features and their effects on user/viewer experience can be context-dependent, a qualitative study to understand viewer experience with AR in sports event videos and identify key constructs is warranted.

### 2.3 Viewer experience with sports videos

Research on sports-watching experiences has studied audience experience in both stadium and sports event video contexts. The latter directly relates to our study and thus is reviewed here.

Research on viewers' watching experience with sports event videos has identified various factors that affect viewers' attitudes and intentions. For example, Hou et al. (2019) suggested that interactivity and humor appeals affect viewers' continuous watching intention with live streaming sports event videos. Qian (2022) reported that in sports livestreaming, streamers' expertise, fit, and virtual interactions positively impact the audience's continuous watching intentions. Lee et al. (2016) indicated that sports commentary can significantly affect audience enjoyment and continuous watching intentions.

Previous studies have not examined viewer experience with AR in sports event videos. Nevertheless, the findings from previous studies on sports event videos and AR in other contexts provide a foundation for the current qualitative study on AR in sports event videos and valuable constructs that this research can relate to.

## 3. Methodology

This research adopts a qualitative research method to study viewer experience with AR in sports event videos and identify salient AR characteristics in this specific context and benefits and drawbacks perceived by viewers. Qualitative research aims at gaining insights and building theory, rather than arriving at statistically valid conclusions (Bryman, 2015). It is suitable for our context of study on AR in sports event videos where understanding of viewer experience is lacking.

In-depth interviews were conducted to understand user experience with AR in sports event videos. Non-probability purposive sampling is applied in recruiting interviewees. Thirty interviewees who consider online sports watching as their main way of sports watching were recruited through advertisement and word-of-

mouth at a university campus in Beijing. As a result, all interviewees are students of five universities in the area.

Table 1 provides the demographic information of the thirty interviewees. The ages of the interviewees range from 19 to 25. Fifteen (50%) are males and fifteen (50%) are females. The interviewees vary significantly in terms of their watching interest and frequency of sports events as well as their sports playing experience. For example, interviewees such as P1 and P2 are basketball fans, who not only follow and watch major basketball games but also play basketball themselves. P10 and P16 are interested in multiple sports and play sports themselves, but only watch sport events occasionally. P23 and P24 have little interests in sports; they rarely watch sports events and do not play sports.

**Table 1. Summary of interviewees.**

No.	Gender	Age	Watching Interests and Frequency	Sports Playing Experience
P1	M	24	Basketball; most events	Basketball
P2	M	19	Basketball; most events	Basketball
P3	M	20	Football; occasionally	None
P4	M	22	football, mega events; occasionally	basketball, None
P5	M	21	Football; 3-4 times a week	None
P6	M	21	Baseball; 2 times a week	None
P7	M	21	Football; daily	Football
P8	M	22	Football, volleyball; 4-5 times a week	Football, basketball, volleyball, badminton
P9	M	25	Football, basketball; most events	Football, basketball
P10	M	21	Football, badminton, swimming; occasionally	Football, badminton
P11	M	21	Football; often	Football
P12	M	25	basketball, F1; 2-3 times a week	Basketball
P13	M	25	Football, basketball; daily	Football, basketball
P14	M	28	Triathlon, skiing, frisbee; 1-2 times per week	Running
P15	M	25	Ball games; occasionally	Football, basketball, badminton
P16	F	22	Football, occasionally	tennis; Swimming, running, badminton, Yoga, rope skipping
P17	F	24	Ice and snow; event only	mega None
P18	F	24	Football, basketball; occasionally	Football
P19	F	24	Short track speed skating; mega event only	None

P20	F	24	Football, occasionally	basketball; Football, basketball
P21	F	24	F1, tennis; every event	Tennis, table tennis, badminton
P22	F	23	Football, mega events; occasionally	Yoga
P23	F	20	None; almost none	Running, swimming
P24	F	20	None; almost none	None
P25	F	20	None; almost none	None
P26	F	21	Football, volleyball; occasionally	basketball, None
P27	F	21	Football, table tennis; occasionally	basketball, Football
P28	F	22	Basketball, occasionally	billiards; Yoga
P29	F	22	Badminton, basketball; occasionally	table tennis, Running
P30	F	25	Basketball, and snow; occasionally	snooker, ice Badminton, tennis

