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Autonomous eMotorsports Racing Games: Emerging Practices as Speculative Fictions

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Abstract

Motorsports games and simulated automobile racing occupy a dynamic genre of computer games for entertaining play, critical game studies and "auto-play." This article utilizes the lens of speculative design to present six scenarios that seek to motivate the design of autonomous eMotorsports games and play experiences through alternative design fictions. These fictions serve to help identify and tease out how different socio-technical configurations emerging around autonomous vehicles, motorsports games, sim racing user interfaces and user experiences, which together embrace or exclude different stakeholders. These stakeholders can shape how autonomous eMotorsports games, game play and game viewing will emerge and prosper. These fictions also serve as a narrative web of possible socio-technical configurations open to critical review through: (a) transhumanist spectacle and spectating; (b) technofeminist and gendered framings of these configurations; and (c) whether digital artifacts configured to realize autonomous eMotorsports games have politics.

Keywords: motorsports games, sim racing, eMotorsports, autonomous vehicles, speculative design, design fictions

Introduction

Automobiles have pervaded modern industrial societies for more than a century. In the last ten or so years, we have begun to see new kinds of cars driven on roadways without human drivers. These new kind of automobiles are *autonomous vehicles,* controlled and driven by an integrated complex of hardware, software, and network systems conceived and deployed for such purpose. It now seems towards the end of the second decade of the 21st Century, most major automobile manufacturers are working on developing autonomous automobiles for global deployment. Such efforts may again transform mobility practices and capabilities for transporting people and material goods from place to place, as well as represent new economic opportunities for these manufacturers. But how and why are unclear.

Computer-based motorsports racing games mirror, codify and re-represent practices, artifacts, and international webs of socio-technical resources that link games to automobiles and car culture via motorsports, spectating, and engaging fantasy. This article considers how autonomous cars may intersect, segment, and reconfigure play within the world of motorsports-focused computer games where humans players and/or software-controlled robots ("bots") compete and manifest new forms of automobile-centric play—*auto-play*—whether for playing automobile motorsports games, for automated play driving games with/against bots, or for both together. This consideration employs analytical methods informed by speculative design and critical study of autonomous technologies, in order to focus on alternative scenarios accounting for less/more problematic emergence of auto-play for autonomous motorsports racing games and simulated

experience.

Speculative design is a design practice aiming at exploring potentialities and criticizing possible futures by creating speculative, and often provocative, scenarios narrated through designed artifacts (Dunne and Rabbe 2014). For example, in the world of automobiles, "concept cars" (Edsall 2003) are a recurring speculative vehicle design motif showcased in consumer-oriented automobile industry trade shows. One recurring concept car motif instance is that of flying cars, though our skies remain clear and uncongested by these still imaginary flying-driving vehicles. In a contrasting example, the artist and critical making scholar Garnet Hertz (2010), has reframed analysis and play with a simulated driving arcade game like *Out Run* (2017), into a provocative speculative design: as a video game arcade car capable of being driven on public roadways[1]. Such a speculative design can trigger new ways for thinking about how video games materialized as arcade machines may be reimagined as vehicle or devices that repurpose daily living activities into playful forms more like that experienced with interactive game play (cf. Apperley and Jayemane 2012).

With this in mind, this article explores speculative designs around autonomous driving vehicles, more specifically those focused on the emergence of autonomous eMotorsports along with related game play machinery and play practices. Six design scenarios are presented that reframe and reimagine how autonomous vehicles, motorsports racing, and motorsports games with automated bots may come together in expected and unexpected ways. This exploration builds from some contextualizing background, then into the scenarios, followed by comparative analytical reframings, all of which inform the conclusions presented.

Background

Speculative design fictions serve as alternative lenses that highlight ways, means, and objectives of different potential stakeholders who shape potential system designs and artifacts that may follow. The future of automobiles and motorsports is one arena where speculative design is common practice. Concept cars and other new car candidates are often presented first as speculative designs that may foreshadow future production models. These are often witnessed as vehicles with spectacular performance potentials, sinuous/aggressive industrial design contours and proportions, and fabrications with exotic materials. These vehicles are intended to ultimately inspire consumers to aspire to acquiring, owning, and driving such vehicles.

In contrast, a different vision for automobiles can be seen in the speculative design motif found in Art Cars created by "cartists." These art cars are presented in venues like the *Burning Man* festival, at the *Art Car World* museum in Douglas, Arizona, or at night in the streets of Japan via *Dekotora* trucks. Such cars and trucks embody personal statements regarding treatment of these vehicles as creative expressions rather than as units of aspirational mobility or practical transportation. Still other speculative car designs have emerged as vehicles envisioned or repurposed from other media, like the *Batmobile* (designed and fabricated by George Barris Studios) from comic books.

While speculative automotive designs continue to inspire, entertain, or entrain consumers into sustaining their dependency on automobile culture and mobility practices, autonomous vehicles are now beginning to appear on roadways, in technology-oriented news media, and in recent

1 See http://conceptlab.com/outrun/. Also see the analysis by Apperley and Parikka (2015).

cinematic feature films like *Logan* (Lee 2017). These vehicles, along with re-created notions of autonomous technology, are no longer simply showcased as speculative. Instead they are presented as increasingly inevitable evolutions of automobiles, mobility, and transportation. These vehicles are portrayed as autonomous cars, trucks, and others that are driven not by humans, but by computer-based vehicle control systems, networks and automated bots. Accordingly, how might consideration of auto-play facilitate, critically reflect, or inhibit the speculative or evolutionary design of digital artifacts that showcase autonomous vehicle technologies and their assumed socializations?

Motorsports represent recurring entertainment circuit venues found world-wide that create and celebrate the spectacle, thrills, and heroic competition among racing cars, drivers, teams, sponsors, corporate manufacturers, media broadcasters, and spectating fans. Competitive motorsports promote car culture, propel new car sales, promote automotive safety advances, accelerate youthful technological expression, normalize accidents and crashes, renew society's love affair with automobiles, and other societal consequences (e.g., Best 2006; Volti 2006). More recently, autonomous race cars are beginning to appear that promote high performance driverless vehicles controlled by software, sensors, and actuators packaged within a purpose-built race vehicle and its neural net computers. See **Figure 1** for a visual example.

