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FRONT-END EVALUATION:

GAME CHANGERS EXHIBITION (FORMERLY TITLED *SPORTING INVENTION*)

Prepared for

The Lemelson Center for the Study of Invention and Innovation
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SUMMARY AND RECOMMENDATIONS

This report presents findings from a front-end evaluation conducted by RK&A, Inc., for the Lemelson Center for the Study of Invention and Innovation at the National Museum of American History (NMAH). The goal of this evaluation is to inform the design and development of *Sporting Invention*, the working title¹ for an exhibition that will replace the current Lemelson Center exhibition, *Places of Invention*. The following summary and recommendations are organized by major trends that emerged from interviews with NMAH visitors.

The findings presented here are among the most salient. Please read the body of the report for a more comprehensive presentation of findings.

OVERALL INTEREST IN THE EXHIBITION

Overall, visitors had positive reactions to the proposed topics/ideas for the exhibition. Many were intrigued to learn more about the history of invention and technology related to sports because it was something they had not considered before. For the most part, their expectations align with the proposed content; most, for instance, expected the exhibition to showcase how and why sports gear has evolved over time. Additionally, the vast majority expressed positive feelings about sports whether they are a serious sports fan or athlete versus a more casual participant or observer. All of this bodes well and indicates the proposed exhibition will include touchpoints for the range of NMAH's visitors.

INTERPRETATION OF "SPORTS"

Results indicate that visitors interpret the term "sports" differently. First, there is the issue of whether "sports" refers to professional, competitive teams or more broadly refers to anything involving physical activity or exercise. Many, for instance, chose the phrase "I have no strong feelings about sports" to describe their relationship to sports because they do not regularly follow professional sports, but then went on to describe being physically active and athletic in their personal lives. Along the same lines, the different "sports" participants mentioned throughout the interviews ranged from organized and professional team sports (e.g., major league football and baseball) to outdoor recreational but non-competitive activities (e.g., hiking and camping) to general fitness activities (e.g., going to the gym). And, several wondered

¹ As of June 2019, the exhibition title is *Game Changers*. We have acknowledged this change on the cover of the report but have kept references to *Sporting Invention* throughout the remainder of this report.

whether the exhibition would focus exclusively on professional teams or if it would also include “everyday” sports. Clarifying and supporting visitors in their understanding of what “sports” entails in the context of this exhibition will be an important consideration moving forward.

INTERPRETATION OF “INVENTION” AND “TECHNOLOGY”

Another confusion arose surrounding visitors’ assumptions about the timeframe to be covered in the exhibition, which largely relates to their interpretations of “invention” versus “technology.” Results indicate that, when thinking about sports, visitors tend to interpret “invention” as a broad and timeless concept, while “technology” is viewed as a narrower, more modern phenomenon. This is largely because visitors associate “technology” with electronics and digital. Visitors described “invention” as creating something entirely new, often giving the example of “inventing” a completely new sport, which they said has happened many times from the ancient past to today. By contrast, they described “technology” as what “develops” or “advances” an invention and as something that only became prominent in sports in the 21st century and particularly in recent decades; they often referred to the advent and popularization of electronics (e.g., television) and digital technologies that track athletes’ performance. While visitors were intrigued by these modern technologies, they were more interested to learn how sports have evolved throughout a longer historical period (see Interest in Proposed Exhibition Themes below). Therefore, the terminology around “invention” and “technology” will be important to prime visitors for the exhibition.

A GUIDE TO VISITOR ASSOCIATIONS WITH KEY TERMINOLOGY

KEY TERMINOLOGY	VISITOR ASSOCIATIONS
Sports	Professional sports teams (major-league) Exercise and athletic activity in general American
Sporting	Old-timey word for sports A verb Not American-sounding
Invention	Creation of something new (e.g., a new sport) Timeless Broad and all-encompassing
Technology	Adaptation, advancement, or development of an invention Modern (21 st century) Involves electronics and/or digital

INTEREST IN PROPOSED EXHIBITION THEMES

Positively, visitors found aspects of all four proposed exhibition themes—The Gear, The Athlete, Digital and Data, The Fan—intriguing. Two themes in particular—The Gear and The Athlete—emerged as most compelling. In general, visitors liked when a theme felt “historical.” Many, for instance, liked The Gear because they were interested to see real equipment that conveys how sports have changed over time (though a few worried including too much equipment would become repetitive or that it would be difficult to show the full breadth of sports equipment in a small exhibition). Similarly, several were interested in The Athlete because they wanted to learn about advances in medicine and science that have, over time, allowed athletes to monitor and improve health and performance. By contrast, Digital and Data came across as less historical and provoked negative or indifferent reactions among some visitors. A few, for instance, were skeptical of whether we can adequately assess the impact of digital technologies on sports since they were only recently introduced. And, as mentioned earlier, several wanted to learn more about the history and development of individual sports.

Visitors also liked the prospect of hearing individuals’ stories related to sports, in part because gear (the “stuff”) was top of mind when they were first told the exhibition topic, so they were surprised to see stories of athletes and inventors (“the people”). For example, in The Gear, several were intrigued to learn that an aerospace engineer invented skis. Visitors also expressed curiosity about athletes’ experiences, from their motivations to how they make decisions to stories of human “competitiveness and endurance.” And, a few related personally as current or former athletes. Several hoped to see more personal and surprising stories featured in the exhibition whether from famous athletes, everyday players, or inventors and designers who worked to develop new technologies related to sports.

Related to this, the ethical issues surrounding invention and technology in sports proved to be intriguing for some yet a turnoff for others (though this was generally not hugely compelling or top of mind for most visitors). Several, for instance, recognized that digital technologies are rapidly changing the nature of sports (for better or for worse) so were curious to investigate issues of fair or foul play that relate directly to electronics or digital technologies used to judge and watch sports, such as whether instant replay should be permitted. However, several visitors said substance abuse (evoked in The Athlete and Digital and Data) is a peripheral and overly familiar topic, and thus not interesting to them.

Finally, one theme—The Fan—emerged strongly as least intriguing and even off-putting to some visitors. While visitors acknowledged that fans are part of the sports world, they also said the topic feels distant from and not as critical to sports as gear, athletes, and digital technologies, especially in the context of the history of invention and technology. And, many also said this theme feels overly familiar since they already know what is like to be fans. That said, while most were critical of this theme, a few named aspects they liked, including conveying a sense of fans’ passion for particular sports or teams.