At the beginning of the interview session, the interviewees were set to watch a short (1 minute and 7 seconds) compilation of AR video clips of a 2022 La Liga game (Barcelona vs. Villarreal). Figure 2 shows the AR-enabled player formation in the video. Before watching the video, participants were told that they would talk about the video afterwards.



**Figure 2. AR enabled formation of players.**

After the video, a semi-structured interview was conducted. Each interview lasted about 20-25 minutes. The interviewees responded to the following questions with the facilitation of an interviewer:

- What are the salient features of the AR applications that you have noticed or you can recall from the sports event video?
- What do you feel are the benefits/advantages of having AR in the sports event video?
- What do you feel are the drawbacks of having AR in the sports event video?
- Based on this watching experience, do you intend to watch sports events with AR again? Will you recommend it to your friends or family members? Would you like to pay for a service to have AR in sports event videos?

- What are needed to make the AR better in the sports event video?
- Please provide any other comments regarding AR in sports event videos.

Content analysis was conducted on the interview transcript through a three-stage interactive process by two researchers. First, the transcript was carefully reviewed, and open coding was conducted to identify important and/or repeating elements and formulate initial groups. Then these initial element groups are carefully reviewed and evaluated to be integrated into more general categories. Finally, we use selective coding (Strauss & Corbin, 1990) to synthesize the general categories to major concepts that respond to our questions. This three-stage process is demonstrated in detail in section 4.3 where staged results on identifying AR features (pertaining to interview Question 1) are provided; this will not be repeated in later sections (i.e., sections 4.2-4.4 when discussing results pertaining to interview Questions 2-5). NVivo was used in the coding process.

## 4. Results and discussions

### 4.1 AR features

First, we coded and analyzed the responses of the interviewees to the first question about the salient features of AR in the sports event video. The interviewees mentioned a wide variety of observations with AR in the sports event video. Through the first two stages of coding and analysis, we identified 10 general categories of AR features that impressed interviewees:

- Increased quantity of information
- Enhanced player information
- Detailed game information
- New AR uses in the video
- I haven't seen this type of video before
- Visual information is vivid
- The visual is cool and different
- It is lively
- Feel like present in the game
- Players seem closer to me

Then in the third-stage analysis, we synthesize the above 10 categories of AR features into four constructs, based on their commonalities, that can be related to the literature:

- Informativeness (Items 1 through 3; mentioned by 24 interviewees)
- Novelty (Items 4 through 5; mentioned by 12 interviewees)
- Vividness (Items 6 through 8; mentioned by 18 interviewees)

- Telepresence (Item 9 through 10, mentioned by 8 interviewees)

Informativeness refers to the richness of information or knowledge provided by a customer service interface (Poullsson & Kale, 2004). Identifying informativeness as a key AR feature in sports event videos is in line with research on AR in other application contexts such as retailing and tourism industries (Hausman & Siekpe, 2009; Qin et al., 2021).

Most interviewees (24 out of 30) mentioned informativeness as one of the key features of AR in the sports event video. In the sports event video, AR provided enhanced information presentations such as those on players, team formation and strategy, and game dynamics. Interviewees commented on both information quantity and quality AR provided. For example, interviewee P7 stated: “AR added useful information in the video. The situation in the game is clearer and I know now who is passing the ball.” P6 commented: “When I watch sports, I often miss some details and need to check them from mobile apps. AR in this video provided me useful information so I don’t need to go to the apps to find it.” Some suggested that AR makes sports event videos look more professional. It is also observed that viewers with various levels of game familiarity focused on different types of AR-enabled information presentation. Viewers who are familiar with the game commented more on the AR-enabled game strategy information, whereas those who are less familiar with the game commented more on the AR-enabled player information.

