DEALING WITH TECHNOLOGICAL CHANGE:
DIFFERING RESPONSES OF THE GOVERNING BODIES IN GOLF AND BOWLING

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DRAFT
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In 1928, swimmer and soon-to-be Tarzan Johnny Weissmuller won his second straight Olympic gold medal in the 100 meter freestyle, dusting the field in a time of 58.6 seconds (International Olympic Committee, 2002). In 2003, a swimmer from Georgia swam the event in 55.7 seconds -- almost three seconds faster than Weissmuller -- unremarkable but for the fact she was high school student Amanda Weir (White, 2003). This is just one striking example of what happens in virtually every sport over time: Performances get better and better, rendering the feats of the prior generation pale in comparison.

In all sports, there are three basic explanations for improved performance over time: athletes become more highly skilled, equipment improves, or playing conditions improve. The latter two reasons can be discounted in the case of swimming, since the only improvements in equipment were the addition of goggles and more streamlined suits, and the pool is still 50 meters long and filled with water. Almost all of the improvements in swimming have been due to improvements in the swimmers themselves. Weissmuller almost certainly did not weight train or understand nutrition, and he definitely did not have his technique evaluated by a computer or have a sports psychologist work with him.

No one begrudges more highly skilled athletes breaking records and revolutionizing their sports, so long as that improvement in skill is achieved within the rules of their sport, and the societal bounds of fair play (Rozin, 2004). But when gains in performance are developed exogenously by improvements in equipment or playing conditions, there always is the question of fairness -- has the athlete really gotten better, or is the improved performance just a function of better technology? The very integrity of the sport is at stake when such claims are levied, so it

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1 Using steroids is one of those socially unacceptable ways of improving performance, even when allowed by the rules of the sport.
is usually up to the governing body of the sport -- the organization which makes and enforces the rules of the sport -- to determine if the new technology should be allowed.

Technological progress in sport usually comes from one of two sources. Competitors sometimes invent new equipment or new techniques (such as the “Fosbury flop”) to give themselves an advantage over their rivals. But in a Capitalist economy, most technological advances come from entrepreneurs or corporations who are seeking profits from their new inventions (Mokyr, 1990). This always creates tension between manufacturers and governing bodies when new equipment is deemed illegal. The governing body sees the integrity of the sport preserved, but the manufacturer sees years of research and development and the promise of future profits squandered.

In a number of ways, the sports of golf and bowling are similar. Superior hand-eye coordination, the ability to repeat shots, steady nerves, and mental toughness are what make great golfers and bowlers, rather than sheer athletic ability. They also share an inordinate reliability on equipment, both at the recreational and professional levels. Without properly fitting equipment both sports are next to impossible, and at the highest levels of the game subtle differences in equipment can separate champions from runners-up. Playing conditions matter as well -- golf courses can be tough or easy, hilly or flat, long or short, and although difficult to determine for the novice, bowling lanes can be set up so that professionals can average over 250, under 190, or anything in between.²

This paper identifies the major changes in technology that have occurred in both sports, how they affected the sport, and how each sport’s respective governing body dealt with the new

² All bowling lanes are “oiled” to protect the surface from prematurely wearing out. Lanes can be high scoring or low scoring, depending on how the oil is distributed on the lane (see Cain (n.d.) for a simple exposition).
technology. The responses will be compared and contrasted, and a determination will be made as to which sport has done a better job dealing with technological progress.

**Technological change in golf**

There are two governing bodies in the sport of golf. In the United States and Mexico, the United States Golf Association (USGA) is the governing body, for the rest of the world it is the Royal and Ancient Golf Club of St. Andrews (R&A). For many years, the USGA and the R&A had separate standards, to the extent that from 1931 through 1990 golfers in the U.S. used a ball 1.68” in diameter, but the rest of the world played with the “small ball,” only 1.62” in diameter (Fields, 2000). Today, the two organizations collaborate in setting rules and regulating technology (United States Golf Association, 2004a), so although they are separate governing bodies, they act as one when it comes to setting standards.

