Human Ethology Bulletin 29 (2014)4: 18-27
Brief Report

WINNER AND LOSER EFFECTS IN MAJOR LEAGUE BASEBALL DOUBLE HEADERS

Andrew C. Gallup[1*] & Omar Tonsi Eldakar[2]

[1]Department of Psychology, State University of New York at Oneonta, Oneonta, NY, USA
[2]Division of Math, Science and Technology, Nova Southeastern University, Fort Lauderdale, FL, USA

a.c.gallup@gmail.com

ABSTRACT

Across the animal kingdom it has been observed that outcomes of conflicts are influenced by past experiences, whereby previous winners are likely to keep winning and losers are likely to lose again. These so-called "winner and loser effects" are hypothesized to result from factors such as information acquisition and endocrine responses following the initial bouts. This paper applies the understanding of this phenomenon to a novel domain: patterns of winning and losing in Major League Baseball (MLB) double headers. By accessing archival data available from www.espn.com, we report on the incidence of a single team winning both games (sweeps) versus each team winning one game (splits) in MLB double headers over the last 13 years. Consistent with previous research on winner and loser effects, we show that sweeps are significantly more common than splits and that there is a home field advantage in this context. Results indicate that disparity in opponent quality or skill, as measured by the difference in team records outside the double header match, was not a significant predictor of whether the outcome resulted in a split or a sweep. In contrast to our hypotheses, there was no difference in the margin of victory in games between sweeps and splits. Overall these results add to the existing literature on winner and loser effects, provide a framework for pursuing further research in MLB, and suggest that winner and loser effects may be present across a variety of other forms of human social interaction.

Keywords: *Baseball, Double Header, Testosterone, Cortisol, Winner and Loser Effect*

INTRODUCTION

Competition is ubiquitous in the animal kingdom. Competition over food, territory and mates is widespread in animals and any relevant information competitors can acquire about themselves (self-assessment) and/or their rivals (social-cues) can provide crucial advantages in forthcoming contests (Rutte et al. 2006). Contests can take the form of direct physical engagements to determine the winner, or be carried out in more ritualized displays to assess the potential fighting abilities of competitors while forgoing elevated risks of injury (Maynard Smith 1974). The outcome of these contests, however, is not always related to the physical attributes of the competitor, also known as the individual's resource holding potential (RHP) (Parker 1974, Maynard Smith 1982), or motivational attributes such as the value of the contested resource (Huntingford & Turner 1987). The outcomes of competitions can also be significantly influenced by the experiences of contestants from previous bouts that have lasting carryover effects to successive contests. These are referred to as winner and loser effects (Rutte et al. 2006), whereby winners are more likely to keep winning ensuing bouts, and losers are prone to keep losing. Winner and loser effects have been observed across the animal kingdom, ranging from spiders (*Argyrodes antipodiana*, Whitehouse 1997) and shrimp (*Alpheus heterochaelis*, Obermeier and Schmitz 2003), to fish (killifish *Kryptolebias marmoratus*, Hsu et al. 2009; Mozambique tilapia *Oreochromis mossambicus*, Oliveira et al. 2009), mice (e.g., *Peromyscus californicus*, Oyegbile and Marler 2005), and humans (Mehta and Josephs 2006). These effects are not trivial. A survey across a variety of taxa revealed that when facing a naïve opponent, and all else is considered equal (e.g., body size), the probability of winning is nearly doubled for previous winners and is more than five times reduced for previous losers (for review see Rutte et al 2006).