Novelty refers to the perceived newness of innovation, idea, or technology (Rogers, 1995; Wells et al., 2010). Previous research on AR in the retailing contexts has identified novelty as a key feature that impresses shoppers (Barhorst et al., 2021; Nikhashemi et al., 2021; Yuan et al., 2021). In this study on AR in sports event videos, the novelty feature of AR is associated with various viewer experiences. Some viewers who have not been exposed to AR or have not seen AR in sports event videos can be simply amazed by the AR in the sports event video. For example, P23 commented, “Wow, so this is AR”. P26 said, “I haven’t seen this type of videos before. It is impressive.” Viewers who have seen AR in sports event videos before identified new and better AR uses. P18, who is a football fan indicated that “there are new varieties of AR use; very fancy.”

Vividness refers to “the ability of a technology to produce a sensorially rich mediated environment” (Steuer, 1992). AR can provide clear, vivid, and detailed images combining the real and the virtual worlds (Barhorst et al., 2021). Vividness has been previously suggested as a key AR feature in the retailing context

(Yim et al., 2017; Whang et al., 2021). Many interviewees (18 out of 30) commented on how vivid the AR image and information are. For example, P2 said AR makes the players and game lively. Participant 7 said the AR visual effects are cool and help him focus and get the game. Participant 21 thinks AR presents the game differently and vividly; it makes the player formation easy to catch and remember.

Telepresence, or presence, refers to the perception of technology users of being present at a place other than their true location (Huang & Liao, 2015; Kim & Hyun, 2016; Sheridan, 1992). In the context of AR embedded videos, perceived telepresence refers to the degree to which a subject is convinced that he or she is truly present in the AR space (Jung et al, 2021). AR can enhance the telepresence experience through stimulation of the senses and full participation of users/viewers (North & North, 2016). Several studies on AR have pointed telepresence as a key feature of AR (Jung et al., 2021; Kim & Hyun, 2016; McMahan et al., 2015). In sports event videos, AR can provide the audience with a sense of being in the sports game or being closer to players. For example, P19 said: “The AR information makes me feel like I am participating in the game. I feel like a coach who is analyzing the situation and directing the players.”

## 4.2 Advantages and drawbacks of AR in sports videos

Feedback on AR in sports event videos is overwhelmingly positive. Most interviewees commented on the advantages of having AR in sports event videos, whereas a few mentioned drawbacks. We followed the three-stage process to identify key constructs on the advantages and drawbacks of AR in sports event videos from the interview transcript on questions 2 and 3. Three key advantages identified through content analysis are:

- Game comprehension (mentioned by 20 interviewees)
- Enjoyment (mentioned by 13 interviewees)
- Fan socialization (mentioned by 7 interviewees)

Two drawbacks emerge from content analysis:

- Distraction (mentioned by 3 interviewees)
- Inauthenticity (mentioned by 1 interviewee)

Game comprehension refers to the extent to which the audience understands sports games (Romdhane & Khacharem, 2021). A large portion of interviewees (20 out of 30) commented that the AR helped them understand the game. These include both interviewees who are familiar with the game and those who are not. P9 indicated that “AR helps me understand the game. I

am definitely interested in watching AR embedded sports event videos.” Some participants further commented that through the images and statistics added by AR, they can understand the game more easily and grasp the important part of the game. This is especially the case for those who were not familiar with the game. For example, P10 stated: “It helps a lot to grasp the situation on the field, and I understand the game better. AR lines players up directly on the field, which is very helpful for the audience who don’t know the team well.” P12 indicated: “Compared with videos with sportscasters’ commentary, it is more intense to watch this video with AR applications. The AR connects the positions of the players more clearly and explains their tactics more specifically. The visual data really enhances the game-watching experience. It is much better than simply watching without fully comprehending the game.”

