**Literature Review**

Without formal research, it is strikingly easy for one to overestimate the effect of momentum. In fact, individuals struggle to identify casual relationships as a whole. People are prone to look for patterns but are, unfortunately, poor “intuitive statisticians.” We identify these patterns, but all too often they are examples of spurious correlation (Kahneman 2011). Why is this? In general, humans misunderstand the nature of random sequences. One tends to underestimate the length and frequency of random strings of wins and losses (Gilovich, Vallone, & Tversky, 1985). In other words, flip 100 coins, and most would underestimate the size of the largest number of consecutive heads or tails. This underestimation leads to improper conclusions. Even when informed that a game is purely random, one tends to deny the independence of successive points (Page & Coates, 2017). Thus, even when individuals know randomness is completely responsible, they still want to draw conclusions. These misconceptions lead individuals to attribute consecutive victories to momentum, when, in fact, randomness is entirely responsible.

This inward shortcoming is compounded by societal pressures and customs. The frequent and arbitrary colloquial use of momentum in sporting events rewards observers for identifying and emphasizing when they believe teams and players have “seized the momentum” or are “feeling hot” (CITE). Thus, observers are looking for momentum. They *want* to find it. This leads to confirmation bias, a well-known psychological error, where individuals tend “to process information by looking for, or interpreting, information that is consistent with their existing beliefs” (Britannica Dictionary). This phenomenon incentivizes the casual observer to notice and remember streaks of consecutive success - or failures - while forgetting interruptions or exceptions. Early research on momentum has supported these biases. An analysis on shooting trends in professional basketball players showed that both fans and players are inclined to believe that a player’s likelihood of making a shot are greater after a make than after a miss. The same study failed to find evidence for any relationship (Gilovich, Vallone, & Tversky, 1985). More recently, Briki et al. (2014) found that observers are prone to overestimate the effects of momentum on table tennis players. The observers expected players to be more highly affected by adverse conditions than they actually were. Altogether, these biases create an environment where events are frequently mislabeled as momentum.

Fortunately, many researchers have approached the subject and conducted extensive and creative analysis on the existence and effect of momentum. They have drawn several nuanced conclusions, and their insight has proved foundational. However, like many complex subjects, comprehensive clarity is scarce. Broadly, there are three overlapping frameworks for explaining momentum: biological, psychological, and economic (Morgulev, 2023).

**Biological Framework**

First, biological researchers have focused their efforts on discovering momentum in the animal kingdom. They suggest that ‘winning’ produces positive hormones that prime animals for future success. This theoretical concept, known as the ‘winner effect’, indicates that past positive winning experiences award individuals a higher likelihood for future victories largely due to inward physiological reactions to winning (Robertson, 2012). In the biological framework, the victory physically improves the animal’s demeanor and skillset. This is because victories emit enhancing hormones like testosterone, estrogen, and cortisol into the body’s bloodstream. This theory has been generally supported by experimental research. For example, testosterone levels increased in humans after victory in the classic video game Tetris and decreased after a loss (Zilioli & Watson, 2014). These hormones are supposed to increase confidence, aggression, and positivity in the individual. This behavior may intimidate and frighten competitors and position the animal in a mindset and circumstance prepared for future success (Morgulev, 2023). In addition, these behaviors make winning animals more likely to participate in future competitions, and, therefore, experience success. Again, the theory has been supported by experimental research. In a study involving male sprinters, high testosterone levels were positively associated with a lower sprint time (Bezuglov et al., 2023). In other words, high levels of testosterone are found to be linked with increased performance.

Overall, researchers have found existence of the winner effect in several animal species. Jumping spiders’ fighting ability increased after victory (Kasumovic et al., 2010). Fighting behaviors and aggression in pupfish were impacted by victory (Hsu & Wolf, 2001). Previous outcomes directly impacted the probability of victory for lizards (Garcia, Murphree, Wilson, & Earley, 2014). In a comprehensive analysis that spanned several animals, the probability of victory nearly doubles for winners when accounting for asymmetries in the competitor’s skill (Rutte et al., 2006). Measuring the winner effect in humans, however, is much more difficult and nuanced.