REACTIONS TO THE THEMES AND LARGER TRENDS

Theme	Interesting Aspects	Least Interesting Aspects
The Gear	<ul style="list-style-type: none"> Historical/change over time Real objects (equipment) “The people” (inventors) 	<ul style="list-style-type: none"> Predictable Concern both (a) it would be repetitive because of breadth; and (b) wouldn’t be able to cover the breadth
The Athlete	<ul style="list-style-type: none"> Historical/change over time Advances in medicine & science “The people” (athletes) 	<ul style="list-style-type: none"> Ethics related to substance abuse/doping
Digital and Data	<ul style="list-style-type: none"> How digital has changed sports Ethics 	<ul style="list-style-type: none"> Ethics Not historical enough Data is a turnoff
The Fan	<ul style="list-style-type: none"> Passion of fans 	<ul style="list-style-type: none"> Too familiar Not as relevant to sports and invention as other topics

History and seeing change over time was received positively. It was most visible to visitors in the themes of The Gear and The Athlete.

People were also a hook. Again, the stories of individuals were most visible to visitors in the themes of The Gear and The Athlete. Surprising or unfamiliar stories were particularly attractive.

Ethics was a polarizing topic. The concepts would best be used more sparingly and focus on unfamiliar topics.

Familiar stories were unappealing. Thus, the section on the Fan was unappealing in general and also perceived as least relevant.

REACTIONS TO PROPOSED TITLES

Visitors had mixed reactions to the five proposed exhibition titles, although *Changing Sports with Invention* and *Game Changer* were considered best representative of the exhibition’s ideas and *Sports = Athletes + Invention* least representative. See the graphic below for individual reactions by title.



A few trends emerged regarding why visitors liked certain titles more than others. First, a few titles—*Changing Sports with Invention*, *Sporting Invention*, and *Invention and Sports*—positively came across as extremely “straightforward” and “literal,” which visitors liked because they easily and quickly understood that the exhibition would deal with how invention relates to sports. By contrast, visitors thought *Game Changer* was “ambiguous” because it could be connected to video games or other types of games as opposed to sports. However, although visitors liked *Changing Sports with Invention*, *Sporting Invention*, and *Invention and Sports* because they clearly conveyed the exhibition’s content, they also said these three titles felt “boring,” “academic,” and not attention-grabbing compared to *Game Changer*, which provoked curiosity and intrigue (i.e., “what is the game changer?”). Additionally, many visitors liked titles that evoke change and evolution (such as *Changing Sports with Invention* and *Game Changer*) primarily because the exhibition is about the history of invention and technology related to sports over time. Visitors also liked concise titles, such as the two-word titles *Game Changer* and *Sporting Invention*.

Finally, one title—*Sports = Athletes + Invention*—provoked almost entirely negative responses, for a few reasons. Several said math equations are generally off-putting so this title would not make them want to visit the exhibition. Related to this, several others found this title convoluted and hard to read (e.g., “it doesn’t look right”). A few others liked the focus on athletes but also said this title ignores other people involved in the history of invention and technology related to sports, such as inventors and designers. Finally, a few criticized it because they came away with the impression that it separates rather than unites the ideas of sports, athletes, and invention.

RECOMMENDATIONS

At this stage, the *Sporting Invention* exhibition tested well; visitors were intrigued by the concept and by most of the proposed themes. Below are some recommendations for moving forward with exhibition development:

- ◆ Visitors think of many different ideas when they hear the word “sports,” ranging from professional sports to everyday fitness activities. Consider strategies to explicitly and repeatedly clarify for visitors what “sports” means in the context of this exhibition to account for their varied interpretations and experiences and further testing visitors’ associations with this word to ensure they align with the exhibition content.
- ◆ Visitors are excited to learn more about the history of invention and technology in sports over time. However, some struggled to understand the timeframe to be covered in the exhibition in part due to their differing interpretations of “invention” and “technology.” Consider clarifying these terms upfront for visitors in the exhibition (in the context of sports) in way that also conveys a sense of time.
- ◆ Visitors found many aspects of the proposed themes intriguing, especially The Gear and The Athlete, because they show historical changes over time and feature surprising and intriguing stories of individuals in sports (e.g., inventors, athletes). Visitors were similarly intrigued by how Digital and Data is rapidly changing sports, but they were also skeptical and do not want to be inundated with data or technology. Move forward with these themes, but also consider ways to integrate Digital and Data content within stories of The Gear and The Athlete.
- ◆ Visitors were not intrigued by The Fan theme because it felt overly familiar and too distant from sports. Consider eliminating this as a larger theme and potentially integrating stories of fans into the remaining themes.
- ◆ Visitors had mixed reactions to the proposed exhibition titles; none were a perfect fit to the exhibition content. The final title must be straightforward, yet catchy, and should also convey a sense of change over time since this proved to be a hook. Consider combining aspects of titles that tested relatively well, like *Game Changer* and *Changing Sports with Invention*, and retesting titles as exhibition development continues.

STUDY BACKGROUND

The Lemelson Center for the Study of Invention and Innovation at the National Museum of American History (NMAH) contracted RK&A, Inc. to conduct a front-end evaluation for the exhibition currently titled *Sporting Invention*, which focuses on stories of invention and innovation as they relate to sports. The exhibition will replace the current Lemelson Center exhibition, *Places of Invention*. Specifically, the objectives of the front-end evaluation are to explore:

- ◆ Visitors' understandings of and associations with sports and invention.
- ◆ Visitors' reactions to preliminary concepts for the *Sporting Invention* exhibition.
- ◆ Visitors' responses to potential titles for the *Sporting Invention* exhibition.

METHODOLOGY

RK&A conducted 40 in-depth interviews with visitors who were visiting NMAH from December 27-31, 2018. In-depth interviews are open-ended and encourage interviewees to express their opinions, understandings, and the meaning they construct. The interviewer followed a continuous random selection method to identify visitors and then invite them to take part in the study. While adults were the primary recruits, children could participate in the interview with adults' permission and if they assented. Most groups were recruited in front of the *Places of Invention* exhibition; a few groups were recruited in front of *Wonderplace* or in the vicinity of *Performance Plaza*. Upon securing agreement, the interviewer gave a brief introduction and then conducted the interview using the guide and materials in Appendix A-B, asking probing or clarifying questions to better understand visitors' experiences. All interviews were audio-recorded and transcribed to facilitate analysis.