Thirteen interviewees mentioned enjoyment as a key benefit AR brings. Enjoyment refers to users’ pleasant feelings about an object or during a process (Davis et al., 1992). For viewers without much game knowledge, AR-enabled information helps lower the bar for sports watching and makes it more enjoyable and relaxing to watch. For example, P14 said “It’s more relaxing to watch the sports event video with AR. I enjoy it.” Interviewees associated the enjoyment with all four AR features identified in the previous section. For example, P21 said “I really enjoy the information provided by the AR.” P30 indicated that “the visual effects are so lively; I like it.” P23 said “Wow. So this is AR. It is nice to watch.”

Fan socialization is an important part of the sports-watching experience (Asada & Yo, 2019; Parry et al., 2014). Sports fans like to discuss games and share opinions and experiences with friends and/or watch sports events together (Parry et al., 2014). AR adds interesting content for sports audiences to talk about, thus adding to the benefit of fan socialization. For example, P23 stated: “I can talk about the AR with my friends if I cannot find another topic.” P23 said: “The AR effects are interesting. I cannot wait to tell my friends about it.”

A potential drawback of AR in sports event videos is a distraction to the audience. P27 stated: “When watching this video with AR, I felt that the information is too much to handle. The AR parts always get my attention. Because of this, I think I missed some player movement that I hoped to follow.”

Another drawback of AR in sports event videos is inauthenticity. The AR makes the sports event video look like computer games and some viewers indicated that they feel like not watching a real event. P10 said: “I’m not sure if the similarity with computer games is beneficial or not, though it is becoming a trend of

sportscasting. I don’t like it because I feel I am watching a computer game instead of a real event.”

### 4.3 Viewers’ intentions

Table 2 provides the summary information and sample quotes on viewers’ intentions as revealed in the interview. Pertaining to Question 4 on viewers’ intentions, about half of the interviewees indicated that they would continue to watch (16 out of 30) or recommend to family and friends (15 out of 30) the AR-embedded sports event videos. Others indicated hesitation, rejection or “don’t know” when inquired about their intention to continue watching and to recommend. While many intend to watch or to recommend, only 4 interviewees indicated that they are willing to pay for a service to have AR in sports event videos, and this often came with a condition. For example, P10 said, “If the price is not too high, I will pay for AR in sports events videos.”

This indicates that AR in sports event videos is liked by the audience, but is not valued as an element that is worth paying for. Thus, its design and integration in sports event videos still need major development to achieve an optimal user experience. Studying AR in sports event videos can offer insights and guidelines to improve viewer experience and positive intentions.

**Table 2. Behavioral intentions of viewers.**

Behavioral Intentions	Replied Yes	Sample Quotes
Continuous Watching Intention	16	If AR is in sports events videos, I will watch it. (P11) My decision of watching is based on teams or players, not AR (P1) If I have a choice between videos with or without AR, I will choose AR ones. But I will not search for it. (P25)
Recommendation Intention	15	I will absolutely recommend sports events videos with AR to my friends. (P16)
Intention to pay	4	If the price is not too high, I will pay for AR in sports events videos. (P10) I will not pay for it. I am fine with sports broadcasting without AR. I can’t see the need to pay for it. (P2)

### 4.4 Viewers’ expectations for AR

Three major expectations emerge from interviewee’s response to our Question 5 (What are needed to make the AR better in the sports event video?):

- Increase interactivity and user autonomy

- Provide a multi-view of the game
- Provide more immersion experience

First, participants have commonly suggested that AR in sports event videos can provide more interactivity and viewers be allowed autonomy in choosing whether or not and what to use AR. For example, P25 suggested: “It would be better if I can operate by myself. This would provide some flexibility. When I need to learn the information, I can open the function; when I don’t need it, I can close it. In this way, I will be more interested in it.” Enhancing user interaction and control can improve user participation and experience, and thus is a direction for further development.