**Psychological Framework**

Second, psychologists examine competition and momentum from a purely psychological perspective. They acknowledge the physiological changes that biologists propose, but their focus is on the psychological factors impacting the competitors (Morgulev, 2023). As such, psychological momentum is associated with confidence and the popular adage ‘success breeds success.’ Typically, this research resides in the domain of sports psychology. Adler & Adler (1978) propose that a series successful events like a steal, dunk, or ace can serve as catalysts of momentum. These catalysts build and contribute to increased confidence and motivation within an individual. Iso-Ahola & Mobily (1980) coined the term *psychological momentum* to describe the effect of these psychological factors on a competitor. They write “psychological momentum is an added or gained psychological power which changes a person’s view of himself or of others or others’ view of him and of themselves.” Taylor & Demick (1994) contributed heavily to the theory of psychological momentum. They propose a six-stage multidimensional model outlining its progression. This “momentum chain” is as follows: (a) precipitating event, (b) change in cognition, affect, or physiology, (c) change in behavior, (d) increase or decrease in performance, (e) opposite reaction in opponent, and (f) change in outcome. Much of the individual links in the model has yet to be directly empirically verified, but, as predicted, positive preceding events are associated with a large array of cognitive and behavioral benefits. Vallerand et al. (1988) links psychological momentum with the notion that one is “progressing towards his/her goal” which in turn reinforces feelings of self-confidence, control, and motivation. Self-confidence is supposed to increase attentiveness, concentration, and even the mental and physical effort of competitors (Iso-Ahola & Mobily, 1980). Briki et al. (2017) argue that past success yields behavioral patterns like persistence and self-determination. Initially, Iso-Ahola & Mobily (1980) proposed that, all else equal, the player with the higher psychological momentum receives a competitive advantage. However, years of mixed results has brought uncertainty into that conclusion.

**Economic Framework**

Third, economists typically view momentum from a game theory perspective. They define contests as “games” between two players who earn a payoff from the game. Payoffs are a numerical estimation of the worth of each outcome to each player. Monetary rewards contribute to this payoff, but so do social and intrinsic rewards (Vojnovic, 2015). In these contests, players have the opportunity to exert different levels of effort which affect their chances of receiving each payoff. However, effort is costly and lessens the players payoffs (Morgulev, 2023). Thus, in order to maximize their payoff, players are incentivized to minimize effort. Theoretically, this means that the structure and payoff of a game make the players’ effort predictable (Malueg & Yates, 2010).

The structure of a game incorporates the rules, circumstances, and score of the game itself. Each game is comprised of a large sequence of small “battles” (Kovenock & Roberson, 2012). As these battles occur, inevitably one player will have an advantage, shifting the structure of the game. In essence, this shift creates a new game in which one player is closer to winning than the other. The losing player must now expend more effort than his/her counterpart to achieve victory (Morgulev, 2023). Effort is costly, so this new game has asymmetric incentives that impact the players’ predicted effort (Konrad & Kovenock, 2009). This change in effort is known as *strategic momentum*. Strategic momentum ignores inward psychological or physiological factors and instead focuses entirely on the change in the game’s structure.

Mago et al. (2012) give a simple illustration using a best of three contest between two equally-skilled players. At the start, economic theory postulates that both players will exert equal effort. However, after one round, the winning player has an advantage. They must exert enough effort to win one round while the losing player must win two. The leading player, armed with strategic momentum, has more incentive to expend energy and thus has a higher chance of winning the second round. If the players are again tied after two rounds, this economic theory predicts that in round three each player has equal incentive to exert effort- and therefore win. This corroborates with empirical studies, which find that equally-skilled players are equally likely to win a third set in best of three set tennis matches (Malueg & Yates, 2010).

**Interactions between the Frameworks**

While unique, these three frameworks contain several notable similarities and distinctions. The biological and psychological frameworks both emphasize the effect of winning on the individual. The biological framework emphasizes the chemical and physiological changes in the winner, while the psychological framework assesses the behavioral and psychological changes. Morgulev & Avugos (2020) integrate the two frameworks under the term *psychophysiological* *momentum*.