Figure 1. Full-scale autonomous racing vehicle prototype realized in 2016 (vehicle design by Daniel Simon, courtesy Roborace.)

Computer-based motorsports racing games re-represent and simulate the artifacts and practices

of competitive motorsports, but at a level, cost, and simulated risk adversity distance suitable for in-home user experience. So restated, how might multi-modal auto-play—play with motorsports games, automated race driving bots, game-based digital artifacts, materialized sim racing user interfaces, and aligned social media—facilitate, critically reflect, or inhibit the speculative design of digital artifacts that showcase autonomous vehicle technologies through motorsports game culture, and their assumed socializations?

Interest in this study is focused on designed artifacts within the intersecting socio-technical worlds of autonomous motorsports vehicles, computer-based motorsports games, and materialized user interface (UI) devices for race driving simulation that help configure the socio-technical surrounds of their uses, cultural practices, and associated spectator viewing (cf. Taylor 2012; Taylor 2016; Watkins 2017). We start from an overview of current motorsport racing games, related UI devices, and possible consequential experiences arising from motorsport game play that lay the foundation for speculative design of autonomous vehicle motorsports games. This is followed by six speculative design fictions that begin to reveal the socio-technical configurations of stakeholders, technological arrangements, and social surrounds that can shape/inhibit the emergence of autonomous vehicle motorsport games.

Motorsports Racing Games

Computer games are a mainstream, widespread kind of digital artifact. The genre of *motorsports racing games* is one that has had comparatively little critical study within the Games Studies or Game Development community. However, these games accommodate a variety of UI devices and play/viewing experiences that collectively serve to provide simulation-based entertainment. Simulation-based entertainment and spectacle have been part of global culture for more than a century (Maloney 1997). Thus, these simulation-based entertainment artifacts are open for for historical, contemporary, and fictional future studies and their related temporal socio-technical framings.

In many contemporary motorsports racing games (*Colin McRae Rally*, *Forza Motorsport*, *Gran Turismo*, *Need for Speed,* etc.), the player-driver often plays against automated bots that control the observable behavior of other competing cars in a race course game level (Racing Games 2017). Bot driving abilities can be set by users from easy to expert, depending on the game. These games are played worldwide by millions of players, and some like Microsoft's *Forza* (Hartman 2017) and Sony's *Gran Turismo* (Gaudiosi 2013) represent billion dollar game franchise series. Some of these games emphasize exuberant, fantastic, or "illegal" street racing game play experiences and high-flying driving-crashing antics within arcade-style game play. Some scholars fear such game play may cultivate risky human automobile driving habits (Fischer, Greitimeyer, Morton, *et al.* 2009). There are no costs or safety risks associated with physical automobiles, nor physical harm to others or their property when driving/racing virtual cars. Other more physically accurate and more challenging to play motorsport games (*Assetto Corsa, DiRT Rally, iRacing, Project CARS 2, rFactor,* etc.) are regularly played or used as dedicated automobile racing game simulators supporting "sim racing" (Sim Racing 2017) and virtual/mixed reality racing experiences (Broadbent 2017b). It is this simulacra embodied in sim racing that draws our attention next.

Increasing Immersive Presence in Motorsports Game Play via Sim Racing

How do motorsports game play via sim racing mirror the technical arrangements and social order that surround motorsports? Are such reflections truthful renderings of the arrangements and order, or do they reflect views that distort and misrepresent such configured realities? Verisimilitude offers a lens through which such renderings may be observed and examined.

In literature, *verisimilitude* denotes likeness to the truth, such as the resemblance of a fictitious work to a real event. Fantasy novels and science fiction stories that discuss impossible events can have verisimilitude if the reader is able to read them with a willing suspension of disbelief. Computer games that mirror, recreate and re-represent motorsports racing practices, artifacts, and social order with virtual race cars and racing simulation represents a form of verisimilitude of interest here. Accordingly, it is plausible to adapt the construct of verisimilitude for comprehending the game-based driving/racing experience as unspoken visceral narratives to draw attention to the authenticity, immersiveness, and near-transfer learning of simulated experience of avid sim racers and sim racing user experiences. Furthermore, motorsports verisimilitude may be mediated by the material artifacts that allow for further embodiment and recreation of simulated race driving actions, events, and experiences, but without the material, socio-economic or safety costs associated with professional motorsports endeavors.

With sim racing, the motorsport game play challenge is to experience, embrace, and endure highly authentic vehicle and driving dynamics in simulated racing conditions (Sim Racing 2017). These virtual driving dynamics can be modulated by simulated variations in tire pressure and temperature, alternative drivetrain gear ratios, in-car cockpit driving views, suspension adjustments, visual replication of professional team car appearance, and timed/course lap constraints (e.g., *24 Heures du Mans*, *Indianapolis 500*), including periodic pit stops to virtually "re-fuel" and service the simulated racing cars. Sim racing enthusiast (or "hard core") players further embrace the verisimilitude of high performance vehicle driving sensation through motorsports game design (vehicle and environmental surround graphics, observable vehicular physics, diegetic audio soundtrack, laser scanned digital race course models, etc.), user interface controls (game-control steering wheels, pedals, gear selectors, driving seat, wraparound displays, motion-control feedback), simulated vehicular tuning options, comparisons to actual racing videos and global spectator/fan discourse via social media, and competitive play racing event experiences.

In sim racing, what escapes recreation are things like complex negotiations surrounding professional motorsports team formation and staff salaries, corporate sponsorships and team financing, news media engagement, commercial product endorsements, insurance and driver/spectator safety protections, travel and material transfer logistics, and more. So motorsports and sim racing game play seems to limit the focus to what their game developers can recreate that focuses attention to the sensational and perceptual embodiment of motorsports race driving, while at present diminishing or ignoring an overlay of business matters, administrative governance, financial costs, economically viable work careers, extended travel schedules, recurring reorientation to new local environments, media coverage and promotion, engaging/avoiding spectators, racing accident injury and recovery, and safety risk management that enable commercial endeavors in professional motorsports racing.