When the USGA was founded in 1895, there was little concern regarding technology. The very first equipment controversy occurred in 1911 when steel shafts were invented, a major improvement from the traditional hickory shafts that were the state-of-the-art in that era. The USGA quickly ruled to ban them from competition until 1920. In 1922, Jock Hutchinson won the British Open using clubs with deep groves, and they were outlawed the following year (United States Golf Association, 2004a). It was after this incident that the USGA added two appendices to their rule book which included this broad statement regarding new technology: “Any design in a club or a ball . . . which might significantly change the nature of the game will be ruled on by the United States Golf Association” (The rules of golf, 2005, p. 134). Over the years, improvements in equipment such as rubber grips, graphite shafts, two-piece balls, and “metal woods” were permitted. Others, such as the “Polara” ball, which had a dimple design that
corrected hooks and slices in flight, were not (Rogers & Thomas, 1986). It was generally accepted by golfers and manufacturers alike that the USGA had the authority to rule on equipment, and had by the 1980’s published lists of approved clubs and balls, along with a list of known illegal equipment (United States Golf Association, 2004b).

This all changed in 1989 when club manufacturer Karsten Solheim took the USGA to court when they ruled his company’s Ping Eye-2 irons to be illegal (Sullivan, 1989). When the Eye-2 irons began production in 1982, they utilized a slightly different groove shape than traditional irons -- what Solheim called a “square groove.” The new design allowed golfers to put more spin on the ball on shots from the rough, which was advantageous especially in wet playing conditions (Hanley, 1990). The clubs conformed to USGA specifications, but several years later the USGA changed the method of measuring grooves, rendering the Eye-2 illegal. The USGA announced that the club would be illegal for competition, and Solheim sued. The case was ultimately settled out of court -- Solheim agreed to drop the suit and to redesign future models of the club, but existing models were grandfathered in -- but the precedent had been set that manufacturers could successfully challenge the USGA’s authority in determining whether or not equipment was legal (Brennan, 1992).

The next wave of technology was designed to get the ball to fly farther, and oversized drivers led the way. Callaway Golf introduced the first oversized driver (the “Big Bertha”) in 1990, and it revolutionized the game. Gradually, the use of lightweight metals such as titanium allowed driver heads to grow larger and larger, with progressively thinner and thinner faces. In 1998, the USGA established rules banning a “spring like” effect off the driver face, and Callaway’s ERC-II driver was deemed illegal. Things got messy for the USGA when no less of a figure than Arnold Palmer -- the USGA’s long-time honorary chairman -- encouraged
recreational golfers to use the ERC-II in spite of the ban (Steinbrender, 2001).\(^3\) The controversy only fueled the sale of the club, since players figured if it was illegal, there must be something really special about it (Hyman, 2000). This time, the USGA avoided a court case by reaching a compromise with Callaway and the other major equipment manufacturers which created a grace period of five years, after which the clubs which violated the spring-face limit would be illegal. Golfers that had spent $500 on a new club could keep using it, and the USGA correctly surmised that the club would be obsolete anyway after a couple of years (Potter, 2002).\(^4\)

The most recent technological furor is over the design of the golf ball itself. Ball manufacturers have been able to match the design of their ball to better exploit the large titanium driver heads, which has resulted in unprecedented driving distances amongst professional players. In 1980, using the best technology of the day -- a driver with a wooden head and a wound ball wrapped in Balata -- Dan Pohl led the PGA Tour in driving distance with an average of 274.3 yards. In 2005, the *median* driving distance on the PGA Tour was 288.4 yards, and only 7 of 202 players averaged lower than Pohl’s 274.3 yards off the tee (PGA Tour, 2006). Jack Nicklaus has been one of the most outspoken proponents of limiting the flight of the ball: “I loved St. Andrews so much and it has stood the test of time, yet all of sudden, because of manufacturer’s ego …. It makes the course obsolete” (“Nicklaus slams,” 2005, p. 117). Criticisms like this have led the USGA to float the idea of “rolling back” the distance a golf ball will fly -- an idea that will almost certainly be rejected by recreational players -- or introducing a less-lively “tournament ball,” an idea which Nicklaus proposed almost a decade ago (Bonk, 2005).