Factors likely contributing to these effects include information acquisition and outcome specific endocrine responses following contests. Competition over food, territory and mates is widespread in animals and any relevant information competitors can acquire about themselves (self-assessment) and/or their competition (social-cue) can provide crucial advantages in forthcoming competitions (Rutte et al. 2006). Individuals that have won or lost their previous bouts gain important information about their relative position in the population with regards to RHP, and therefore can better estimate their chances of victory and injury when deciding to engage in future contests. For example, adjusting behaviors based on the outcome of observed contests has been demonstrated across a variety of species (Early and Dugatkin 2002; Obermeier and Schmitz 2003; Oliveria et al 1998), whereby individuals exhibit reduced aggressiveness or avoid fights altogether with perceived winners of previous bouts. Winner and loser effects also seem to be mediated by changes in hormone levels (Rutte et al. 2006), such as stressor hormones (Schuett et al. 1996) and androgens (Wingfield et al. 1990, Oyegbile and Marler 2005, Mehta and Josephs 2006, Oliveira et al. 2009). Winners often benefit from rises in testosterone, while losers show declining testosterone and heightened levels of glucocorticoids (steroid hormones that mediate stress responses).

Research conducted on humans has shown that winner and loser effects do not arise solely from instances of physical combat, as has been primarily studied in non-human animals. Given the ubiquity of sporting contests across cultures and the role endocrine responses, handedness and other biologically relevant factors play in determining outcomes, recent evolutionary approaches have increased our understanding of human sporting competitions (reviewed by Widermann et al., 2011). Winner and loser effects have been observed both in the context of contemporary sports such as tennis (Booth et al. 1989), soccer (Oliveira et al. 2009), and crew (Kivlighan et al. 2004), as well as non-physical mental competitions such as chess matches (Mazur et al. 1992) and number tracking tasks (Mehta and Josephs 2006). Witnessing the outcome of contests can even produce physiological effects in the spectators, as measurable changes in testosterone have even been observed in the fans of winning and losing teams at sporting events (Bernhardt et al. 1998).

Studies on humans typically demonstrate winner and loser effects by revealing predicted shifts in hormone levels that likely influence future contests, but do not track whether winners are likely to keep winning (or losers to continue losing) in these ensuing bouts. Here we aim to view patterns of consecutive winning and losing in contemporary sports through the lens of winner and loser effects. One such candidate comparison is the win-loss outcome of Major League Baseball (MLB) double-headers, whereby two consecutive 9-inning baseball games are played with only a brief intermission (typically 3 hours). Although in many studies on humans, winner and loser effects are assessed through saliva assays 15-30 minutes following the conclusion of the competition (e.g., Mazur et al., 1992; Oliveira et al., 2009), testosterone differences have been observed to last into the day following competition (Booth et al. 1989). Furthermore, while peak testosterone is observed at 45min following contests in California mice (*Peromyscus californicus*, Oyegbile and Marler 2005), differences in aggression attributed to winning a contest have been observed long after hormone levels return to baseline (Trainor et al. 2004). Similarly, winner and loser effects have been documented to last up to 48 hours in fish (*Rivulus marmoratus*, Hsu and Wolf, 1999), and loser effects in copperhead snakes (*Agkistrodon contortrix*) persist for up to five days even though differences in corticosterone are only observable for an hour post-contest (Schuett et al. 1996). Therefore, it seems reasonable that these effects may also be present within the given timeframe of a MLB double header.

In this study we performed analyses on archival data available from www.espn.com reporting MLB double header results from 2002 to 2014. In accord with the aforementioned literature, we hypothesized that more double headers will result in sweeps (one team wins both games) than splits (each team wins one of the two contests). Each MLB team plays a total of 162 games a season, spanning from late April to late September. MLB double headers are scheduled prior to the start of each season, and sometimes are also scheduled ad hoc due to the postponement of games earlier in the season. Thus, each team has an equal chance of playing in double headers, and the likelihood of a team playing a double header at their home stadium is random. If the outcomes of the two games were independent, we would expect an equal proportion of splits and sweeps. That is, by chance

we would expect the team winning the first game to have an equal likelihood of winning or losing the second game.