Finally, it is worth noting that sim racing games and their advocates are currently biased in favor of play on personal computer and console gaming systems rather than mobile game

devices. This is not to say that motorsports games don't flourish on mobile devices, since there are many popular racing games that are enjoyed by millions to hundreds of millions of players world-wide[2]. Instead, that the culture of sim racing games, game play and play spectating/viewing are clustered by their enthusiasts into venues and social media that arrange, define, and distinguish merely entertaining racing games and game play from serious, high authenticity, difficult to play sim racing games and kinesthetically immersive simulated race driving. Interest going forward in this article is limited to motorsports sim racing.

Embodied Authenticity and Immersion via Multi-mode User Interface Devices

In computer gaming, increased authenticity and immersion of user experience is enhanced through the use digitally materialized UI devices configured to operate with desktop personal computers (PCs) (cf. Apperley and Jayemane 2012). With sim racing games, modal UI devices include force-feedback steering wheels, transmission gear selectors, and foot pedals used to affect sim vehicle control with desktop PC or game consoles serve as affordances that help scaffold learning, facilitate immersion, and make user experiences more kinesthetically memorable for player-drivers. **Figure 2** provides an example of a lower fidelity, do-it-yourself, home-based sim racing system configuration with user.

Virtual reality (VR) and mixed reality (MR) head mounted displays are also available for those seeking further gaze-oriented immersive experience, or a willingness to experiment with new/future game UI modalities (Brennan 2017; Broadbent 2017a). These devices supplant, displace, or take the role of providing more immersive embodied physical activities than otherwise available to conventional game players who are limited to the use of traditional keyboards and mice, though possibly in variants designed and manufactured for use by enthusiast gamers. Furthermore, the operational verisimilitude of these UI devices is mediated by their cost, so that more authentic appearance and behavior triggers more immersive, visceral user experience.

The sim experience is also enhanced via driving seats for the player, wide field of view (or multiple) displays, and a motion-control seat apparatus that induces physical motion forces that create more immersive race driving experiences for the sim racing driver. See **Figure 3** for an example that also conveys the visual fidelity now achievable in motorsports racing sim games. Also, the choice for a sim racer to add racing equipment like a race helmet as seen in **Figure 3**, though not necessary for sim racing, can futher add to visual immersion by providing a restricted view port within the helmet, thereby allowing the sim racing driver to have their available field of view to be filled more effectively. Such a high fidelity sim racing configuration often cost 10-20 times the cost of a DIY configuration seen in **Figure 2** (cf. Lang 2017).

Racing sims are treated as sufficiently realistic such that would-be/accomplished race car drivers regularly use racing sims of different kinds for practice, organized sim racing competition events (Inside Sim Racing 2017), and professional motorsports driver training and career development. The observable authenticity and motion feedback induce kinesthetic immersion. Such immersion is intended to engage a driving flow user experience that enables near-transfer learning of high performance driving skill in competition with bot driven simulated competitors.

2 For example, the iPhone and Android based mobile street drag racing game, *CSR Racing* is advertised to have more than 130 million downloads. https://itunes.apple.com/us/app/csr-racing/id469369175?mt=8. Access date 10 January 2018.

Authenticity is also enhanced through global online network of motorsports game mod developers, who act to produce evermore realistically plausible, user-created racing sim content/assets for modded game play (cf. Champion 2013; Kücklich 2005; Scacchi 2010).

Figure 2. A lower fidelity, do-it-yourself sim racing rig for home usage (courtesy T. Milner).

Sim Racing and eMotorsports: crossing the amateur playbour—professional motorsports career chasm

Sim racing continues to emerge as a dedicated venue for *eSports* game play (sometimes referred to as "eMotorsports") and tournament competitions (FIA 2016). Such tournaments bring together groups of driver-players who compete in multiplayer racing game play for cash prizes and sometimes professional motorsports driving opportunities, sponsored by a mix of game companies (e.g., Sony Computer Entertainment), technology producers (NVIDIA), and automotive/motorsports companies (McLaren F1 (Watkins 2017), Nissan (GT Academy 2018)). This form of *playbour* (Kücklich 2005)—play activities that also provide productive unpaid labor—is readily engaged by aspiring sim racing driver-players.

Driver-players seek to enact their professional race car driving ambitions, albeit in a low cost, low risk manner. Though many ambitious driver-players may sign up for such tournaments, only a small handful make the cut for final round competition where career-making rewards may be earned (Gitlin 2017). But this may be little different from the aspirations and ambitions of young people who dream of playing in the Winter/Summer Olympic games, or be selected to join a professional sports team in football, basketball, baseball, or other athletic sports. Many hear the

siren call to play in local venues, but few are chosen to play at the highest level of spectacle and financial reward.

Figure 3. A high fidelity, motion-controlled, multi-display sim racing system suitable for professional, commercial, or in-home usage (courtesy CXC Simulations).

Serious play with motorsports game artifacts is enabled via a commitment to simulated racing game tournament circuit play (e.g., see *iRacing* http://www.iracing.com/). It is further enabled via an investment in a sim racing rig, continuing engagement of professional motorsports media spectating, and online social discourse that serves to narrate, sustain, or elevate one's position in the world of motorsports racing game culture (Taylor 2006; Taylor 2012; Watkins 2017).

Autonomous Technology in Motorsports and eMotorsports Games

As the innovation of autonomous vehicles has recently emerged for passenger automobiles, to little surprise, they have also recently appeared for motorsports as *autonomous motorsports vehicles* appearing under the branded sponsorship of *Roborace*™ racing league for robocars (Dow 2017; Roborace 2017). With robocars, the racing vehicles are designed to be fully automated, driverless, and unable to be occupied by a human (e.g., no steering wheel, no pedals, no seat, no space/room for a driver or passenger—see **Figure 1** and **Figure 4**). Lead robocar

vehicle designer, Daniel Simon, is known from his work in designing futuristic vehicles that appear in sci-fi feature films like *Tron: Legacy*, *Oblivion*, and *Captain America: The First Avenger*, and elsewhere (Simon 2007, 2013). In this regard, Simon can be recognized as someone who creates diegetic prototypes as part of his professional design practice (Kirby 2010).