\(^3\) It should be noted that Palmer was a paid endorser of Callaway golf equipment at the time.  
\(^4\) The USGA was correct in that assumption -- the ERC-II is no longer in production -- and Callaway has changed the design of their top-of-the-line driver three times since the ruling.
But has all of this technology made for lower scores? For all the criticisms levied by Nicklaus and others, not really -- USGA handicaps have not changed very much over the past 30 years (Potter, 2006). On the professional tours, players are hitting the ball longer than ever, but tougher and tougher course set ups have to a certain extent negated these gains.

In 2004, the USGA and the R&A issued a joint statement regarding their philosophical stance on technological change, and how they plan to deal with it:

In a historical context, the game has seen progressive developments in the clubs and balls available to golfers who, through almost six centuries, have sought to improve their playing performance and enjoyment. While generally welcoming this progress, the R&A and the USGA will remain vigilant when considering equipment Rules. The purpose of the Rules is to protect golf's best traditions, to prevent an over-reliance on technological advances rather than skill, and to ensure that skill is the dominant element of success throughout the game. (United States Golf Association, 2004c)

It is clear the USGA plans on remaining vigilant, even in the face of legal action, to ensure that golf skill will always trump golf equipment as the deciding factor in posting the lowest score.

Technological change in bowling

Bowling has been an organized sport in the U.S. for about as long as golf has. The American Bowling Congress (ABC) was established in 1895 to standardize the rules and equipment for the sport and to organize national championships (Matzelle & Schnieder, 1995). Over the years, other national and international governing bodies were created, but almost all of
them adhered to the rules set by the ABC and its new incarnation, the United States Bowling Congress (USBC). Although playing rules have changed very little over the past 110 years, rules regarding equipment have changed quite a bit. It took about 40 years of the ABC tinkering with standards for lanes and balls to develop a game that would be recognized by most bowlers throughout the 20th century: Lanes 60 feet long and 40 inches wide, balls limited to 16 pounds and statically balanced to within 1 ounce, and pins not weighing less than 3 pounds, 4 ounces.

In the sport of bowling, other than the skill of the player, performance can be influenced by several factors (in no particular order): The design, weight, and material of the ball, the weight and design of the pins, and the condition of the lane (Cain, n.d.). As the sport evolved, the ABC realized that they would have to exert control over all of these technological aspects of the game to maintain its integrity, just as the USGA had in golf.

Early bowling balls were made of wood, but they were replaced by molded rubber ones soon after 1900. This allowed manufacturers to design balls much heavier than they could with wood, and also to manipulate the internal balance of the ball. The ABC found that bowlers using 24 pound balls with a pound a weight added to one side of the ball (these were called “Dodo” balls) destroyed the pins and made for higher scores, so rules regarding ball weight and balance were added in 1913. Pin weights and shapes, the height of gutters in the pin deck, even the liveliness of the kickbacks all had an effect on scoring, and the ABC addressed each of these issues in turn (Cardinale, 2005).

Bowling lanes of the time were made of wood and finished with a very labor-intensive process using shellac. Lanes were coated from foul line to head pin and to be regularly maintained by hand-polishing the surface. In the late 1930’s, lacquer finishes gradually replaced

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5 In 2005, the ABC merged with the Women’s International Bowling Congress and the Young American’s Bowling Alliance (junior bowling’s governing body) to form the USBC.
shellac as the final surface coating on the lanes themselves. Proprietors found that the new synthetic finishes were not as durable and that lanes developed “tracks” in them. This had two results: The lanes wore out faster and required complete resurfacing more often, and scores went up -- the track literally left a path in the lane that a skilled bowler could follow to the pocket frame after frame. To combat these problems, the lanes were covered with a thin coat of oil (known in the industry as “dressing”) to protect the lanes, and prevent tracks from forming (DePaul, 2004). By the end of World War II, a lacquer lane surface with an oil-based dressing had become the industry standard. The dressing reduced scoring, protected the lanes, and ushered in a 20 year period in which technology remained unchanged, but the sport became more popular than ever (see Table 1).