Strategic momentum, however, is distinct from both other frameworks. Strategic momentum assesses the situation of the two competitors, while biological and psychological momentum evaluate the competitors themselves. Researchers are interested in distinguishing the frameworks, but in most contests, both types of momentum co-exist (Cohen-Zada et al., 2017), so separation is difficult. However, several researchers have constructed laboratory experiments or identified natural experiments to isolate strategic and psychological momentum. For example, Mago et al. (2012) conducted a laboratory experiment, using varying prizes to incentivize best of three contests, and they found evidence for strategic momentum but not for psychological momentum. In contrast, an analysis of professional judo tournaments found that judo players arriving at a bronze medal fight after a win are more likely to win than a player arriving after a loss (Cohen-Zada et al., 2017). This unique setting lacks strategic momentum, but contains psychological momentum. Likewise, Meier et al. (2020) assess interruptions in tennis contests and find evidence that psychological momentum and not strategic momentum is the main driver of a performance increase. Several researchers, therefore, argue that the value of psychological momentum exceeds that of strategic momentum (Descamps et al., 2022; Morgulev, 2023). The findings of Depken et al. (2022) are more nuanced. They design a model based purely on incentives from strategic momentum and interpret deviations as psychological momentum. Under this interpretation, they find evidence for a *psychological reversal* after set one and weak evidence for psychological momentum after set two. Altogether, strategic and psychophysiological momentum both exist, but the dominance of one over the other often depends on the design and situation of the empirical study.

**Procrastination and Anti-Momentum Theory**

Economic theory is not unanimously convinced that success breeds success. Success leads to favorable, comfortable situations that can dissuade individuals from expending effort towards a future goal. Colloquially, this is known as procrastination. Behavioral economics introduces procrastination into decision making through the concept *hyperbolic-discounting*. Hyperbolic-discounting is a cognitive bias, where individuals tend to value smaller immediate rewards higher than larger future rewards. Phelps & Pollak (1968) introduced the concept, and Laibson (1997) popularized and justified it. He argues that laboratory and field studies demonstrate that humans disproportionately value the future (Ainslie, 1992). Laibson writes that the hyperbolic discounting structure “sets up a conflict between today’s preferences, and the preferences that will be held in the future.” In essence, “the hyperbolic discounting approach captures the psychological phenomenon that the present is given special treatment” (Rubinstein, 2003). Shigeta (2022) illustrates hyperbolic discounting by separating the utility and consumption of an agent’s current self from the utility and consumption of his or her future self. If the future is far enough away, the current self effectively treats the future self as a different individual. Psychologically, this inconsistency is categorized as a lack of self-control and a misunderstanding of the importance of the future (Laibson, 1997). Overall, the model has been widely applied to a variety of financial situations like investment planning (Laibson 1997) and corporate finance (Grenadier & Wang, 2007). Evidence has been found to support hyperbolic discounting in the job search market (Paserman, 2008) as well as procrastination, addiction, information acquisition, and self-regulation (Rubinstein, 2003). There is very little empirical research to apply the theory of hyperbolic discounting to contests, but the theory translates. Under the hyperbolic discounting model, individuals value time and energy in the present more highly than in the future. Thus, players with many opportunities to secure victory will be incentivized to exert less effort in the early opportunities and potentially “procrastinate” victory.

**Momentum in Sports**

The presence of “streakiness” or momentum in sports has fallen under considerable debate in the last forty years. Gilovich, Vallone, & Tversky (1985) published a landmark report comprehensively rejecting the notion of the “hot hand” in basketball. In both live shooting and free throw attempts, they find no evidence that a made basket positively impacts a player’s chances to make the subsequent shot. In addition, they find no evidence that the number of runs of consecutive makes or misses differs from the predicted number of runs governed entirely by chance. A few years later, Albright (1989) came to a similar conclusion with hitting streaks in baseball. He found that baseball players as a whole do not exhibit streakiness beyond the scope of randomness. In fact, Gould (1989) concluded that Joe DiMaggio’s 56-game hitting streak in 1941 was the exception. Vergin (2000) expanded these conclusions to teams as a whole, finding that winning streaks from both professional basketball and professional baseball teams are comparable to the results expected if the games were determined independent of each other. These results and more have led Bar-Eli, Avugos, & Raab (2006) to conclude after an extensive review that little empirical evidence supports the relationship between past and future success.