To our knowledge, only one study has systematically evaluated the incidence of splits versus sweeps in MLB double headers. Consistent with the literature on winner and loser effects, Goodman (1969) found a significantly higher incidence of sweeps compared to splits for all MLB double headers played in 1964 (113 swept, 81 split). Our investigation extends this analysis to identify whether this pattern holds true in contemporary MLB, and over a longer period of time (i.e., www.espn.com currently provides all double header results from the past 13 seasons). In addition, home field advantage has been well documented across various sporting events (Courneya and Carron, 1992), with contributing factors including crowd size and its relation to enhancing home team performance and/or altering officiating in favor of the home team (Nevill and Holder, 1999). A meta-analysis performed across a range of sports also indicated that time era, season length, game type, and type of sport moderated the effect of home field advantage (Jamieson, 2010). Research has also revealed a home field advantage, or residency status effect, in nonhuman animal contests. For example, in a seminal paper on territorial defense in the speckled wood butterfly (*Pararge aegeria*), Davies (1978) demonstrated that residents remained undefeated against intruders. Recent research in a mammalian system has further shown that winning and losing outcomes are largely influenced by the location of the contest (Fuxjager et al., 2009). Specifically, it was shown that California mice with no previous experience have higher plasma testosterone when fighting in their home cage compared to when fighting in an unfamiliar cage (Fuxjager et al., 2009). Therefore, we also predicted that the home teams would be more likely to win both games in instances where a sweep occurs. Lastly, we compared the margin of victory or run differential of games between sweeps and splits. We hypothesized that a greater margin of victory in the first game might have corresponding physiological and informational effects that would increase the likelihood for the winning team to sweep the double header. Therefore, we expected that the run differential in Game 1 would be higher for sweeps than splits. Similarly, we tested the possibility that the margin of victory in Game 2 would be greater for sweeps than splits.

METHODS

Information on MLB double headers was acquired from archival data available on www.espn.com, which included the date, location and score from all games played from the 2002 to 2014 seasons. A total of 324 double headers occurred during this timeframe. These data were compiled and the incidence of sweeps versus splits was charted. In addition, the margin of victory for each game was derived. The win total from each team for the season (minus the wins accumulated during the double header) was also recorded.

A binary logistic regression was first used to assess whether the absolute disparity in season win total between teams playing double headers predicted the outcome of a sweep

versus a split. Binomial tests were then used to test whether sweeps and splits and home team versus away team victors were evenly distributed across this timespan. Given the null hypothesis that the outcome of each game should be independent, the binomial test with a probability set to 0.5 is an appropriate statistical test. Independent t-tests were then used to compare the margin of victory between games played within double headers that were swept versus those that were split. These tests were adjusted accordingly when variances between samples were unequal using the Levene's Test. Statistical analyses were performed in SPSS v.21 with α set to 0.05.

RESULTS

From 2002-2014 an average of 24.92 double headers were played each year. MLB teams play 162 games each season, and therefore a team that finished with a 0.500 record would accumulate 81 wins and 81 losses. Across the 13 years of data we collected, the average win total of teams that played in double headers was 80.71 (s.d. = 11.23), with a range from 43 to 105. To assess whether better teams were more likely to win over lesser opponents, we computed the absolute difference in total wins outside the double header match between each team for all 324 double headers played from 2002-2014 and included this as a covariate in a binary logistic regression (dependent measure: sweep vs. split). The rationale being that if superior teams were more likely to win both games then we would expect there to be a greater disparity in win totals between double header teams that resulted in sweeps. In other words, we would expect splits to be more common among teams with similar season records. The regression revealed that the discrepancy between team records did not predict the outcome of sweep vs. split in double headers (R^2 = 0.003, β = 0.014, p = 0.289). Thus, better teams were not more likely to sweep their opponents.

A binomial test was then used to test whether splits and sweeps were evenly distributed across the 324 double headers played between 2002-2014. Across the 13 seasons, the distribution of sweeps to splits was nonrandom. Consistent with the research on winner and loser effects, as well as the single year report from Goodman (1969), there were more sweeps (179/324, or 55.25%) than would be expected by chance (binomial test, $X \geq 179$: p = 0.033; see Figure 1). In other words, the winner of the first game was more likely to win the second game. Across the 13 years available for analysis, nine had a greater number of sweeps, 3 had a greater number of splits, and one year (2012) had an equal number of sweeps and splits (see Table 1).