Figure 4. Promotional example of a Robocar autonomous motorsports vehicle in late 2017, comparable in vehicle design and dimensions to a *Formula 1* or *Formula E* professional race car, featuring potential international corporate sponsorship branding. (courtesy of Roborace)

Prototype robocars are also being developed by professional race cars designers and manufacturers as "DevBots" (Hall-Giesler 2017). Similarly, university student engineers and other closely aligned amateurs are also moving into research and development of robocars based on currently available *Formula Student* vehicles that are converted to autonomous vehicle control operation (Hatton 2017a, 2017b), much like early autonomous automobiles represent existing production cars modified to be driven/controlled by autonomous driving technologies.

Robocars are not radio-controlled vehicles like scale-model airborne racing drones, "battle bots," or other remotely controlled vehicles whose pilot/operator stands adjacent to the race course, or wears a head-mounted display, while using a (game) controller to direct vehicle behavior and performance. Neither are robocars envisioned as an outgrowth of simple AI-controlled, scale-model car racing toys, as suggested by *Anki Overdrive* (2017) or *RealFX* (2017). Instead, autonomous racing cars like robocars are envisioned as globally branded, professional team-level, AI software driven, full-size *Formula 1*-like driverless electric vehicles that race against one another on municipal motorsport circuit courses for prizes, media broadcast and eMotorsports fans. Robocar racing is thus complex and confounding, while positioned to intersect the worlds of computer games, sim racing, and advanced automotive technology.

What kind(s) of auto-play does Robocar racing or autonomous eMotorsports represent? A review of available promotional media suggests that Robocar racing is about *motorsports engineers and software development teams competing against one another through the automated/AI software application/algorithm bots* they produce, refine, and independently operate as multiple decentralized AI agents. These bots execute on purpose-built AI automobile driving supercomputers sourced from NVIDIA, rather than engaging a driver/pilot to control a centralized processor common with a unitary PC or console for motorsports game play.

Autonomous eMotorsports is envisioned to enable multi-bot motorsports racing, where people participate either as application software engineers or spectators, rather than as virtual automobile drivers. But where does such a world of automated technology, motorsports, game design, game play, and spectating stand at this time? What can Autonomous eMotorsports become?

Anticipating Alternative Autonomous eMotorsports Game Designs and Play Scenarios

Autonomous motorsports, motorsports games and sim racing can come together in a number of different ways and through different means. Six different scenarios can be anticipated through speculative designs that do not yet exist, but for an array of digital artifacts and surrounding cultural conditions that can be configured to transform these fictions into potential practices. These scenarios range from those anticipating from incremental advances in technology and social affairs, to those more radical and transformative through conventions not readily apparent to the casual observer. Each is described in turn.

Motorsports engineering showcase: Professional motorsports engineering as corporate endeavor.

Both automotive and race car engineers can utilize eMotorsports racing as a venue for developing new algorithms for both high performance and ordinary performance driving of autonomous vehicles. They can similarly utilize such digital driving experiences as the basis for agile vehicle control dynamics that master collision avoidance in the presence of competitors who are moving to advance their respective positions in a competition racing event. Autonomous driving systems engineering can also attend to managing vehicular energy/fuel usage, thermal conditions for cooling to mitigate over-heating circuits/devices, preventing/reducing excessive tire and slowing/brake pad materials, positioning vehicle in/out of airflow paths to increase/decrease vehicle aerodynamic resistance affecting vehicle performance or thermal management, and more.

New corporate intellectual property appears poised to center around proprietary algorithms for collision avoidance, automotive operating system management, and their interactions. Robocar racing is well suited to create specialty challenge races that may not be appropriate for human drivers due to potential driver safety risks. For example, on a figure 8 race course, all vehicles cross through a high-speed intersection each lap facing possible collision with other vehicles that approach the intersection from a different direction. Timing and coordinating braking, steering, and throttle control are paramount to safely traversing the otherwise hazardous intersection. Collisions arising in front of trailing vehicles pose rapidly changing dynamic hazard conditions that require split-second vehicular control adjustments to avoid secondary collisions.

Robocar racing is positioned to produce valuable engineering data artifacts that record and can replay complex collision situations. These navigation and traversal data renderings are likely to be prized, studied, and re-analyzed by automobile manufacturers that support such racing activities and venues, possibly to inform their development of autonomous vehicles for sale to consumers. Whether there will be sufficient spectator interest may be of secondary concern, at least until it can be reliably demonstrated that robocars can drive fast, navigate challenging road

conditions and avoid complex dynamic collisions, while maintaining safe vehicular driving dynamics.

Student autonomous vehicle engineering showcase: Amateur/student motorsports engineering team versus similar.

Autonomous eMotorsports is an ideal venue for college students and others to get engaged with these new technologies. As students are often already strongly invested in computer game play on their own, as well as in competition with their friends, intercollegiate teams, or bots, eMotorsports attracts students around the world who also maintain an interest in professional motorsports like Formula 1 (F1), World Rally Championship (WRC), Indy Car Racing, or NASCAR, and perhaps even Formula E (the electric vehicle counterpart to F1). Intercollegiate autonomous eMotorsports teams are beginning to form, following the lead of efforts in EU countries like Germany's *Formula Student* (Hatton 2017b), and as suggested in **Figure 5**.

The emergence of intercollegiate competition to develop autonomous motorsports cars whose control bots are programmed by student engineers points to an emerging workforce that can support future automotive industry. Such industry needs engineers who can design and produce viable autonomous vehicles. The competition instills a desire to win, or at least perform at a level competitive with peers in other collegiate settings. Such competition generates innovation in ways and means to produce autonomous vehicle control systems and algorithms. Such innovative practice also supports a future workforce capable of working to produce innovative, company or automobile product line specific autonomous vehicles, as well as potential motorsport vehicles from the same firms. Whether an academic-industrial complex can emerge to support the ongoing research and development of autonomous vehicles is yet to be determined.

ProAm showcase: Professional teams working with networks of amateurs

Starting in 2017, the McLaren F1 team began to organize and sponsor eMotorsports tournaments in order to identify and recruit the best sim racing drivers. These top sim racers were sought for competitive recruitment and employment as professional "simulator drivers" that could support the professional McLaren F1 racing team (Gitlin 2017). Tournament play would only be against other human competitors, but all competitors were expected to prepare and train with different sim racing games like *iRacing*, *Forza Motorsports*, or others where they would compete and level up their driving skills against competitive race driving bots. Some sim drivers would also watch F1 races online as enthusiast spectators, so that the sim drivers can compare their lap times, driving conditions (weather, on-track debris, vehicles colliding ahead, etc.), and simulated race car setups to those observed in actual professional races (Phillips 2015).