However, several studies have found empirical evidence for momentum in sports. Smith (2003) found a “hot hand” effect in horseshoe pitchers. He argues that horseshoe competitions have many structural properties that eliminate confounding variables present in other sports. Smith (2003) posits that the small duration between pitches and little strategic complications play a large part in the findings. In a similarly simple game, Dorsey-Palmateer & Smith (2004) found evidence for streakiness in bowling. They found that bowlers are more likely to roll a strike after a series of strikes than a series of non-strikes. Recently, papers have found evidence for momentum in more complex sports. This is potentially a direct result of increased access to large data sets (Jane, 2023). Raab, Gula, & Gigerenzer (2012) find evidence for streakiness in half of the volleyball players and conclude that the hot hand effect exists in volleyball. Shea (2013) finds evidence for streakiness in professional basketball’s three-point contests and professional baseball’s home run derby. Like previous findings, he argues that the simplicity of these games allows for more direct analysis and removes potential structural or strategic challenges. An analysis of the change in win probability in professional football indicates that team’s possessions are dependent and that long streaks of successful drives are more likely than randomness would suggest (Roebber, Burlingame, & deWinter, 2022). In a challenge to Gilovich, Vallone, & Tversky’s foundational paper, Jane (2023) finds evidence for both a hot hand and choking under pressure on free throw attempts in professional basketball.

**Momentum in Tennis**

The game of tennis holds incredible value for researchers because of its simple and repetitive structure. Players are continually exposed to the same conditions and are not subject to the complex interactions and strategic decisions that impact the dynamic of many team sports (Sarcevic, Vranic, & Pintar, 2021). In addition, tennis has been described as a best-of-n and tug-of-war game (Gauriot & Page, 2019). This hierarchical scoring structure makes it easier to identify asymmetric incentives between the players and assess momentum. In singles, there are always two possible outcomes and two players. This provides two significant empirical advantages. First, after each point in the match, one player always inches closer to his or her goal in a measurable way. There are no neutral outcomes. Second, the same two players compete for the entire duration of the match. This makes it possible to adjust for any inequality in skill between the two players in a more controlled fashion. These structural benefits and the abundance of available data have made tennis to be an ideal sport to analyze the presence of momentum.

Klaasen & Magnus (2001) delivered the first major contribution towards momentum literature in tennis with the conclusion that points at Wimbledon are not independent and identically distributed. They concluded that, while controlling for the quality of the players, winning the previous point positively impacts players chances of winning the subsequent point.

Other researchers have noticed that not all points in tennis are the same. In his famous book *Winning Ugly,* famous tennis coach Brad Gilbert argues that “specific points and games” have an outsized impact “on the momentum and outcome of the match.” These uniquely impactful points then have a potential to be exploited by researchers to assess their momentum effect. Page & Coates (2017) assessed the effect of long tiebreaks in the first set on future sets. They demonstrate that the result of sets with long tiebreaks are ultimately decided by only two points even though players often enter the tiebreak having played about 78 points. Thus, after the set’s conclusion, the two players will have won about the same amount of points, but one player will have emerged with a massive strategic and psychological advantage. In men’s matches, they find that in first set tiebreaks lasting longer than 20 points, the winner of the first set has a 60% chance of winning the second set. They conclude that winning a close set produces momentum. They attribute this advantage to the winner effect.

Similarly, Gauriot & Page (2019) assess the effect of shots landing close to lines on future points. If a player hits a ball that lands one centimeter outside the line, he or she has a 0% chance of winning the point, but if the player hits a ball that lands one centimeter in, he or she has a positive probability of winning the point. Thus, within these few centimeters there is a large discontinuity in the outcome of the point. In men’s matches, they find that shots close to lines give players a higher chance to win the next point. Interestingly, this effect increases when the game score is tied or near its conclusion and falls when the score is asymmetric. Gauriot & Page (2019) conclude that the momentum effect is strongest when the match is close and nearing its end.

Meier et al. (2020) exploit the hierarchical structure of tennis by assessing the effect of a breaking the opponent’s serve on future points. Breaks of serve are uncommon and often sufficient in determining the winner of a set (Klaasen & Magnus, 1998). A server’s chance of winning his service game increases by almost 9 percentage points after a break (Meier et al., 2020). However, if players are interrupted by a changeover in between the break and the subsequent service game, the momentum effect is drastically decreased. Thus, breaks of serve act as a catalyst for momentum, but these catalysts are diminished by a delay in play. Meier, et al (2020) conclude that psychological momentum - not strategic momentum - primarily causes the momentum effect.