DATA ANALYSIS AND REPORTING

The data are qualitative, meaning that results are descriptive. In analyzing the data, the evaluator studied the transcripts and notes for meaningful patterns and grouped similar responses as patterns and trends emerged. The objectives of the study, as well as our professional experience, informed the analysis. Findings are reported in narrative, supplemented with exemplary quotations from participants. Trends and themes in the data are presented from most- to least-frequently occurring. Verbatim quotations from interviews (edited for clarity) illustrate participants' thoughts and ideas as fully as possible. The interviewer's questions appear in parentheses. Within quotations, an asterisk (*) signifies the start of a different speaker's comments.

Qualitative methods typically produce a wealth of data from a smaller number of people. In thinking about qualitative data, one should consider trends relative to one another. That is, more

weight should be given to comments made by many visitors versus those made by a few visitors; however, the reader could consider the comments made by a few visitors when thinking about findings, as one person might offer valuable insight. When describing the findings, this report uses qualitative data terms such as “most” and “several,” as is appropriate for the sample size and the type of data collected. Proportions, such as one-half or one-third are used where appropriate. Such descriptive language is intended to provide readers with a sense of the general trends. Readers should regard the trends as general categories rather than rigid numerical counts.

INTERVIEW FINDINGS

RK&A conducted interviews with a random sample of visitors at NMAH. A total of 111 6 visitor groups were recruited; 4 were ineligible owing to language and 40 agreed to participate, for a 38 percent participation rate.² A total of 78 individuals participated in the 40 interviews.³

Of the individual participants:

- ◆ Most are adults; one-fifth are children under 18 years.
- ◆ Adult participants range in age from 18 to 89 years, with a median age of 40 years.
- ◆ Child participants range in age from 10 to 17 years, with a median age of 14 years.
- ◆ More than one-half are male, and almost one-half are female.
- ◆ Nearly two-thirds are first-time visitors to NMAH.
- ◆ Almost all reside in the United States, while a few reside in foreign countries.⁴ Of United States residents, several each are from Maryland or North Carolina.⁵
- ◆ More than one-half visited NMAH in adult-only groups or alone, and almost one-half visited in groups with children under 18 years. Most of those visiting the museum in groups with children were visiting with children 10 years or older (the target age range for the exhibition).

² There are no statistical differences in the sample who agreed and those who declined to participate by age, gender, or the presence of children.

³ Almost all interviews were with one to three visitors. One interview was with a group of four visitors.

⁴ Of foreign residents, two are from Germany, and one each is from Australia, Canada, England, or India.

⁵ Additionally, a few United States residents each are from the following states: Florida, Georgia, Kansas, New York, Oklahoma, Pennsylvania, Tennessee, Texas, or Virginia. The other one-half of United States residents reside in other states.

INITIAL ASSOCIATIONS WITH EXHIBITION TITLE

Before participants were shown any specific materials related to the new exhibition, they were told its proposed title—*Sporting Invention*—and were asked to discuss what comes to mind when they hear this title. Several trends emerged:

- ♦ **Evolution of sports gear:** Nearly three-quarters mentioned that sports gear has improved over time and gave examples, such as football helmets, baseball gloves, and skis. A few named reasons why gear has evolved, such as to improve athletes' safety, training, or performance. One also mentioned that certain gear can make sports accessible to those with disabilities or sensory disorders.
- ♦ **Creation of new sports:** More than one-third said the invention of sports that “never existed” came to mind, and, along with that, the idea that the rules of sports have and continue to change. A few gave examples of newer sports, such as those featured in the X-Games (e.g., snowboarding).
- ♦ **Technology:** About one-fifth mentioned technology. Most did not elaborate but a few said technology has “grown with sports” and “contributes to sports.”
- ♦ **Non-traditional or non-professional sports:** Several mentioned or alluded to the idea that the term “sports” includes “active” recreational activities (e.g., fishing, hiking) as well as professional sports.
- ♦ **Sports history:** A few said what came to mind is the history of sports “from the past to the present” day, but they did not expound.
- ♦ **Confusion:** A few mentioned the above ideas but also said the title *Sporting Invention* is “vague” and “confusing” and they were not confident in their responses. Along these lines, two interpreted the word sporting as a verb, as in “sporting the invention.” And, one said the word “sporting” brought “old-timey hunting” to mind rather than modern professional sports.



*“When I think of ‘Sporting Invention’ the first thing that comes to mind is invention related to sports, athletic activities – like either the history of how sports evolved and what human innovations made that [sports] better, easier, allow[ed] for athletes to perform better. *I would say equipment that has changed games, new training techniques that have made athletes bigger, stronger, faster, and new ways to play the games for whatever reasons.* Creating sports that never existed in the past.*

—Adult male (age 21) and adult male (age 50)

Additionally, just over one-half of participants mentioned specific sports in their responses. In order from most- to least-mentioned they include: football, baseball, basketball, soccer, skiing, snowboarding, rugby, car racing, fishing, camping/hiking/being outdoors, and bobsledding.

EXPECTATIONS FOR THE EXHIBITION

Next, participants were told the new exhibition is about the “history of invention and technology related to sports” and asked to discuss what they expected to see or do in the exhibition. Several trends emerged, which echo participants’ reactions to the proposed title:

- ◆ **Gear/equipment:** Most expected the exhibition would showcase how and why sports gear has changed over time; for instance, by showing old versus modern sports artifacts (e.g., helmets, balls, uniforms).
- ◆ **Historical context:** Many spoke about the broad history of sports. Several, for instance, said the exhibition might cover how sports “came to be” or how rules and regulations have changed over time. A few others wondered if the exhibition would focus on sports invented in America (e.g., baseball) and provide context on how sports became “part of our culture.”
- ◆ **Sport science:** One-third thought the exhibition would highlight modern technologies used to monitor athletes’ performance and fitness, for a variety of purposes including comparing performance with other athletes, improving training regimens, and recovering from injury.
- ◆ **Officiating:** Several speculated the exhibition would discuss technologies that make it easier for referees (and fans) to keep track of what is happening during a game/match. Some examples mentioned include instant replay, live play-by-play, electronic scoreboards, and sensors that determine whether a ball is in or out of bounds.
- ◆ **Watching sports:** Several mentioned technologies that have, over time, changed the experience of watching sports or made sports more accessible to the masses, such as broadcast television, drone cameras, stadiums, and social media.
- ◆ **Negative effects of invention:** One wondered if there would be a “sinister” side of the exhibition that discussed technologies and stories of cheating, doping, and/or gambling; in short, sports scandals. Similarly, another speculated there would be opportunities for visitors to reflect on whether certain inventions or technologies have been good or bad for sports.
- ◆ **Interactivity:** Two hoped the exhibition would provide hands-on opportunities to test sports equipment or other technologies to better understand “how they work.”