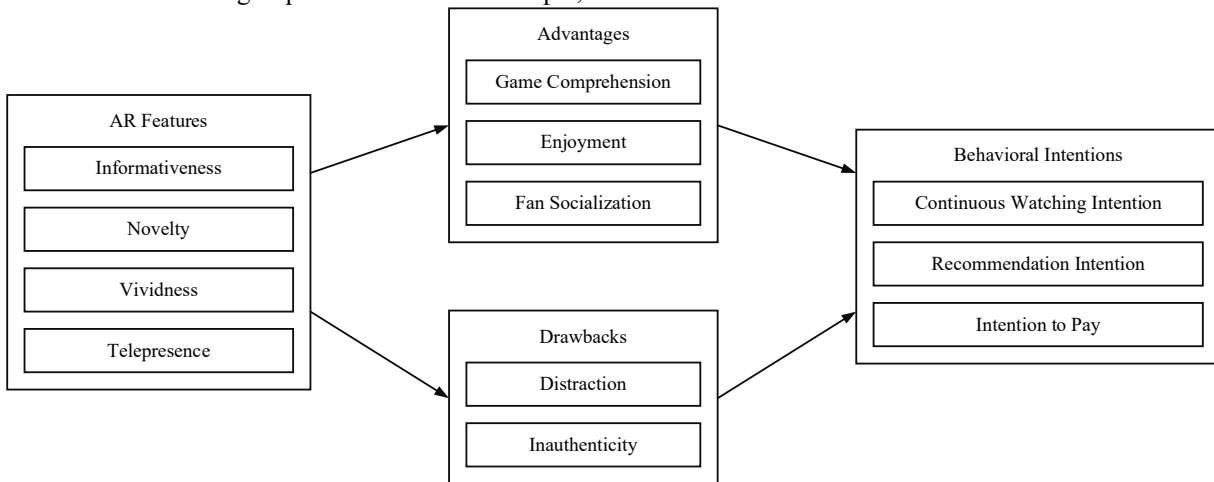
Second, participants suggested a multi-view of the game, such as a view of players, of coaches, and of other roles in a game. This will add significant value for viewers, particularly for those who are familiar with the game and seek more participation experience. It will also make the watching experience fun. For example,

P22 stated: “I hope the watching experience can be like playing FIFA (the computer game). I can choose to watch a game from a coach’s perspective or a player’s perspective.”

While many identified telepresence as a salient feature of AR, some suggested that it can be enhanced to create an immersion experience. Particularly, participants indicate stadium experience to be created. For example, P26 stated: “It would be better if I can feel like I am in the stadium.”

#### 4.5 A conceptual model and propositions

Aggregating our findings on the salient features of AR in sports event videos as well as their advantages and drawbacks through a net valence approach (Breward et al., 2017), we generate a conceptual model and its associated propositions. Figure 3 shows the conceptual model.



**Figure 3. Conceptual Model.**

This model outlines 4 key features of AR in sports event videos: informativeness, novelty, vividness, and telepresence. It outlines three advantages that AR brings to viewers of sports event videos—game comprehension, enjoyment, and fan socialization; and two potential drawbacks—distraction and inauthenticity. The conceptual model puts forwards several propositions:

P1: AR features such as informativeness, novelty, vividness, and telepresence can enhance viewer benefits of game comprehension, enjoyment, and fan socialization.

P2: AR features such as informativeness, novelty, vividness, and telepresence may lead to audience distraction and feeling of inauthenticity.

P3: AR’s advantages on viewer experiences, such as game comprehension, enjoyment, and fan

socialization, are positively associated with viewers’ intentions to continue watching, to recommend, and to pay.

P4: AR’s drawbacks to viewer experiences, such as distraction and inauthenticity, are negatively associated with viewers’ intentions to continue watching, to recommend, and to pay.

## 5. Contributions and limitations

### 5.1 Theoretical contributions

This research has important theoretical contributions to two streams of literature. First, this research contributes to the literature on AR applications in business by extending the scope to fan engagement in sports. Specifically, this research identified key features

of AR in sports event videos and conceptualized their effects on viewers' behavioral intentions through a net value approach on AR's advantages and disadvantages perceived by viewers of sports videos. Thus, this research opens a valuable new field in the research of AR applications in business.