Overall, several studies find a larger momentum effect in men than in women. Depken et al. (2022) analyze the set-level momentum effects and find significant differences in male and female responses in sets one and two of a best-of-three set match. Page & Coates (2017) found a winner effect in men’s players after winning a close tiebreak, but they failed to find a winner effect for women. Gauriot & Page (2019) also fail to find any significant patterns for women’s matches after a shot lands close to the line. They, however, leave open the possibility that momentum exists in women’s tennis. This distinction between male and female contributors aligns with conclusions from other fields (Cohen-Zada et al., 2017) and fits with physiological explanations derived from the biological framework (Bezuglov et al., 2023).

**Summary**

Altogether, existing research suggests that momentum is difficult to assess. Humans are quick to identify patterns of momentum, but these patterns are frequently spurious. Yet, there is a growing domain of literature that supports the presence of momentum and three frameworks that explain it. The biological framework introduces the winner’s effect and suggests that winning produces positive hormones that orient the competitor for future success. The psychological framework holds that success breeds confidence, motivation, and general positive feelings that increase concentration, attentiveness, and future success. This process is known as psychological momentum. The economic framework introduces strategic momentum and holds that small victories in a competition change the competition’s structure and incentivize winners to exert more energy than losers. However, the economic field is not unanimous. In direct contrast to the strategic momentum, the concept of hyperbolic discounting theorizes that players in successful positions will procrastinate effort to future moments in the competition.

Initial empirical studies in sports found very little support for momentum as a whole. Gilovich, Vallone, & Tversky (1985) rejected the notion of the hot hand in basketball, and Albright (1989) dismissed streakiness in baseball hitting. These findings left a mark on the field and at the very least demonstrate that streakiness is more nuanced and often less impactful than observers would expect. Recently, an increase in accessible and detailed data has allowed for more specific and nuanced studies on momentum. These studies have contributed to growing evidence for the existence of momentum in sports.

Tennis’s simple and hierarchical structure has provided a suitable experiment ground. Researchers observe changes in momentum after several distinct moments in a match. Klaasen & Magnus (2001) find evidence for momentum after winning a point. Page & Coates (2017) conclude that winning a close set generates momentum for future sets. Gauriot & Page (2019) find that shots landing close to the line generate positive momentum. This effect is strongest when the match is close and nearing its end. Meier et al. (2020) find evidence that a break of serve yields positive momentum, but that interruptions in play dampen momentum. Finally, most of these studies find much stronger evidence for momentum in men’s tennis than in women’s tennis. Altogether, these findings have influenced our experimental structure and have provided guidance for its interpretation.