“I would expect to see things in the exhibit starting from the early 1900s, all the way up to where we are now in the development of the equipment. I guess also involved in that would be sports injuries. Like the way they study science now with brain injuries, traumatic injuries, and the equipment gets more advanced and helps with that.”

—Adult male (age 35)

ROLE OF INVENTION AND TECHNOLOGY IN SPORTS

Participants were asked to discuss how, if at all, they think invention and technology affect sports and how long they think invention and technology have played a role in sports.

OVERALL ROLE

Participants shared several ideas about how invention and technology affect sports:

- ◆ **Safety:** Nearly two-thirds cited improvements to gear that have lowered the risk of injury for athletes; for instance, modern football helmets that better prevent concussions, mouthguards, and shin guards.
- ◆ **Athleticism:** More than one-third discussed the role technology has played in improving athletic performance—making athletes “lighter,” “faster,” and “stronger.” Several mentioned using data analytics to track athletes’ physical condition (e.g., energy expenditure, nutrition) and using this information to better plan training regimens or medical technologies (physical or digital) that help athletes quickly recover from injury.
- ◆ **Spectator experience:** Around one-third said technology has improved the experience of watching sports and made sports more accessible. Several again mentioned how television allows fans to watch at home and technology like instant replay and on-screen graphics make it easier to follow along with the game.
- ◆ **Ease of play:** One-quarter said new or refined gear or apparatus/equipment can make sports easier to play; for instance, lighter bats, pucks, or balls; swim caps and goggles; specialized shoes, like cleats; and turf fields.
- ◆ **Evolution:** Several explained that invention and technology makes sports “more advanced” as the rules and regulations change over time in response to new ideas. In other words, invention and technology are “fused into the evolution” of sports.
- ◆ **Officiating:** A few said technologies, such as instant replay, support officials in making sure plays are judged accurately “after the fact.” Two said this increases fans’ trust but another, whose father is a basketball referee, was skeptical and said the presence of technology can make fans and players second guess expert officials.
- ◆ **Unsure:** A few were unsure or doubted whether invention and technology affect sports.
- ◆ **Monetization:** One said technology has helped to monetize sports; for instance, through digital advertisements or advertisements on athletes’ uniforms.

TIMELINE

Three trends emerged when participants were asked how long they thought invention and technology have played a role in sports:

- ♦ **Always played a role:** Just over one-half said invention and technology have always played a role in sports, from ancient times (e.g., Mayans) to the first Olympics to today. They explained that people are naturally ambitious so have always sought out ways to improve sports (i.e., improving equipment, changing rules). Several of these participants wondered whether the exhibition would focus on sports globally or only in America.
- ♦ **Mostly played a role in the last century:** More than one-third said while changes have occurred since the beginning of time, they thought the role *technology* has played in sports accelerated and became more prominent only within the last century. Several cited the advent of television in the mid-20th century, which made sports more accessible to the masses and sparked the creation of more technologies to enhance the spectator experience. Similarly, a few others said the use of technology in sports increased in the last two decades along with rapid progress in computing to track player data. And, two children guessed invention and technology have played a role only in the last decade.
- ♦ **Unsure:** A few were unsure how to respond and expressed confusion.

How long has invention and technology been a part of sports?

“Since the beginning. Basically when every sport is created, they have to invent certain tools and equipment for those sports to make it unique.”

—Female child (age 17)

“I think it’s obviously accelerated a lot as we’ve gone into the 21st Century, with how far technology has advanced. It’s probably come in since the 20th century but more so been significantly a part of sport[s] in the 21st century.”

—Adult female (age 24)

INTERPRETATION OF TERMS

In their responses, about one-third of participants also offered thoughts on their interpretations of the terms “invention” and “technology:”

- ♦ **Invention:** Several said they interpret invention as creating something entirely new that has never existed before. In sports, this could mean creating a brand-new sport or a totally new type of equipment.
- ♦ **Technology:** Several said technologies are what “develops” or “advances” an invention; that is, what is used to improve the original idea. Several others said they think of technology as a recent phenomenon (20th-21st century) because it brings to mind electronics and digital.

PARTICIPANTS' RELATIONSHIP TO SPORTS

Next, participants were asked about their relationship to sports. First, they were shown three statements and asked to pick the one that best describes them. Then, they were asked to explain why they picked that statement and to discuss the role sports play in their lives.

Statement that Best Describes My Relationship to Sports

Statement	% of Participants (n = 76) ⁶
I like sports	66
I have no strong feelings about sports	32
I dislike sports	1

I LIKE SPORTS

Two-thirds chose this statement and described having a positive relationship to sports. Many recalled playing sports as children, which they said helped them learn to work with others (“be part of a team”), win or lose “gracefully,” and take instruction (“become coachable”). Several said they are still involved in athletics in some capacity for the social, physical, and mental health benefits, either through recreational teams or more leisurely activities, such as hiking. Many also said they watch sports; several follow professional or college teams diligently, while several others said they enjoy watching professional sports occasionally (e.g., the Super Bowl) for entertainment and to bond with friends and family. A few, however, described themselves as athletic but also said they do not enjoy watching professional sports, except for the Olympics.

I HAVE NO STRONG FEELINGS ABOUT SPORTS

Nearly one-third chose this statement. They described having a positive but more distant relationship to sports than those who choose “I like sports.” For instance, most said they sometimes play sports for fun or do physical fitness activities (e.g., go to the gym, hikes), but also that they are generally not interested in watching professional sports or do not care deeply about the results when they do. Several spoke about this distinction in a relatively neutral tone but a few shared negative feelings about professional sports; for instance, that it is too commercialized, that athletes are paid too much money, or that it is not an “intellectual” activity.