Second, this research contributes to the literature on sports management by examining the role of AR in shaping viewers' online watching experience and behavior. Fan experience has been a focal topic in sports management literature for decades. This research adds a new perspective on how emergent cutting-edge technology affects fan engagement in the online context and generates intriguing findings. It provides a sound foundation for future research on AR in the sports context.

## 5.2 Practical implications

This research provides fresh insights for broadcasters and online streaming platforms of sports events to develop and deploy AR for enhanced audience experience. First of all, the findings of this research suggest that AR in sports event videos is a beneficial practice to enrich online viewers' experiences and engagement them. Hence, it is a wise decision to invest in this emergent digital technology. Furthermore, sports video producers can focus on AR features such as informativeness, novelty, vividness, and telepresence in developing AR uses to enhance sports fans' watching experience.

Second, the proposed conceptual model of how features of AR in sports event videos affect viewers' behavior intentions offers nuanced insight into how to shape viewers' behavior intention using AR. Specifically, the identification of the advantages and drawbacks of AR in sports event videos provide fine-grained guidance on designing impressive AR effects for sports event videos. Sports video producers can make efforts to maximize the advantages and minimize the drawbacks.

Finally, this research offers three directions for the future development of AR in sports video: user interactivity and autonomy, a multi-view of the game, and immersion experience. These directions are derived from viewers' suggestions. Therefore, broadcasters and online streaming platforms of sports event video need to consider and implement them seriously.

## 5.3 Limitations and future research

Although this research has highlighted several innovative and intriguing findings, we acknowledge that there are still some limitations. First, we not only identified four salient features of AR in the sports event

video context but revealed three key advantages and two drawbacks of AR to sports audiences by conducting a semi-structured interview with 30 college students. However, college students are only a representative viewer group of sports event videos. Future research can involve more diversified participants to check the robustness of the findings across viewers of different ages and occupations.

Second, although we collected the gender, watching interests, watching frequency, and sports playing experience of the interviewees, we have not shed light on the roles that these viewer characteristics play in the effects of the features of AR in the sports event videos on viewers' behavior intentions. Future research can delve deeper into the potential moderation effects of the viewer characteristics. Finally, this research provided a theory-building process by generating a conceptual model and its associated propositions. To further validate this model, future research needs to incorporate more studies using quantitative methods, such as survey studies and experimental studies.

## 6. Conclusion

AR, with its unique advantages, has been quickly adopted in many domains of application, such as retailing, tourism, and real estate, to enhance consumer/user experience (Poushneh & Vasquez-Parraga, 2017; He et al., 2018; Ullah et al., 2018). The sport industry is one of the early adopters of AR, which has now been widely used in sports event broadcasting (Laurie, 2019). However, little research has studied viewer experiences with AR in sports event videos. As AR features and user experiences with AR can be context-dependent, research on viewer experience with AR in sports event videos is needed.

This research provides a qualitative study to identify key features as well as advantages and drawbacks of AR in sports event videos. This leads to the formulation of a conceptual model based on a net valence approach. A semi-structured interview was conducted with 30 interviewees. Four salient AR features in sports event videos emerge from content analysis on the interview transcript; they are informativeness, novelty, vividness, and telepresence. Three key advantages, including game comprehension, enjoyment, and fan socialization, as well as two potential drawbacks, including distraction and inauthenticity, are identified. The overall feedback is positive, with most interviewees commenting on AR advantages and only a few mentioned drawbacks.

Based on the findings, a conceptual model is proposed. The relationships between AR features and viewer intentions through the mediation of viewer



perceptions of AR advantages and drawbacks are postulated.

The interview also reveals several directions of AR development in sports event videos. These include user interactivity and autonomy, a multi-view of the game, and immersion experience.

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