In the late 1960’s, some proprietors learned that lane dressing could be used to influence bowlers’ ability to score. All good bowlers throw a “hook ball” -- for a right hander, this means that the bowler applies spin to the ball so it moves right to left down the lane. When thrown properly, a hook ball results in more strikes due to better pin action than a straight ball. The lane dressing technique which became known as “blocking” was simple: By putting more oil near the

<table>
<thead>
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<th>Year</th>
<th>ABC</th>
<th>WIBC</th>
<th>Combined</th>
</tr>
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<tbody>
<tr>
<td>1945-46</td>
<td>810,000</td>
<td>250,478</td>
<td>1,060,478</td>
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<tr>
<td>1948-49</td>
<td>1,368,000</td>
<td>432,926</td>
<td>1,800,926</td>
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<td>1958-59</td>
<td>2,500,000</td>
<td>1,231,529</td>
<td>3,731,529</td>
</tr>
<tr>
<td>1968-69</td>
<td>4,023,220</td>
<td>2,968,268</td>
<td>6,991,488</td>
</tr>
<tr>
<td>1978-79</td>
<td>4,777,436</td>
<td>4,232,143</td>
<td>9,009,579</td>
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6 In 1938, Allie Brant rolled an 886 series for three games on this sort of condition, a record which stood for 50 years (Matzelle & Schnieder, 1995).
center of the lane and less near the gutter, errant shots thrown too far right would hit the dry part of the lane and hook back towards the pocket. Errant shots too far left would hit the oil and skid right into the pocket. Combined with new polyester bowling balls, which came to market in 1959 and hooked ever so slightly more than rubber ones, bowlers now had a four, five or even more board target to shoot at and still strike, instead of just one or two. In 1966, the ABC instituted a rule which made it illegal to “condition a lane to create a ball path” (Cardinale, 2005, ¶16).

The next major technological change came from a professional bowler looking for an edge. Don McCune was a journeyman bowler, a 12 year veteran with two PBA titles. In 1973, he had the bright idea to soak his polyester bowling ball in powerful chemicals to soften the surface, thinking it would create more hook. He was right -- he won six titles and PBA Player of the Year during the 1973 season -- but his advantage was short lived, as the ABC instituted a minimum hardness requirement for balls the next season. McCune never won another professional tournament, but his creativity inadvertently marked the beginning of bowling’s technological revolution that continues to this day (Maugh, 2003).

Ball manufacturers began to hire chemists and physicists to design their bowling balls, all with the desire to create more hook and hitting power within the limits set by the ABC. In short order, urethane replaced polyester, reactive resin replaced urethane, and the insides of the balls began to look like science projects -- companies’ marketing of balls was soon focusing on “coefficient of friction” and “radius of gyration” instead of the ball’s cool color (Falcioni, 1993, Lemonick, 2006). The balls were tested and refined using supercomputers and robotic bowlers,

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7 A 40 inch wide bowling lane is made of 1 inch wood boards laid on edge. Although there are various intermediate targets such as dots and arrows to aim at, good bowlers will pick out a single board as a target, anywhere from 5 to 40 feet down the lane. Very few, if any, look at the pins while they throw the ball.
and each new generation of equipment made it easier and easier to strike (Saunders, 2000). All
the while, the ABC did little to reign in the new technology, leading to an explosion in scoring
which many feel has permanently destroyed the integrity of the sport.

During the 50’s and 60’s, scoring remained pretty much unchanged, but that begs the
question, how does one measure the overall level of scoring in the sport? Detailed records of
season averages are not available, but it is likely that a 190 average fell in the top 1% of all male
bowlers, a 200 average would probably have been in the top 1/10th of 1%. The top bowlers of
the day averaged around 215, and averages over 220 were unheard of. Although average data is

not available, accurate information about the number of bowlers who bowled “honor scores” each year is, so it is possible to examine the number of perfect games that were bowled each season. At one time, a 300 game was an extremely rare feat -- during the 50’s and most of the 60’s, the odds of bowling a 300 remained steady at approximately 650,000 to 1 (Miller, 2006) -- which meant you were more likely to be hit by lightening than bowl a perfect game (Barry, 2000).