**Sources**

1. Separating psychological momentum from strategic momentum: Meier (https://www-sciencedirect-com.ezproxy.baylor.edu/science/article/pii/S016748702030026X)
   1. “Strategic momentum arises from the different relative positions of competing agents in a dynamic contest, which leads to asymmetric future expected prizes.” (1)
   2. “agents are not typically equally skilled, and thus success might lead to further success simply because the successful agent has greater abilities” (2)
   3. “In contrast, psychological momentum suggests that a precipitating event triggers a performance increase due to changes in the perception of the agents.” (2)
   4. “Our results show that the breaking player’s probability of winning a game increases after converting a break point. Thus, we find evidence of momentum. Moreover, we find that this momentum effect is negatively affected by a changeover interruption. Based on these results, we conclude that psychological momentum is the main trigger of the immediate performance increase after a realized break point.” (2)
   5. Strategic momentum results are mixed – pg 2-3
   6. Good description of psychological momentum, mixed results– pg 3
   7. Interruption is common terminating factor of psychological momentum (putting is streakier than dart throwing)
   8. Separated strategic from psychological momentum by analyzing interruptions after a break – pg 4-5
   9. “The proportion of breaks does not significantly differ between games followed by a changeover interruption and the games not followed by a changeover interruption” (pg 7)
   10. Results - “We find that a server’s chance of winning his service game significantly increases by 8.8 percentage points (p = 0.0000) in the game following a converted break point… we find evidence that a changeover interruption significantly decreases the server’s likelihood of winning his subsequent service game by 5.0 percentage points… suggesting that the momentum a player experiences after breaking his opponent is mainly due to psychological reasons” (pg 7)
2. Psychological momentum builds up and breaks down in table tennis: Hartigh
   1. Time outs are utilized in ping pong to interrupt negative momentum (p2732)
   2. Experiment demonstrated that participants perceptions of momentum returned closer to normal after a time out (p2735)
3. Differential reactions of virtual actors and observers to the triggering and interruption of psychological momentum: Briki
   1. Very similar to previous
   2. It shows that observers might notice momentum when the players themselves do not. This could affect my report.
4. Set-level Strategic and Psychological Momentum in Best-of-three-set Professional Tennis Matches: Depken (https://journals.sagepub.com/doi/epub/10.1177/15270025221085715)
   1. “In other words, psychological momentum is “*the tendency of an outcome to be followed by a similar outcome****not caused by any strategic incentives of the player****.*” (Intro)
   2. Game Theory descriptions of strategic momentum
   3. “we show that in Set 2 the first-set winner *underperforms* compared to theoretical predictions”
   4. “we find that if the favorite wins the Set 1, the probability of the favorite winning Set 2 increases with game differential. This is consistent with psychological momentum but not strategic effect models. In Set 3, the evidence for psychological momentum is weak: the order of winning in Set 1 and Set 2 is significant in one specification but the result is not robust to the inclusion of other controls.”
5. Effects of negative momentum on predicted performance and choking in tennis players: Ashford
   1. Non-professional tennis players were sent a survey about performance in in negative momentum situations. It indicated that stronger players feel more confident in low-momentum situations. This probably isn’t helpful.
6. Winner and loser effects in human competitions. Evidence from equally matched tennis players: Page and Coates (https://www.sciencedirect.com/science/article/pii/S109051381630232X)
   1. Narrowed data set to close rank
   2. “Even when controlling for these physiological advantages, pure winner and loser effects emerge, suggesting that winning and losing in themselves contribute to future performance” (Intro)
   3. “How can we know that a winning streak is not due to a player's greater ability?” (Intro)
   4. Good description on importance of a tiebreak (Data and method)
   5. Higher ranked players win first set tiebreaks more often
   6. For men, “Even when rank is controlled for, the act of winning or losing the first set tie-break created a large discontinuity in the probability of winning the second set.” (Results)
   7. “The estimated second set winning probabilities for hypothetically identical players (equal ranks and same number of points won in the tie-break) are 42.4% for the loser and 57.3% for the winner.”
   8. “Winner effects may thus depend on the existence of benchmark achievements.”
   9. Winner effect

# A Combinatorial Approach in Predicting the Outcome of Tennis Matches: Sarcevic, Vranic (https://sciendo.com/article/10.34768/amcs-2021-0036)

# Model for predicting winner of tennis match, assuming independence. Relies on “the same scientists have proven that these facts are rather weak and that the assumption of identical and independent point distribution is good enough when predicting the outcome of tennis matches”

# “The reassessment of the assumption of an independent and identical point distribution in tennis was started by Klaasen and Magnus (2001). They showed that players are more likely to score points at their service if they have previously won a point on their service (psychological momentum), while the likelihood is lower when serving a very significant point in the match (psychological pressure).” (p528)

# Are Points in Tennis Independent and Identically Distributed? Evidence From a Dynamic Binary Panel Data Model: Klaasen and Magnus (https://www.researchgate.net/publication/4744107\_Are\_Points\_in\_Tennis\_Independent\_and\_Identically\_Distributed\_Evidence\_From\_a\_Dynamic\_Binary\_Panel\_Data\_Model)

* 1. “Winning the previous point has a positive eﬀect on winning the current point, both for men and for women… the stronger the players, the weaker is this effect… at important points the server has a disadvantage” (p15)
  2. **“**Our results also suggest that–even though iid is rejected–the assumption of iid in speciﬁc applications (such as forecasting) could be relatively harmless.**”**