I DISLIKE SPORTS

One participant chose this statement and explained that their dislike of sports largely stems from not being allowed to play sports as a child due to health and financial limitations.

⁶ Two participants did not choose a statement.

REACTIONS TO EXHIBITION THEMES

Next, participants were shown materials representing the four potential themes for the *Sporting Invention* exhibition: The Gear, The Athlete, Digital and Data, and The Fan. The interviewer showed participants four handouts, one-by-one, while briefly describing the themes; each handout contained images and a question related to a single theme (see Appendix C). Participants were then asked to discuss their reactions and probed about what they found most- and least interesting. Individual participants' ratings are presented in the table below, followed by their summarized comments on individual themes.

Individual Participants' Reactions to Exhibition Themes

Most Interesting Theme⁷	% of Participants (n = 78)
The Gear	41
The Athlete	26
Digital and Data	21
The Fan	13

Least Interesting Theme	% of Participants (n = 78)
The Fan	29
None ⁸	27
The Athlete	19
Digital and Data	18
The Gear	6

⁷ Note that while all participants identified a theme they found most interesting at the evaluator's prompting, several also said they found all of the themes interesting.

⁸ These individuals said no theme was least interesting or that they could not choose a least interesting theme because there was something they liked about each theme.

THE GEAR

“The Gear” is about how inventors and the creation of new equipment affects sports. Many rated this theme most interesting while a few rated it least interesting.

MOST INTERESTING ASPECTS

Aspects of “The Gear” participants found interesting include:

- ◆ **History:** Many were interested in how gear has changed over time. Several were interested in the aesthetic experience of seeing objects to compare older and more modern gear, while others spoke broadly about gaining insight into how gear helped “enhance” sports by making them easier to play and even sparked the creation of new sports. Along these lines, a few said this theme feels the most “historical.”
- ◆ **Surprising facts:** Several were interested in specific stories of gear referenced on the handouts. A few, for instance, were surprised to learn that certain swimsuits were banned from competition. Another, who is studying engineering, was surprised that skis were invented by an aerospace engineer.
- ◆ **Process and materials:** A few were interested in the design process and materials used to make sports equipment; for instance, how skis used to be made of wood and are now made of fiberglass. And, one was interested in hands-on experiences with the materials to help understand how gear has improved over time.
- ◆ **“Relatable:”** A few said the subject of gear feels “relatable” because gear is used by “everyday” athletes, not just by professionals.

LEAST INTERESTING ASPECTS

A few had negative (though idiosyncratic) reactions to this theme:

- ◆ **“Predictable:”** One called gear the most “predictable” theme for an exhibition about the history of invention and technology in sports. Similarly, another said stories of how gear has evolved in different sports would quickly become repetitive.
- ◆ **Breadth:** One wondered how to adequately and thoroughly cover this theme with limited space (i.e., if it involves showing many objects from different sports).



(Which theme do you find most interesting?) “Probably the gear for me. I think it was the most influential prior to new technology. This is more historical, you know.”

-Adult female (age 30)

“I think the gear, if there were some way to experience the evolution. So the first [bicycle] frame was probably really heavy, and now the frames are much lighter. So if there was some way to feel them or test them or something.”

-Adult female (age 43)

THE ATHLETE

“The Athlete” theme is about how the invention of new technologies affects the body. It was rated the second-most interesting theme, after “The Gear.”

MOST INTERESTING ASPECTS

Aspects of “The Athlete” participants found most interesting include:

- ◆ **Staying fit:** Many wanted to learn more about how athletes prepare and work to remain competitive, from their training regimens (“what they do”) to the technologies or substances they use (“how they do it”) to their motivations (“why they do it”), as well as specific advancements in medicine, science, and nutrition that athletes have benefited from to better take care of and “improve” their bodies. A few were also interested in seeing stories of “human competitiveness and endurance.”
- ◆ **Surprise factor:** A few said they were pleasantly surprised and intrigued by this theme because they thought of “tangible stuff,” like equipment, when they were told the exhibition topic and had not considered people.
- ◆ **Relatable:** A few said this theme is relatable. One, for instance, was a college athlete so could empathize with athletes’ experiences. Another said substance abuse is an international problem so would resonate with diverse visitors.
- ◆ **Prosthetics:** A few cited the example of Van Phillips and said they were interested in seeing more stories of athletes who use prosthetics and learning more about how they are developed. One also noted the military’s influence on developing prosthetics.
- ◆ **Substance use/abuse:** A few wanted to know more about performance-enhancing drugs themselves, why athletes decide to take them, which are legal, and whether taking them constitutes cheating.
- ◆ **Gatorade:** Two were interested in learning more about the development of this and other everyday products that athletes use to enhance performance.

LEAST INTERESTING ASPECTS

Several participants did not like this theme, for the following reasons:

- ◆ **Prefer other themes:** A few said they found the other themes more intriguing, without pinpointing something specific they did not like about “The Athlete” when probed.
- ◆ **Issue with substance use/abuse focus:** A few found this part unappealing, for different reasons. Two said taking performance-enhancing drugs (e.g., steroids) is “cheating” and “not really a part of sports” since it is banned. Two others similarly said this is “peripheral” to the overall athletic experience and a familiar, “overrated” topic.
- ◆ **Lack of interest in biology:** Two said “the Athlete” does not appeal because they are not interested in medicine and physiology, which felt like a focus of this theme.

DIGITAL AND DATA

The “Digital and Data” theme explores how inventions and technology enhance or replace humans in sport. It was rated third-most interesting, after “The Gear” and “The Athlete.”

MOST INTERESTING ASPECTS

Aspects of “Digital and Data” that participants found interesting include:

- ◆ **Changing the nature of sports:** Several liked this theme since digital technologies are becoming more commonplace (“growing bigger and bigger”) and thus rapidly changing the nature of sports by taking humans out of the equation. A few recalled other examples of digital technology they have seen used in sports based on their experience as fans (e.g., instant replay, the yellow line). Along these lines, one was interested in ethical questions surrounding the use of digital technologies, such as whether it is fair for referees to use instant replay.
- ◆ **Personal connection:** A few connected personally. One, for instance, studies computer science so was interested in the coding involved in digital technologies used in sports. Another recalled watching video replays to strategize and improve his performance while a college athlete. Still another described an experience at a golf range where golfers’ performance was tracked by electronic chips in the golf balls.
- ◆ **New and unfamiliar:** A few expressed a general interest in this theme because it is new and unfamiliar topic to them.
- ◆ **Interactivity:** One said this theme presents “fun” interactive opportunities; for instance, watching instant replay and voting whether a ball is in or out of bounds.