In the future, many professional racing teams, machine learning experts, and sim drivers expect to be able to sign-up to access live race car telemetry (cf. Swinhoe 2018). This can enable them to further tune the sim race car setups or settings, as well as to compare their resulting performance, all as part of a sim racing experience. Once such data sharing is enabled, it may also feed back in the other direction, so that professional teams can review what off-site sim race enthusiasts find may be more productive vehicle tuning settings based on their simulated experiences. Coordinating and aggregating the sharing of tactical telemetry data will then merit careful attention, once or if it offers to provide competitive advantage to the teams able to successfully affect socialized telemetry data sharing.

Figure 5. Example of a conventional but now driverless *Formula Student* race car operated through autonomous vehicle control devices, engineered by students at Karlsruhe Institute of Technology (Hatton 2017b).

Last, in anticipation of growing engagement of a new generation of F1 racing fans and sim racers, F1 drivers like Fernando Alonso (also from Team McLaren) have begun to invest in establishing professional eMotorsports sim racing league teams that compete via young human sim racing drivers (Noble 2017). ESports is a rapidly growing global industry that attracts millions on online viewers who do not watch sports on television. EMotorsports sim racing may thus serve as a new channel to capture and capitalize on emerging global interest in eSports as a global entertainment media enterprise and online (re)broadcast venue delivered to millions of millennial spectators via *Twitch.tv*, *YouTube, Facebook Live, Twitter* or the like (eSports Marketing 2017; Taylor 2016).

Autonomous vehicle motorsports as CS/AI technoscience showcase

Operational control of autonomous vehicles or motorsports game bots is a scientific technology (sci-tech) problem for Computer Science and Artificial Intelligence (CS/AI) research and development efforts. Autonomous eMotorsports vehicles would be expected to operate and process sensed telemetry data under self-controlled computational means while on the race course. Processing command updates while the vehicle is racing is not permitted by rule, but is permitted when the vehicle is at rest in the garage/pit area, or in service setting mode. Thus there is a premium on autonomous operation and vehicular self-awareness of space, time and dynamic behavior. Autonomous eMotorsports vehicles need to rely on machine learning capabilities realized in deep, multi-layer neural network software that utilizes autonomous vehicle processing

hardware, such as will be provided by semiconductor manufacturing firms like NVIDIA, Intel, AMD, or others (NVIDIA 2017).

The continuing advance of interest in AI and Machine Learning can ensnare autonomous eMotorsports. Bot controlled racing vehicles can potentially demonstrate circuit performance and virtual driving capabilities *beyond the physical and neurocognitive limits of human race drivers*. Computer scientists can utilize eMotorsports racing as a venue for developing new algorithms for learning micro-performance variations relating to real-time vehicle dynamics, and to reconcile them against known 3D terrain maps of roadways and current road conditions (e.g., vehicle performance on road course during rainy weather and random, small-scale road debris like tire fragments or vehicle skid plate shards/debris). This is a recurring challenge for computer vision systems, especially those that must integrate/fuse visually sensed data from multiple smart cameras and laser range finders ("LIDAR") positioned to provide a 360º hemispherical view around the car of varying circumference associated with vehicle speed or competitive surrounds (cf. NVIDIA 2017). Autonomous eMotorsports vehicles can utilize visual sensing and perception capabilities beyond those of the most capable human drivers who are limited to two eyes, visual line of sight from their driving cockpit positions, and rear-view mirrors, perhaps augmented by secondary "spotters" around the race course who observe and communicate upcoming road course conditions and competitor positions/actions.

There is also growing emphasis in CS/AI research on faster and multi-modal integration of sensor telemetry data. Such data fusion would be intended to allow the race vehicle to continuously engage in deep learning. This kind of vehicular AI is intended to improve vehicle performance via "observe, reason, act, and adapt" telemetry sensing-and-control loops from its physical and competitive environments. Similarly, there is growing interest in the design and configuration of multi-agent human-bot teams, whether to support engineering problem-solving or for shared responsibility in autonomous eMotorsports systems operations. Here, participants whether human or AI-controlled bot, need to be able to "mentally" model the capabilities and limitations of the other, as well as when acting together in ephemeral groups (e.g., those addressing a "we need to fix this now" repair task). There is similar need to model the organization of persistent hierarchically managed teams with planned divisions of labor. In this way, the AI R&D challenge for autonomous eMotorsport games is in confronting issues in the organizational design of socio-technical systems and artifacts that model, enact, observe, and learn from results good/bad arising from human-bot teamwork. Such teamwork thus entails transhuman organizational design, deliberative participation, organizational behavior, and management/governance practices. These teamwork challenges suggest that plausible solutions will be difficult to attain (cf. Chilvers 2008, Ferrado 2013).

Finally, there is also CS/AI interest in developing anti-cheating technologies for computer games, and thus by extension, for autonomous eMotorsports games. Such technologies and algorithms are needed to mitigate competing teams from realizing covert, unfair competitive advantages through the use of non-compliant or covert control technologies. There may be similar interest in mitigating excessively reckless driving performance and inter-team drama, reminiscent of the high-flying driving antics witnessed in the *Speed Racer* animated and live action films, especially within sanctioned league autonomous eMotorsport tournament races. However, it seems reasonable to expect that motorsports game modders, pranksters and other counter-racing enthusiasts may seek to capture, study, replicate and share such cheat codes to

achieve other community or scholarly objectives (Consalvo 2007; Trammell 2017).

Collective play sim racing experience and composite social driver-bot bodies

Autonomous eMotorsports allow for new forms of fan/user participation in scheduled racing events. While traditional motorsports relies on individual professional drivers backed by professional race car teams generally financed by corporate sponsors, autonomous eMotorsports can allow for virtual drivers realized through the collective real-time actions of geographically distributed player-drivers. These player-drivers operate within their own sim racing setup at home, at an arcade, or a specific sim-racing venue to continuously "vote" how to control their shared driving vehicle through their personal articulation of local UI devices. **Figure 6** shows a scenario of ten sim racing UI systems that could be repurposed (Scacchi 2015), from supporting of ten player-drivers each controlling one in-game race vehicle, to all ten providing driving control inputs to control a single driverless autonomous eMotorsports vehicle. Such a capability is not physically possible to replicate with a human-driven race car in an agile, low-latency manner, but is technically possible with a driverless autonomous vehicle, whether physical or virtual. How might such a collective driving play experience be possible?