1. On the existence of momentum in football Roebber https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0269604#pone.0269604.ref003
2. Analyzing Wimbledon: The Power of Statistics <https://books.google.com/books?hl=en&lr=&id=F_lQEAAAQBAJ&oi=fnd&pg=PP1&ots=LofSNMdicQ&sig=tq13xGHh3tYQQvXiUdOYdkEWgIo#v=onepage&q&f=false>
   1. Interesting book, not sure if I’ll have time to read it
3. <https://theanalyst.com/na/2022/03/capturing-momentum-in-tennis/>
   1. Not a peer reviewed article, but defines leverage and talks through momentum
   2. “leverage is the amount a player’s match win probability changes given the outcome of the next point.”
4. On the existence of momentum in professional football <https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0269604>
5. Success breeds success: Physiological, psychological, and economic perspectives of momentum <https://www.sciencedirect.com/science/article/pii/S2667239123000102>
   1. Did not conduct research, but attempted to synthesize momentum research - morgulev
6. Testosterone, and winning and losing in human competition <https://psycnet.apa.org/record/1990-14074-001>
7. Winner Effect book - I.H. Robertson: The winner effect: The neuroscience of success and failure <https://books.google.com/books?hl=en&lr=&id=VVasDSnfgT8C&oi=fnd&pg=PR7&ots=rcbm5Tt33p&sig=KKHhap7YNnxfDPynBdRv_k_mCgs#v=onepage&q&f=false>
8. Testosterone across successive competitions: Evidence for a winner effect in humans? Zilioli and Watson
9. Testosterone Levels with sprint <https://www.sciencedirect.com/science/article/pii/S003193842300269X>
10. Jumping Spider <https://academic.oup.com/beheco/article/21/2/404/322443>
11. What sets the odds of winning and losing https://www-sciencedirect-com.ezproxy.baylor.edu/science/article/pii/S0169534705003332#aep-section-id12
12. Guariot and Page – shots close to line and momentum https://academic.oup.com/ej/article/129/624/3107/5536246?guestAccessKey=09c4cfbf-7e98-4850-a925-aa65fa2a5b05&login=false
13. Guariot and Page – scoring before half-time in soccer <https://www.sciencedirect.com/science/article/pii/S0167268118300453>
14. The hot hand in basketball: on the misperception of random sequences <https://www.sciencedirect.com/science/article/abs/pii/0010028585900106>
15. Kahneman thinking fast, thinking slow
16. Coin term psychological momentum Iso-Ahola & Mobily <https://journals.sagepub.com/doi/10.2466/pr0.1980.46.2.391>
17. Alder 1981 <https://cir.nii.ac.jp/crid/1130282272253242880>
18. Vallerand 1988 <https://journals.humankinetics.com/view/journals/jsep/10/1/article-p92.xml?content=abstract>
19. Taylor and Demick 1994 https://www.tandfonline.com/doi/abs/10.1080/10413209408406465
20. Mack and Stephens – assessing taylor and demick <https://www.proquest.com/docview/1311943075?pq-origsite=gscholar&fromopenview=true&imgSeq=1>
21. Vojnovic [https://books.google.com/books?hl=en&lr=&id=42NSCwAAQBAJ&oi=fnd&pg=PR13&ots=6rCQLHZZ9Y&sig=t8BdaxAvd-3PIFB3uRcoQrOawPQ#v=onepage&q&f=false](https://books.google.com/books?hl=en&lr=&id=42NSCwAAQBAJ&oi=fnd&pg=PR13&ots=6rCQLHZZ9Y&sig=t8BdaxAvd-3PIFB3uRcoQrOawPQ" \l "v=onepage&q&f=false)
22. Malueg and Yates <https://direct.mit.edu/rest/article/92/3/689/57843/Testing-Contest-Theory-Evidence-from-Best-of-Three>
23. Kovenock and Roberson <https://papers.ssrn.com/sol3/papers.cfm?abstract_id=1679624>
24. Konrad and Kovenock <https://www.sciencedirect.com/science/article/pii/S0899825608001139>
25. <https://www.tandfonline.com/doi/full/10.1080/1750984X.2020.1830426> - morgulev and avugos
26. <https://www.sciencedirect.com/science/article/pii/S0167268117300094> cohen-zada
27. <http://apps.olin.wustl.edu/faculty/pollak/2296547-1968.pdf> phelps and pollak, lame hyper
28. <https://web.s.ebscohost.com/ehost/pdfviewer/pdfviewer?vid=0&sid=d4566498-166a-4228-ad51-52112d9fca80%40redis> job search
29. <http://picoeconomics.org/PDFarticles/OpenEyes.pdf> ainslie
30. <https://web.s.ebscohost.com/ehost/pdfviewer/pdfviewer?vid=0&sid=eca19fbc-0965-42bb-ba51-f6a8aa5aee6f%40redis> rubinstein
31. [https://www-sciencedirect-com.ezproxy.baylor.edu/science/article/pii/S0022053122001089#br0380](https://www-sciencedirect-com.ezproxy.baylor.edu/science/article/pii/S0022053122001089" \l "br0380) shigeta
32. <https://www.sciencedirect.com/science/article/pii/S1469029206000240#aep-section-id62> – bar-eli, avugos, raab summary of hot hand
33. <https://www.tandfonline.com/doi/abs/10.1080/09332480.1989.10554932> - gould, dimaggio
34. <https://www.tandfonline.com/doi/abs/10.1080/01621459.1993.10476395> - albright, baseball streaks
35. <https://home.cs.colorado.edu/~mozer/Teaching/syllabi/7782/readings/gilovich%20vallone%20tversky.pdf> – Gilovich hot hand
36. <https://eds.s.ebscohost.com/abstract?site=eds&scope=site&jrnl=01627341&AN=3193802&h=DiiGqAD45fp0zpwfAZliwXLEwVs5QYSCToCN3IGEjzsBlmhkyWRucZlA%2biZBRiuGYeQ2c4uA5y3qFsBV552EZQ%3d%3d&crl=c&resultLocal=ErrCrlNoResults&resultNs=Ehost&crlhashurl=login.aspx%3fdirect%3dtrue%26profile%3dehost%26scope%3dsite%26authtype%3dcrawler%26jrnl%3d01627341%26AN%3d3193802> vegin team winning streaks
37. <https://link.springer.com/article/10.3758/bf03196542?utm_source=getftr&utm_medium=getftr&utm_campaign=getftr_pilot> gary smith horseshoe
38. <https://www.tandfonline.com/doi/abs/10.1198/0003130042809> palmateer bowling
39. <https://onlinelibrary-wiley-com.ezproxy.baylor.edu/doi/full/10.1111/kykl.12326> Jane - hot hand and choking
40. <https://psycnet-apa-org.ezproxy.baylor.edu/record/2011-23769-001?doi=1> volleyball raab
41. <https://onlinelibrary-wiley-com.ezproxy.baylor.edu/doi/10.1002/pchj.39> baseball shea
42. <https://scholar.google.com/scholar_lookup?title=The%20importance%20of%20breaks%20in%20tennis%3A%20Four%20years%20at%20Wimbledon.%20Working%20paper&publication_year=1998&author=J.%20Magnus&author=F.%20Klaassen> importance of breaking serve in tennis