LEAST INTERESTING ASPECTS

Several named aspects of this theme they did not like. Responses include:

- ◆ **Skeptical of impact:** A few were skeptical that digital technologies have had a large effect on sports and said this theme felt unnecessary and “disconnected” from athletes. Similarly, two others said “Digital and Data” has less historical value than the other themes since it is too soon to fully understand the impact of digital technologies.
- ◆ **Virtual reality (VR):** A few found this specific subtopic unappealing, either because they have used VR and did not enjoy it or because they were skeptical of whether VR benefits athletes (“you don’t get as much exercise as you do [with] physical stuff”).
- ◆ **Anti-technology:** A few said they have a “love-hate” relationship with technology or are anti-technology, so this theme does not appeal. Another did not want the exhibition to privilege technology over real objects.
- ◆ **“Boring” data:** One said data can overwhelm and feel “boring” so they would gloss over data in the exhibition unless it was presented in a “cool and interesting new way.”

THE FAN

“The Fan” theme explores how innovation changes the way the public consumes and experiences sports, as well as how public opinion of and public consumption of sports drives technological change. It was rated the least-interesting theme overall.

MOST APPEALING ASPECTS

Aspects of “The Fan” that participants found appealing include:

- ♦ **Critical role:** A few said fans are a “big deal” in shaping sports and that many people do not realize how much influence they have on teams and individual players; for instance, fans can boost or hurt players’ reputations via social media.
- ♦ **Interest in subtopics:** A few were interested to learn more about the subtopics within this theme, such as technology used in stadiums and broadcasting.
- ♦ **Fans’ passion:** A few were interested in seeing fans’ passion for sports (“what drives them”) come through in the exhibition. One, for instance, recalled how passionate sports fans are in his hometown of Philadelphia.
- ♦ **Surprising point of view:** Two were generally surprised and intrigued to learn about fans because athletes, not fans, are top of mind when they think about sports.

LEAST APPEALING ASPECTS

Many found this theme least interesting. Reasons include:

- ♦ **Too familiar:** Several said this theme is not attention-grabbing compared to the other themes because they already “know what it’s like to be a fan” and have used particular technologies mentioned, such as social media or those related to ticket sales.
- ♦ **Uninterested in other fans’ experience:** A few acknowledged a relationship between fans and sports but also said they were not interested in learning about other fans’ experiences. One, for instance, was uninterested in hearing other fans’ “wild” opinions. Another said other fans’ experiences do not affect their “enjoyment of sports.”
- ♦ **Not an essential part of sports:** A few said “The Fan” is the “least important” theme because fans are not as essential to sports as athletes and gear. As one put it, “it’s too far away from the sport for me to consider it part of the sport.”
- ♦ **Uninterested in social media and/or advertising:** A few were put off by these specific subtopics, mostly because they find them overwhelming. Two, for instance, discussed being surrounded by social media in daily life, while another explained that they stopped watching sports because they feel bombarded by advertisements. And, one said exhibition content related to social media would quickly feel outdated.



*(Which theme do you find least interesting?) “Out of the four, the fan would be the least [interesting] of them all. They’re watching. The rest of [the themes] are geared to ‘I want to do this.’ *I agree. I know there’s a relationship, but do I really want to come to a museum and learn about the relationship?* I don’t know if going to a museum to learn about how the interaction between the fan and their teams—if that would inspire me to come and see an exhibition.”*

-Adult male (age 65)

OTHER EXPECTATIONS

After viewing materials related to the four proposed exhibition themes, participants were asked if there was anything they would have expected or liked to see that was not represented in the materials. Responses include:

- ◆ **Nothing:** More than one-half said there was nothing else they expected to see.
- ◆ **History and development of individual sports:** Several said they expected to see more stories of how individual sports were created and have evolved over time, as context for the other more specific and “modern” topics covered in the exhibition.
- ◆ **Definition of sports:** A few wondered how “sports” will be defined in the exhibition; for instance, will it focus only on professional sports or also include Little League? Will it include individual sports like camping, hiking, and rock climbing, or only team sports?
- ◆ **Gear topics:** A few named ideas related to gear that they would have liked to see more about, including comparisons of older and newer uniforms and more stories about safety. One also suggested finding ways to combine stories of gear with “Digital and Data,” such as how the amount of air in NFL footballs is meticulously tracked.
- ◆ **Individual people’s stories:** A few spoke about this. Two wanted to know more about individual athlete’s stories within individual sports (whether they are famous or not). Related to this, another hoped to see stories of women in sports integrated throughout the exhibition. And, one hoped to hear audio recordings of people sharing their stories.
- ◆ **Stadium design:** A few were curious to learn more about how stadiums are designed and how their design has changed over time, including how “playing surfaces” (e.g., grass versus turf) have been improved.
- ◆ **Fan topics:** A few named ideas related to the fan experience they would like to know more about, including gambling (both online and in-person), regional differences in the fan experience (e.g., east versus west coast sports fans), and fantasy leagues.
- ◆ **Real objects:** A few spoke broadly but stressed their desire to see real objects in the exhibition, mostly related to gear.
- ◆ **Skill development:** One wondered whether the exhibition would include information or stories related to how sports helps athletes develop social and physical skills, like teamwork and coordination.

REACTIONS TO TITLES AFTER REVIEWING MATERIALS

Finally, participants were again shown the proposed exhibition title, *Sporting Invention*, as well as four other potential exhibition titles: *Invention and Sports*, *Sports = Athletes + Invention*, *Changing Sports with Invention*, and *Game Changer*. They were asked to discuss which titles best and least represents the exhibition materials, and to share any other general reactions to these titles. Individual participants' ratings are presented in the table below, followed by their summarized comments on individual titles.