Among the double headers that were swept, we then investigated whether the home team was more likely to win both games. Consistent with sports science research showing a home field advantage (Courneya and Carron, 1992; Jamieson, 2010; Nevill and Holder, 1999), as well as results from fighting contests among territorial mice (e.g., Fuxjager et al., 2009), we found that home teams were more likely to sweep the visiting teams (106 out of

the 179, or 59.22%) than would be expected by chance (binomial test, X ≥ 106: $p = 0.008$; see Figure 2).

Table 1 Splits versus sweeps in MLB double header results each year from 2002-2014.

Year	Sweeps	Splits	Proportion Swept
2002	14	10	.583
2003	20	8	.714
2004	23	15	.605
2005	7	11	.389
2006	10	13	.435
2007	12	9	.571
2008	14	11	.560
2009	13	10	.565
2010	7	10	.412
2011	18	16	.529
2012	10	10	.500
2013	16	9	.640
2014	15	13	.536

We also investigated whether the margin of victory in the first game would be higher for sweeps than splits. The average margin of victory in first game for sweeps was slightly greater than the run differential in game 1 for splits (3.570 vs. 3.435), but was not significantly different ($t(321) = -0.397$, $p = 0.692$). We also tested the possibility that the margin of victory would be greater in the second game for sweeps than splits. Similarly, however, there was no significant difference in the run differential for game 2 and in this case the trend was in the opposite direction (3.324 vs. 3.931; $t(273.08) = 1.963$, $p = 0.051$). Furthermore, when comparing the margin of victory for home teams sweeping their opponents versus being swept, no significant differences emerged (Game 1: $t(101.220) = 1.798$, $p = 0.075$; Game 2: $t(177) = 0.901$, $p = 0.369$).

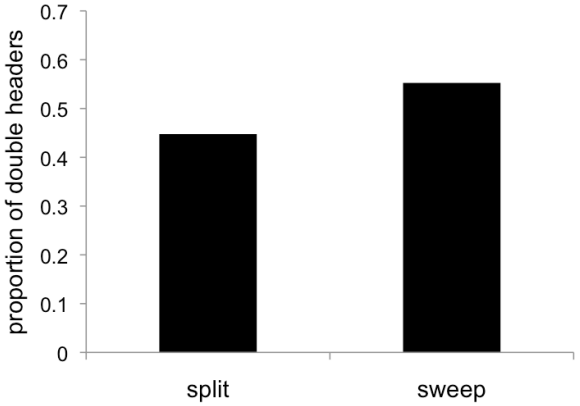

Figure 1. Total splits versus sweeps in MLB double headers from 2002-2014. There were more sweeps than would be expected by chance (179/324; $p = 0.033$).

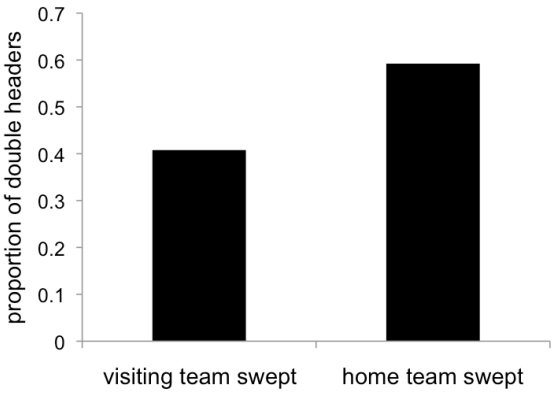

Figure 2. Total visiting team versus home team sweeps in MLB double headers from 2002-2014. The home team was more likely to sweep the visiting team (106/179; $p = 0.008$).