Other Sources

1. <https://otexts.com/fpp3/ses.html#fig:7-oil> forecasting text
2. <https://r4ds.hadley.nz> R for Data Science

Outline of Lit Review Thoughts

* Does Momentum exist?
  + Uncertainty – Meier article has numerous examples of both finding momentum and not finding momentum
    - Literature is convincing that momentum exists
    - Less certain about sports
    - Yes and No
  + Difficulty of determining if winning is result of ability or momentum (Page and Coates)
    - Recently in tennis, yes – focus in on main articles
* If it does exist, what causes it?
  + Biological/Psychological/Game Theory
  + Strategic momentum (Meier and Depken)
  + Psychological momentum (Meier and Depken)
  + Not necessarily focus of study, we’re focused on…
* When does momentum happen?
* Interruptions halt momentum, evidence from winning a previous point, and from a tiebreak
* If so, how can we track it and how can we predict it…
* Usefulness of tennis, benchmark achievements (hierarchical)
  + Numerous points with the same conditions
  + Strategic momentum resets
  + Find in combinatorial approach article

Paper Walk Through: Background - Explanation of Tennis – Lit Review – Data – Methods – Results - Conclusion

**Background**

Momentum is tangible. In tense moments, a collective anticipation suffocates a crowd.

In statistics, we love to imagine our problems are full of independent

Momentum is not physics.

* Momentum explanation
  + Background, hot hand, baseball streak in sports, colloquial, crowd noise (find in Klaasen article), elections
  + Description of tennis and its importance