Individual Participants' Reactions to Exhibition Titles

Best Represents Materials⁹	% of Participants (n = 78)
Changing Sports with Invention	36
Game Changer	33
Sporting Invention	17
Invention and Sports	15
No selection	9
Sports = Athlete + Invention	4

Least Represents Materials¹⁰	% of Participants (n = 78)
Sports = Athlete + Invention	38
Game Changer	27
No selection	18
Sporting Invention	8
Invention and Sports	8
Changing Sports with Invention	4

⁹ Fourteen percent of individual participants selected two titles as the best fit for the exhibition materials; all of their selections are represented in the above table.

¹⁰ Three percent of individual participants selected two titles as the worst fit for the exhibition materials; all of their selections are represented in the above table.

CHANGING SPORTS WITH INVENTION

The highest proportion of participants said this title is the best fit for the exhibition materials; only a few ranked it as the worst fit. Comments on this title include:

- ◆ **Extremely clear:** Several said this title clearly and simply describes the content of the exhibition (how sports are changed through invention). They liked its “straightforward” and “literal” nature— “I know what I’m in for.”
- ◆ **Evokes change/evolution:** A few more specifically liked this title because it includes the word “change,” evoking how sports have evolved over time. However, another said this word does not adequately describe what happens to sports but struggled to think of an alternative.
- ◆ **Not catchy:** A few said while they liked that this title is straightforward and literal, it is “plain” and not catchy compared to the other titles.
- ◆ **Too long:** One said this title adequately describes the exhibition content but is too long.

GAME CHANGER

The second-highest proportion of participants said this title is the best fit for the exhibition materials. However, many also said it is the worst fit, indicating tension among participants. Comments on this title include:

- ◆ **Attention-grabbing:** Many said this title is “catchy,” “intriguing,” and would hook them into visiting the exhibition because they would want to find out what it is about (“what is the game changer?”). A few specifically said they liked the pun because it is a familiar phrase that is commonly used in sports commentary.
- ◆ **“Ambiguous:”** Many others said this title is vague and does not clearly communicate the content of the exhibition. Several, for instance, said “game” might be interpreted to mean video games or board games instead of sports. A few others said the fact that “game” is singular makes it seem as though the exhibition is about one event, phenomenon, or sport rather than many.
- ◆ **Evokes change/evolution:** A few liked “Game Changer” because it explicitly evokes how sports have evolved over time.
- ◆ **All-encompassing:** Two said this title is (positively) broad and “all-encompassing”— “it could evoke any sport.”
- ◆ **Cheesy:** Two did not like the pun and said the title is “cheesy.”
- ◆ **Short:** One liked that this title it is “not a mouthful” compared to other, longer titles.

SPORTING INVENTION

This title ranked in the middle. Comments include:

- ◆ **Accurate picture:** Several liked this title because it “clearly” and “accurately” describes how the exhibition will showcase the ways invention has transformed sports (“straight and to the point”). They also liked that it is broad, allowing for many possibilities.
- ◆ **Concise:** Several said this title is “short and sweet” and not overly convoluted. As one put it, “you don’t want a three-foot-long title.”
- ◆ **Not catchy:** A few called this title “blah” and “boring” and said it does not catch their attention. One also said using “sport” or “sporting” as the first word could be a turnoff for non-sports fans.
- ◆ **Feels old:** One said the word “sporting” feels old and not in line with how we talk about modern sports.
- ◆ **Leaves out athletes:** One said this title does not make them think of athletes.

INVENTION AND SPORTS

This title also ranked in the middle. Comments include:

- ◆ **Focus on invention:** Several liked that the first word in this title is invention since this is a main focus of the exhibition. A few explained that this order makes intuitive sense to them because “inventions come first” and then they affect sports.
- ◆ **To the point:** A few said this title is very straightforward— “the most obvious description” of the exhibition—but did not expound.
- ◆ **“Boring:”** A few said this title is similar to *Sporting Invention* because both clearly convey that the exhibition is about invention in sports; but also, that, between the two, they prefer *Sporting Invention* because it is catchier. By comparison, *Invention and Sports* feels too academic (“like a book you’d never want to read”).
- ◆ **No emphasis on change:** One did not like this title because it does not convey change over time.

SPORTS = ATHLETES + INVENTION

The highest proportion of participants rated this title the worst fit with the exhibition materials. Comments were mostly negative and include:

- ◆ **Math equation unappealing:** One-fifth did not like that this title is a math equation because it feels “convoluted,” “hard to read,” and generally “doesn’t look right.” One suggested avoiding equations unless the museum wants to appeal specifically to engineers or others who work with data.
- ◆ **Too narrow:** Several expressed ways this title feels restrictive. A few, for instance, said emphasizing athletes it takes away from all of the other people involved in sports that were highlighted in the exhibition materials, such as fans, engineers, and designers. A few others similarly said this title visually presents the concepts of athletes, invention, sports are separate rather than inherently “intertwined.”
- ◆ **Not catchy:** Several said this title would not attract them to the exhibition. A few had trouble articulating why, but a few others said it is “generic” and “boring.”
- ◆ **Focus on athletes:** A few were confused by the word “athlete” in the title because the exhibition materials did not feel focused on athletes.
- ◆ **Clever:** Two said this title cleverly unites the core concepts of the exhibition and demonstrates their relationship, though they also said there is likely a way to do this without math symbols.
- ◆ **Confusing:** Two gave no specific critique but said they were “lost” and could not understand this title.
- ◆ **Leading with sports:** One did not like that the first word of this title is sports rather than invention (“you would lose me”).

“

(Which title least represents the exhibition materials?) “Unless you’re trying to appeal to someone with an engineering degree, having it be an equation is a really bad approach. Because sports is not athlete plus invention. Sports is about engagement and competing and trying to win. And I think what we’re ultimately trying to talk about is how innovation and invention have been a part of sporting activities for centuries and to help people see that kind of experience.”

-Adult male

*“Sports = Athletes + Invention [is] not an appealing title. I would know what it was, but it wouldn’t draw me in at all. *I agree. It doesn’t tell you exactly what you’re going to see. Doesn’t reel me in, I guess.*”*

-Adult male (age 19) and adult female (age 18)

APPENDIX

APPENDIX A: INTERVIEW GUIDE

Sporting Invention Front-end Evaluation Interview Guide

Hi, today we are talking with visitors about a new exhibition for the museum. Your participation will directly impact the eventual content of the exhibition. If you have a few minutes, I'd like to ask you a few questions **[Upon agreement]**

Great. And are you 18 years or older? **[If Yes, proceed. If No, stop interview]**.
Are you the parent/guardian of the minors participating? **[If Yes, proceed. If no, only interview the adult]**.