Figure 6. Repurposed scenario where multiple human drivers share control a single autonomous eMotorsports vehicle through collective, real-time driving action "votes." (Original source image, courtesy of Vesaro.com).

The basis for such a capability might denote *a real-time, participatory game play democracy* (cf. Lerner 2014). Networked or cloud-based data collection and aggregation servers can

continuously monitor player-driver UI input telemetry and translate these input votes through hard real-time voting schemes. Such voting may collectively represent the situated common will for how to drive and direct the autonomous vehicle (e.g., via some democratic proportional voting scheme like majority rule, supermajority rule, plurality rule, or some multi-attribute utility or shared optimization rule). So if the collective momentary will of participating player-drivers is to slow down their shared vehicle, negotiate a slight left turn around a road course curve, then accelerate, the intent is that the autonomous racing vehicle performs this visually observed maneuver with minimal latency.

Player-drivers must learn how best to master common shared-intent driving in the presence of voting and voting outcome latencies. This might rely on shared voice chat common in multi-player eSports game play, or by AI teamwork coordination algorithms. However, there is also need to accommodate other player-drivers who are actively seeking to compete in the race in other shared controlled vehicles, or to exhibit some other playful behavior like virtual reckless driving and crashing. Overall, such a game play-oriented democracy will represent a technocracy of limited participatory deliberation capabilities (Chilvers 2008), rather than a more democratic shared governance regime by and for the people. But such playful engagement may help people who play such autonomous eMotorsports games to learn and experience a different form of democracy in action, as well as real-time democratic decision making (Lerner 2014).

Auto-erotic body experiences delivered to player-drivers or spectators of autonomous eMotorsports sim racing.

Auto-erotic experience can emerge from situated, embedded, immersive and orchestrated multi-modal sensory stimulation in or about cars. Such experience transcends the functional specifications of sim racing rig for the player as a naive driver experience, and enters the realm of ecstatic arousal and euphoric experience. Viewing sim racing videos by media influencers who sim race historic cars like a Ferrari F2004 Formula 1 car equipped with a 10 cylinder race engine, and configured as driven by legendary F1 driver Michael Schumacher when he won his seventh F1 World Championship, provides such an example (Broadbent 2017b). The sim racer who experiences auto-eroticisms is the consummate enthusiast of racing with race cars of particular configurations, motorsport circuits that pose particular race driving challenges, and competitive racing conditions against bots driving at a high competitive level. Such a racer is also a PC sim racing rig enthusiast. It is clearly possible for a person to be all of these things at once, and it is those people who enjoy and seek out the ecstasy and euphoria of exotic sim racing experiences. But such experiences can be fleeting, ephemeral, and subject to disruptive breakdown due to operational system or game glitches.

The core construct here is whether autonomous sim racing force feedback devices can stimulate kinesthetic, euphoric, or ecstatic experience of speed, multi-dimensional haptic forces, along with sensational visual and auditory illusions of speed, spectacle, and heroic driving experience. This entails identifying whether autonomous motorsports game developers can create, deliver, and accentuate feedback control signals that communicate the visceral thrills of engaging multi-sense neurocognitive inputs preconditioned by technolust[3].

Autonomous vehicle racing experiences do not require social identification with an heroic

3 Technolust, following the *Urban Dictionary* denotes “the constant desire to have the newest, flashiest, fastest, shiniest gadget available.”

vehicle driver, as is common in traditional motorsports. Instead, it allows the player/viewer to identify simply with the visceral experience associated with an abstract, fantastic, virtual driving machine, the player-driver sim racing rig configuration of UI devices, and the thrill of high speed driving of cars that simulate exotic multi-million dollar racing machines. This leverages the recurring love of technology (Latour 1993) that avid game enthusiasts communicate, share, and defend with their like-minded cohorts who are also part of this sim racing scene. To be clear, these auto-eroticisms are not generally anticipated to be aligned with mechanophilia or orgasmic in a sexual manner, but instead focus on the love of fantasy and play with artifice, as well as arousal from experience with other worlds or other worldly experiences, whether for pleasure or hedonistic entertainment. Auto-play begats auto-eroticism and vice-versa, as well as the practices of each that co-evolve with the other.

Hybrid compositions

While there is some lure to look for ways and means to rationalize alternative (re)configurations of the six alternative scenarios, such effort merely compounds these speculative fictions perhaps beyond thresholds of credulity. Each scenario serves to resolve certain socio-technical affairs and resource arrangements, while ignoring others that may dilute, undercut or defeat their efficacy. Speculative design scenarios are fictions and thus lies, though their verisimilitudes may be seductive, revolting, or something in-between. As such, the next turn is towards analytical critique, rather than towards hybrid composition, of the speculative designs that help illuminate the intersecting and segmenting worlds of autonomous vehicles, motorsports games, and sim racing (cf. Taylor 2006).

Why Care about Autonomous Vehicles and Autonomous eMotorsport Games: Revealing Socio-technical Embeddings

At least three analytical lenses can be orthogonally positioned for viewing and re-viewing the six speculative design scenarios just presented. These are the lenses that focus observation and attention to cross-cutting issues surrounding: (a) transhuman spectacle and spectating; (b) technofeminism, gender, bodies and identity play; and (c) autonomous technology as technics-out-of-control that reinvent and subjugate recurring techno-political affairs.

Transhuman spectacle and spectating

Historically, cinema and television have proffered and transmitted images of mostly dystopian visions and rationales for autonomous robots. Such robots appear diversely in cinematic renderings as uncertain human-controlled Mechas in Japanese anime, sexualized cyborgs dating back to Fritz Lang's *Metropolis* (1927), faceless humanoid and destructive light-ray projecting Gort in *The Day the Earth Stood Still*, endless droid armies in *Star Wars: The Clone Wars* and *I, Robot*, the combative human-like robot-vehicle *Transformers*, and many, many others. These mediated images, personifications, and fictional narratives create and reinforce a culture that questions whether robots/bots are menacing, seductive, or/and just transhuman. These transhuman renderings help cultivate desire to watch, be entertained, and accept entrainment of posthuman robotic techniques as inevitable artifacts of our future. Autonomous vehicles motorsports and sim racing can be positioned and ironically configured as merely another “next

step" in transhuman evolutionary progress. So the audience needs to be gathered to witness the spectacle of autonomous vehicle competitions and eMotorsports game play (cf. Taylor 2006; Taylor 2012).