DISCUSSION

We applied the existing theoretical framework for winner and loser effects to test the hypothesis that MLB double headers would be more likely to result in sweeps rather than splits. By comparing the outcomes of MLB double headers over the last 13 years, we show that the relative superiority of the opponents did not predict the number of wins accumulated during these consecutive contests. Rather, we found that the victor in the first game was significantly more likely to also win the second game. This research replicates a single report documenting the outcomes of double headers in 1964 (Goodman, 1969), and adds to the existing literature on winner and loser effects across diverse taxa. In accord with recent comparative research showing a home field advantage in sporting events and other non-human contests (Courneya and Carron, 1992; Fuxjager et al., 2009; Jamieson, 2010; Nevill and Holder, 1999), we also found that sweeps were more likely performed by the home team. Contrary to some novel predictions, however, the average margin of victory for double header games was similar between sweeps and splits and did not depend upon home field.

Our general findings from MLB double header outcomes are consistent with winner and loser effects documented in cases ranging from intrasexual competition in spiders (Whitehouse 1997) to chess matches in humans (Mazur et al., 1992). We speculate that, consistent with previous research on team sporting events (e.g., Oliveira et al. 2009), corresponding changes in testosterone levels of the players following wins and losses influence these nonrandom patterns of victory in MLB double headers. Future research

could test this hypothesis by taking hormonal assays before and after each game. This approach could also be used to investigate whether MLB players show a similar location or home field advantage effect of heightened testosterone following wins. In conjunction with endocrine responses, key information acquired from the first game in a double header could be utilized to alter strategies and/or performance in the second game played a few hours later. We hope further research is conducted to tease apart these and other potential factors contributing to the nonrandom outcomes reported.

Using an ecologically valid data set, this paper takes a biological perspective on winner and loser effects to understanding outcomes in MLB double headers. We replicated a previous report showing that sweeps are more common than splits in MLB double headers, provide insight from non-human animal research into the home field advantage present in this effect, and offer predictions for future research in this area. There are certainly many open areas of research to explore in regards to winner and loser effects in sporting competitions, which could lead to fruitful interdisciplinary collaborations (for a discussion, see Dugatkin and Reeve, 2014). We believe that winner and loser effects are extensive in human social interactions, and may influence outcomes in a variety of contexts yet to be formally investigated.

ACKNOWLEDGEMENTS

We are grateful to the two anonymous reviewers and handling editor for providing helpful comments and suggestions on earlier drafts of this manuscript.

REFERENCES

Bernhardt, P. C., Dabbs Jr, J. M., Fielden, J. A., and Lutter, C. D. (1998). Testosterone changes during vicarious experiences of winning and losing among fans at sporting events. *Physiology & Behavior*, *65(1)*, 59-62.

Booth, A., Shelley, G., Mazur, A., Tharp, G., and Kittok, R. (1989). Testosterone, and winning and losing in human competition. *Hormones and behavior*, *23(4)*, 556-571.

Courneya, K. S., and Carron, A. V. (1992). The home advantage in sport competitions: a literature review. *Journal of Sport & Exercise Psychology*, *14*(1).

Davies, N. B. (1978). Territorial defence in the speckled wood butterfly (*Pararge aegeria*): The resident always wins. *Animal Behaviour*, *26*, 138-147.

Dugatkin, L. A., and Reeve, H. K. (2014). Winning, losing, and reaching out. *Behavioral Ecology*, *25(4)*, 675-679.

Earley, R., and Dugatkin, L. A. (2002). Eavesdropping on visual cues in green swordtails (*Xiphoporus helleri*): a case for networking. *Proceedings of the Royal Society of London. Series B: Biological Sciences*, *269*, 943-952.

Fuxjager, M. J., Mast, G., Becker, E. A., and Marler, C. A. (2009). The 'home advantage'is necessary for a full winner effect and changes in post-encounter testosterone. *Hormones and Behavior*, *56*(2), 214-219.

Huntingford, F. and Turner, A. (1987). *Animal Conflict*. London: Chapman & Hall.

Hsu, Y., Lee, I. H., and Lu, C. K. (2009). Prior contest information: mechanisms underlying winner and loser effects. *Behavioral Ecology and Sociobiology*, *63*, 1247-1257.