[Bring visitor to tables]

Before we begin, please know your participation is voluntary, and we can stop at any time. Also know that I work for RK&A, an outside company that was hired by the Smithsonian to conduct these interviews. I tell you this to encourage your honest opinions.

In this interview, I will ask about your thoughts and opinions about subjects and materials related to the new exhibition the museum is working on. All feedback, positive and negative, is helpful. I would like to audio record our conversation to capture your feedback accurately. We will transcribe the interviews and analyze them for trends and patterns. We will report the aggregate results of yours and others interviewees' feedback to the museum with recommendations for the exhibition. The results may be shared at professional conferences or presentations, but no individual participants will be identified. And, we would delete the audio files after the project is complete.

Is it okay with you that I audio-record this interview? **[Upon agreement]**

[Begin interview]

1. The current title for the new exhibition is "Sporting Invention." What comes to mind when you hear "Sporting Invention"? This isn't a test. We are just listening for associations.

[Show card that reads "Sporting Invention." Leave long pauses. Ask, anything else?]

2. The exhibition will be about the history of invention and technology related to sports. What might you expect to see or do in an exhibition about that?

[Show card that reads “History of Invention and Technology related to Sports.” Probe about their interpretation of the words invention, technology, and sports as necessary.]

3. How do you think invention and technology affects sports? Can you give me a specific example?
4. What are your thoughts about how long invention and technology has played a role in sports? Can you tell me more about that?
5. I have three statements here. Which one best describes you?

[Show card with statements “I like sports”; I have no strong feelings about sports”; and “I dislike sports.” Ask visitors to explain why they picked that statement.]

6. How would you describe the role of sports in your life?

[Probe about what type of sports do you play or watch, how often, gauge level of enjoyment]

Now I would like to show you a few more specifics about how the museum is currently thinking about this exhibition. Right now, there are four ideas they are considering in relation to Sporting Invention. I will show/read them all to you first and then ask you about them.

The first is Gear. [Show card]. It is about how inventors and the creation of new equipment affects sports. Some examples may include:

- The mountain bike - Joe Breeze’s prototype for the JBX1 is the first bike frame designed for the rigors of mountain terrain, so it created a new sport (mountain biking).
- Skis – Howard Head was an aerospace engineer. He set out to invent new sports equipment, like skis, that would be make playing sports easier and more enjoyable.
- The swim suit - Speedo LZR shark swimsuits made swimmers faster and helped them break world records. But ultimately it was disallowed from future competition as its technology was deemed to undermine the authenticity and integrity of the sport.

The second is the Athlete [Show card], which talks about how the invention of new technologies affects the body. Some examples may include:

- Gatorade – This is a common product sold to help athletes enhance performance.
- Injections – Performance enhancing drugs or blood transfusions are other ways athletes enhance performance.
- Prosthetic – This is Van Phillips, who lost his lower leg in a water skiing accident but went on to develop the cheetah running prosthetic.
- Nutrition/fitness tracking, which allows athletes to monitor and adjust their performance.

The third idea, Digital and Data [Show card], explores how inventions and technology enhance or replace humans in sport. Some examples may include:

- Hawkeye – Hawkeye is one invention used to replace human judgment in officiating sports. It is used in tennis but other similar technologies have been integrated into or alternately banned from other sports.
- Artificial Intelligence/Virtual Reality/Robotics , which is used for training players.

The fourth idea, The Fan, explores how innovation changes the way the public consumes and experience sports. And in turn, how does public opinion and public consumption of sport drives technological change? Some examples include:

- Stadium experiences – This could include everything from tickets sales and entry to purchasing concessions.
- Broadcasting – This is about how we follow sports, radio, TV, VR, etc.
- Social media – This is about how social media, like Twitter, allows spectators and athletes to interact.

7. Were any of these surprising to you based on what we have talked about so far?
8. Which of these topics is most interesting to you? Why is that?
9. Which one is least interesting to you? Why is that?
10. Are there things you expected to see or would have liked to see that are not shown here?

11. Now that you have seen some materials, I want to ask you about the title again. “Sporting Invention” is the current title but here are some other options. [Show card]
 - a. Which title best represents the materials I showed you? Why is that?
 - b. Which title least represents the materials I showed you? Why is that?
 - c. Any other thoughts on these title options?
12. Do you have any other comments or feedback for the museum on the exhibition materials?
13. Great! I have just a few background questions: [Ask all visitors in group to complete log with these questions]
 - a. Is this your first visit to the National Museum of American History?
 - b. Do you reside in the US? [If yes, ask for zipcode. If no, ask for country.]
 - c. May I ask your gender and age?

Thank you so much for talking with me. As a token of appreciation, I have a small gift for you (pencil, pen, notepad).

Great. And do you have any other questions about the study, or would like to take a copy of this information sheet with our contact information [gesture to sheet]?

APPENDIX B: VISITOR DEMOGRAPHIC LOG

**National Museum of American History
Sporting Invention Front-end Evaluation
Background Questions**

ID: _____

1. Is this your first visit to the National Museum of American History?
 No
 Yes

2. Do you reside in the United States?
 No. What country? _____
 Yes. Your zip code? _____

3. Your gender: _____

4. Your age: _____

5. Are you visiting with children under 18 years?
 No
 Yes

If yes, what ages? Check all that apply.

 - 0-5
 - 6-9
 - 10-13
 - 14-17

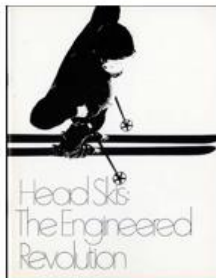
Thank you for your time!

APPENDIX C: FRONT-END EVALUATION MATERIALS

The Gear



In what ways do inventions, new materials, and equipment change sports?



THE LEMELSON CENTER
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The Athlete



In what ways do inventions change the physiology of the natural body in athletes?



THE LEMELSON CENTER
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Digital and Data



In what ways do inventions and technology enhance or replace human creativity and expertise in sports?



The Fan



How do invention and technology alter the relationship between spectator and athlete?