At the time of writing this article, spectating of online broadcast of computer game play is rapidly overcoming the audience for traditional sports and motorsports. Correspondingly, broadcasters and media influencers are acting to recognize, reproduce, and exploit this emerging global millennial demographic market share. *Twitch.tv, YouTube,* and others social media broadcasters now distribute literally millions of hours of computer game-based play video streams to often small enthusiast audiences of game play spectators that sometimes coalesce into tens/hundreds of thousands of concurrent online viewers (Consalvo 2016; Taylor 2016). Supporting online social media like Facebook, Twitter, Instagram and others act to mobilize and commodify game spectators who participate in watching, chatting, and listening to "casters" and influencers who produce game play spectacle in online venues ("channels"). The final sim race of the F1-sponsored eMotorsports championship of Fall 2017 engaged larger online spectating audiences than either the U.S.-based National Basketball Association (NBA) and National Hockey League (NHL) final championship games broadcast online (eSports Marketing 2017). Interestingly, these online audiences were determined to be primarily located outside the U.S., mostly in Europe, perhaps in line with the EU-based origins of F1 racing.

The spectating audiences for eMotorsports games are capable of being produced in forms ready for engagement and market segmentation online by endemic corporate manufacturers and non-endemic sponsors ready to consume commodified spectator gaze (cf. Consalvo 2016; Taylor 2012; Taylor 2016). Consequently, can the *sportification* of autonomous vehicle racing, whether on physical race courses or online virtual race courses, be far behind? If they build it, will the audience come to watch driverless, faceless robocars under the software programming control of motorsports engineers? Similarly, will online millennials direct their Web media browsers to tune into autonomous vehicles racing events? As noted above, existing sim racing games already engage both human-human motorsport race competitions and human-bot race practice training. So why not also bots versus bots race competitions? Finally, can academic participation supporting industrial workforce development and ProAm collectives give rise to a new generation of extraordinary motorsports/sim racing experiences and racing choreographies? Will friendly intercollegiate student competitions and ProAm motorsports engineering socializations become the new basis for reproduction and sustainability of motorsports culture? There are more questions than answers concerning transhuman spectacle and spectating.

Technofeminism, gender, bodies and identity play

So far unexamined and unaddressed is the potential role of feminist studies and advocacy practices in the speculative design of autonomous vehicles futures, autonomous eMotorsports game play/spectating, and sim racing. How should these new expressions of automobility, auto-play, and sim racing artifact configurations be informed by, for example, gender-focused game studies (e.g., Gee and Hayes 2010; Guertin 2009; Huntemann 2012; Kafai, Heeter, *et al.* 2008; Losh 2016), cyber feminism and feminist technoscience (Haraway 1991; Hayles 2006; Wajcman 2004)? The subtext of the six speculative design scenarios silently reiterates male-dominated automotive system design regimes and autonomous CS/AI control schemes. Feminist perspectives have not yet addressed whether and how there can be a non-masculine or

technofeminist design regime for autonomous vehicles and CS/AI control schemes appropriate for motorsports and automobility. Accordingly, what might such informing perspectives help illuminate? Clearly, material in this section is very modest, conceptually shallow, and ultimately inconclusive. But perhaps it may serve to seed follow-on examination and more thorough critical articulation.

EMotorsports vehicles are driverless and transhuman, at least from a spectator viewpoint. These vehicles are neither part of natural world nor are they cyborgs, as they lack biological elements and human backbone: they are instead high performance, digitally embodied mobility artifacts. So cyborg feminism (Haraway 1991) may not be the most informing critical lens to employ here. As such, we need some other critical framing construct (cf. Hayles 2006). The drivers of these artifacts are CS/AI-controlled bots programmed, networked, configured and incrementally reconfigured by teams of engineers for the benefit of other team participants, affiliated sponsors, corporate and broadcast media advocates, and spectators. But do these vehicles nonetheless denote or delimit gendered posthuman bodies and identities? This question need not literally translate into matters pertaining to sexualized vehicular shapes, personalized name, male fetish gaze or technolust. Instead, it may draw attention to where the locus of vehicular control rests, who can access and study it, and which stakeholder interests inform their design goals and the ethics of their practices (cf. Taylor 2006; Turkle 1995).

Autonomous vehicles remove and relocate the locus of vehicular control away from human drivers and passengers, into the hands of corporate engineers and enthusiasts who are predominantly male, and who routinely fail to address/recognize feminist perspectives or their informing sensitivities. But where and how can motorsport, especially online eMotorsports, be open to provocative engagement of contemporary feminist advocacy? Traditional views of women in sports often draw attention to physical demands and potential bias in the design and configuration of sports games play/viewing around the male physique, “bromance” play, and paternalistic hierarchical team role play. But with eMotorsports game system design and game play/viewing still in their early formative stages, this may pose fewer and lower cost barriers to entry/participation within feminist advocacy/studies. These openings may more likely be found in and around the digital artifacts that enable motorsports games and online game culture, compared to the professional multi-million dollar motorsport endeavors that depend on global corporate underwriters to sponsor hedonistic racing spectacles and engineering challenges that draw attention to traditionally masculine motorsport tropes and cultural practices. Finally, emerging queer game studies may also be engaged and mobilized to provide other gendered perspectives, insights, and saliencies (Ruberg and Shaw 2017, Shaw and Sender 2016).

Last, autonomous eMotorsports play may lead to recognition of a new modality of posthumanism, namely that of gameful posthumanism (cf. Ferrado 2013). *Gameful posthumanism* allows for and accommodates collective simulator-based play conditions featuring situated verisimilitudes for both representational motorsports game artifacts that sit-in for high cost race cars, and for play experiences that immerse bodies through visceral and kinesthetically authentic UI devices. Similarly, the ecstatic and euphoric pleasures that arise from auto-erotic body-sensory stimulation, and from the reactive cognitive challenge of high-speed virtual driving, also point to new possibilities and problematics arising within gameful posthumanism. Whether such matters gain the interest in posthumanist studies of technolust, gendered technologies, and digitally controlled artifact configurations as materially embodied identities or

body interface receptacles, are open questions for further exploration and study.