Figure 1 illustrates the ratio of 300 games per ABC member from 1907 (when the first 300 game was bowled) through the 2004-2005 season. From 1907 until World War II, the number of 300 games varied from year to year as the ABC tinkered with ball and lane specifications. Scoring remained flat during bowling’s boom years, but the trend which began in the late 1960’s is indisputable -- each year leads to more perfect games per bowler. Those 650,000 to 1 odds of the 1950’s dropped to only 3000 to 1 in 2005, so a perfect game is still an accomplishment, but not anywhere near the rare feat that it used to be. The once-magic average of 200 was now commonplace, and at most bowling centers several bowlers can be found averaging in the 230’s or higher. The data leaves little doubt that bowling scores have increased dramatically since the 1960’s.

Conclusions

One of the jobs of both the USGA and the USBC is to establish the rules of their respective games, and in part that entails regulating equipment. It would seem that both have a

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8 Honor scores include a perfect game (300, all 12 strikes), 299 and 298 games (the first eleven strikes), and combined score of more than 800 for a three game series (even rarer than a 300, because it requires the player to average 267 over three games to achieve the honor).

9 Working in a bowling center as a teen in the late 1970’s, we took pride in the fact there had been only four 300 games bowled in the history of the center, dating to the 1930’s. Bowling in that same house in 2005, I recalled that fact vividly as I watched SIX perfect games bowled in one evening.
similar charge in their rules: The USGA will not allow new equipment which will “change the nature of the game” (*The rules of golf*, 2005, p. 134), and the USBC exists in part to “ensure the integrity and future of the sport” (*USBC playing rules*, 2005, p. 1). Both sports have experienced unprecedented technological progress in their equipment over the past 30 years, but with very different results: USGA handicaps haven’t changed much over the past 30 years (Potter, 2006), while bowling scores have probably increased at least 10-20% over the same time period (M. Miller, personal communication, February 17, 2006).

What could account for this variation? It is impossible to measure the absolute gains in the equipment improvements in each sport, but it is clear that golfers today have equipment that will hit the ball farther and more accurately than ever before. Bowlers have balls which will hook more and create more striking power than ever before. There is little evidence to surmise that the fitness of either golfers or bowlers have improved faster than one another -- professionals in both sports now routinely weight train and do aerobic exercise, which would likely improve their performance, other things equal. Both sports have improved teaching and technique, once again, there is no evidence to suggest one sport have improved faster than another.

So assuming that all of the above has progressed at approximately the same pace in both sports -- equipment, fitness, and technique -- it leaves only one variable unaccounted for, and that is the condition of the field of play. In my opinion, this is where the two sports have gone in exactly the opposite direction.

Golf courses have gotten progressively more difficult over the years. Back in the 1960’s, courses of 6700 to 6800 yards were considered long -- today, major championships are routinely contested on courses longer than 7400 yards. Superintendents have learned how to make greens
faster and firmer, how to grow thicker rough, and course architects have employed more and more diabolical designs to make their courses more resistant to scoring (Spousta, 2005). Professionals and recreational players alike have faced courses that are made progressively tougher, precisely to keep pace with improvements in equipment.

On the other hand, bowling lane conditions have gotten easier and easier over the years. Forgotten are the days in which an ABC representative would inspect the lanes after and honor score was shot, to make sure that the lanes were not “too easy.” The ABC, and now the USBC, has pretty much allowed any lane condition to meet their approval, and the result has been an explosion in scoring, and a cheapening of the sport’s greatest feat, the perfect 300 game. It has also changed the nature of the game -- power is now more highly valued that accuracy, when 30 years ago it was exactly the opposite. The USBC needed to do one of two things: Reign in ball technology, or make sure that lane conditions did not become to easy. Since they did neither, scores are far higher than ever, and it will be very difficult, if not impossible, to put the scoring genie back in the bottle.

By comparison, the USGA enjoyed a huge advantage -- instead of the playing conditions getting easier, as in bowling, they got harder -- so the gains from technology were masked. The USGA generally gets kudos for their stance on technology, where the USBC gets blasted. In conclusion, both governing bodies let technology improve, and it has become easier to play both sports. The difference was that the USBC ignored improvements in playing conditions -- a factor which was under their control -- and this had led to scoring increases in bowling, while golf scores have remained relatively unchanged.
References