Hsu, Y., and Wolf, L. L. (1999). The winner and loser effect: integrating multiple experiences. *Animal Behaviour*, *57(4)*, 903-910.

Jamieson, J. P. (2010). The Home Field Advantage in Athletics: A Meta-Analysis. *Journal of Applied Social Psychology*, *40*(7), 1819-1848.

Kivlighan, K. T., Granger, D. A., and Booth, A. (2005). Gender differences in testosterone and cortisol response to competition. *Psychoneuroendocrinology*, *30(1)*, 58-71.

Maynard Smith, J. (1974). The theory of games and evolution of animal contests. *Journal of Theoretical Biology, 47*, 209-221.

Maynard Smith, J. (1982). Evolution and the theory of games. Cambridge UK: Cambridge University Press.

Mazur, A., Booth, A., and Dabbs Jr, J. M. (1992). Testosterone and chess competition. *Social Psychology Quarterly*, 70-77.

Mehta, P. H., and Josephs, R. A. (2006). Testosterone change after losing predicts the decision to compete again. *Hormones and Behavior*, *50*, 684–92.

Nevill, A. M., and Holder, R. L. (1999). Home advantage in sport. *Sports Medicine*, *28(4)*, 221-236.

Obermeier, M. and Schmitz, B. (2003). Recognition of dominance in the big-clawed snapping shrimp (*Alpheus heterochaelis* Say 1818) part II: analysis of signal modality. *Marine and Freshwater Behaviour and Physiology*, *36*, 17–29

Oliveira, R. F., McGregor, P. K., and Latruffe, C. (1998). Know thine enemy: fighting fish gather information from observing conspecific interactions. *Proceedings of the Royal Society of London. Series B: Biological Sciences*, *265(1401)*, 1045-1049.

Oliveira, T., Gouveia, M. J., and Oliveira, R. F. (2009). Testosterone responsiveness to winning and losing experiences in female soccer players. *Psychoneuroendocrinology*, *34(7)*, 1056-1064.

Oliveira, R. F., Silva, A., and Canário, A. (2009). Why do winners keep winning? Androgen mediation of winner but not loser effects in cichlid fish. *Proceedings of the Royal Society of London. Series B: Biological Sciences, 276*, 2249-2256.

Oyegbile, T. O., and Marler, C. A. (2005). Winning fights elevates testosterone levels in California mice and enhances future ability to win fights. *Hormones and Behavior*, *48(3)*, 259–67.

Parker, G. A. (1974). Assessment strategy and the evolution of fighting behaviour. *Journal of Theoretical Biology*, *47*, 223–243

Rutte, C., Taborsky, M., and Brinkhof, M. W. G. (2006). What sets the odds of winning and losing? *Trends in Ecology and Evolution*, *21*, 16-21.

Schuett, G. W., Harlow, H. J., Rose, J. D., Van Kirk, E. A., and Murdoch, W. J. (1996). Levels of plasma corticosterone and testosterone in male copperheads (*Agkistrodon contortrix*) following staged fights. *Hormones and Behavior, 30(1)*, 60–8.

Trainor, B. C., Bird, I. M., and Marler, C. A. (2004). Opposing hormonal mechanisms of aggression revealed through short-lived testosterone manipulations and multiple winning experiences. *Hormones and Behavior, 45*, 115–121

Whitehouse, M. E. A. (1997). Experience influences male-male contests in the spider Argyrodes antipodiana (*Theridiidae: Araneae*). *Animal Behaviour*, *53*, 913–923.

Widermann, D., Barton, R.A., and Hill. R.A. (2011). Evolutionary perspectives on sport and competition. In Roberts, S. C. (ed.), Applied Evolutionary Psychology. Oxford University Press.

Wingfield, J. C., Hegner, R.E., Dufty Jr., A. F., and Ball, G. F. (1990). The challenge hypothesis – theoretical implications for patterns of testosterone secretion, mating systems, and breeding strategies. *American Naturalist, 136*, 829–846