Technics-out-of-control and the politics of autonomous eMotorsports

Some forty or so years ago, critical technology theorist Langdon Winner posed the question of whether it is possible for any technology to be treated as autonomous (Winner 1977). His answer at the time was to call out myths and misdirections surrounding autonomous technology, and counter with the need to attend to socio-political surround that situate the design regimes and control schemes ("technics") embodied in the technological artifacts subjected to the question. He similarly indicates the need to recognize who controls their realization and who captures their economic/symbolic benefits—what he referred to as "settling affairs." As this question remains relevant to the matters in this article, possible answers should be identified and explored.

Autonomous vehicles, autonomous eMotorsports games, and sim racing systems/interfaces represent different kinds of structural stakeholder interests networked within and across the six speculative design scenarios. There are firstly the *dominant interests* of technology and automobile manufacturers, and new technoscience (CS/AI) developers who are responsible for system design and bot-based control mechanisms. This includes the realm of engineers, software developers, system designers, and interstitial technicians: those whose rationalize and build their careers around inventing, making, mastering, and evolving their identities and ways to think, while developing and co-evolving their chosen technologies of interest (cf. Hayles 2006; Wilson 2010).

Juxtaposed against the dominant are the motorsports teams and drivers as *contending interests*. Without these contenders, at least historically, there is no motorsports, no heroic individuals, no spectacle that entertains, and no organized and corralled spectators to engage with branded corporate messaging. Similarly aligned would be motorsports game studios and game makers.

Next, there are critical analysts and advocates of new/reframed cultural practices grounded in feminism, gender and identity play, as well as new forms of collective participation in sim racing user interfaces, auto-eroticisms and motorsport playbour—all of *those whose interests at present are discounted, ignored, or repressed* in this arena.

Other recurring stakeholder sub-worlds in autonomous vehicle motorsports network include: non-endemic corporate sponsors, endemic motorsports venues and spectators, broadcast media and producers of audience, motorsport event promoters as creators of spectacle and hedonistic entertainments, motorsport game modders and playbourers, and alternative computer game and eSports play/viewing genres sub-worlds. These secondary stakeholders most likely get/elect to be aligned with either the dominant or contending interests when conflicts over system design, control schemes, their interactions or consequences become visible. These peripheral stakeholders occupy supporting roles on the sidelines during conflict, until such affairs can be settled through deals that reallocate resources or move narrowly deliberative technocratic participants in/out of conflict generating/resolving conditions. In contrast, those whose interests are repressed are marginalized beyond the periphery of narrative discourse regarding the possible futures of autonomous vehicles, though autonomous eMotorsports speculative designs can accommodate such voices and legitimize peripheral participation.

Autonomous vehicles and autonomous eMotorsports games are not autonomous, except in name and portrayal in promotional media—their autonomy is mythic and something of a misdirection away from the loci of their centers of control. Their naming and marketing

mediations are contrived distractions that help manifest dominant techno-political design regimes and control schemes as inevitable technological progressions and innovations. Disrupting the dominant/contending techno-logics and fictions that help rationalize autonomous vehicles is a daunting challenge for advocates of posthumanist practice, emancipatory social change, and sustainable (re)allocations of resources supporting automobility and its alternatives.

Conclusions

Motorsports and eMotorsports games and game play experiences have been an under-explored domain for game studies. Yet as portrayed in this article, they represent an interesting and conceptually deep arena for critical analysis. Auto-play is an appropriate arena of study of emerging issues within and across autonomous vehicles, motorsports racing games and sim racing, together within speculative design future fictions addressing the potential emergence of autonomous eMotorsports games and online game play/spectating experiences.

Speculative design fictions can serve as a conceptual lens for anticipatory game studies that complement reflective/historic game studies that currently dominate critical game studies. The six speculative design scenarios presented in this article span a socio-technically diverse range of possible futures for autonomous eMotorsports games and experiences. The range covers from incremental extensions of current technological system configurations, to more progressive socio-technical cultural transformations. These transformations have not been part of the discourse surrounding the emergence of autonomous vehicles, motorsports games, or sim racing user interface devices and experiences. But speculative design serves as a critical mechanism that allows such transformations to begin to be articulated, explored and compared through cross-cutting analysis. However, the ethical value and limitations of speculative design and design fictions as analytical lenses for understanding eMotorsports gaming and anticipating autonomous eMotorsports games and play/view experiences merit further consideration and deconstruction.

Auto-play, as well as play with automobile culture and motorsport tropes, are open for analysis as transhuman spectacle and spectating, technofeminism and posthumanism, and for the nascent politics of autonomous eMotorsports games, game play and game viewing/spectating. Similarly, auto-play artifacts, tools, and techniques can enable new ways for thinking about and transforming culture through game play and spectating experiences (cf. Hayles 2006, Wilson 2010).

Moving forward, why should anyone care about the emergence of autonomous eMotorsports games and game play experiences? If motorsports games have so far emerged without critical study, maybe they merely denote a cultural niche populated with hobbyists whose practices are mundane, ordinary, and engaged without broader audiences. Such games may be for insiders only—outsiders need not apply, care, or worry about what lies therein. Yet studies of cultural niches are often quite informing about broader cultural conditions and associated configurations of niche-focused technologies, social relationships and socio-technical affairs still in play or temporarily settled.

Last, as this article shows, even marginal, understudied computer game worlds may be culturally rich and diverse (Taylor 2006). Such worlds may similarly serve as emerging arenas where the interests of global industries and academic-industrial sci-tech networks help to shape and constrain the politics of technological artifacts like autonomous vehicles, motorsport games, and sim racing user interface devices and experiences. Similarly, they also shape what constitutes

game play and game spectating experience (Consalvo 2016), as well as motorsport entertainment and future car culture (Watkins 2017). Pedal to the virtual metal, then accelerate to full speed ahead to see who gets to the finish line first.

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