

## Blue Judogis may Bias Competition Outcomes

David Matsumoto<sup>1)</sup>, Jun Konno<sup>2)</sup>, Stephanie Hata<sup>3)</sup> and Masayuki Takeuchi<sup>4)</sup>

### Abstract

In this study we investigated the existence of a win bias in judo competition as a function of judogi color. We analyzed the results of four major international competitions—the 2001, 2003, and 2005 World Championships, and the 2004 Athens Olympic Games—in terms of whether or not athletes were more likely to have won their matches when wearing the blue judogi. The results indicated a statistically significant bias in winning percentage for male athletes who wear the blue judogi, but not for females. This bias increased within a tournament from beginning to end, and across years.

**Key words :** Judo, Judogi color, competition, outcomes, bias

### I. Introduction

Blue judogis have been used in international judo competition since 1997, and are now a well accepted aspect of international competition. They were instituted by the International Judo Federation to improve the understandability of judo matches for spectators and officials alike, differentiating the action of the two contestants. The blue judogi made the sport more spectator-friendly and dynamic.

Yet, adopting the blue judogis was not easy. The merits of the change from white-white to blue-white judogis were hotly debated for years prior to the acceptance by the International Judo Federation. The leading proponent of the change was the European Judo Union, while

the leading opponent was Japan.

Almost a decade ago, in the midst of this hotly debated subject, we argued that, instead of resorting to rhetoric and argument, a scientific approach to the issue would be productive<sup>7)</sup>. Literature reviews in psychology at that time demonstrated convincingly to us that color had various effects on individual emotions and performance. Then, we argued that research should be conducted on the merits of the proposed changes in order to determine what effects – positive or negative – they would have.

Now, a decade later, we are ten years into our social psychological experiment of the use of blue judogis, and fortunately we can assess the possible impact of the use of blue judogis on

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1) San Francisco State University

2) Nihon University

3) University of California, Davis

4) Daito Bunka University

1600 Holloway Avenue San Francisco, CA 94132 USA

E-mail: dm@sfsu.edu

1) サンフランシスコ州立大学

2) 日本大学

3) カルフォルニア大学デイビス校

4) 大東文化大学

performance. A particularly important question concerns whether or not wearing a blue judogi is associated with a performance bias. Although the word bias has a negative connotation, here we define it as a non-random and unexpected fluctuation from what would be expected by chance alone. In this context, bias would be observed if wearing the blue judogi in competition is associated with either a positive (e.g., greater winning percentage) or negative (less winning percentage) result than what would be expected purely by chance (50%). If there were such a bias, we believe it would be important for judo organizations to know that such bias exists, to take steps to understand the bases of such biases, and to rectify the situation in the name of fair play.

In fact, there *should* be no such bias. Judogi color assignment is determined largely randomly, as players need to switch blue and white judogis depending on where they are in the tournament brackets. Because the top player in a bracket always wears blue, a player's judogi color is supposedly random because, in one match they may be the top player, and in the next they may be the bottom player. The only difference to this rule to our knowledge is the fact that many (not all) tournament programs place seeded players in the top position of a bracket in the first round, mandating that they wear blue. After that, however, bracket position, and thus judogi color assignment, should be random.

The lack of a bias in judogi color assignment is also an important aspect of the contest rules of judo. The rules are designed for safety and fair play, meaning that players should not receive an unfair advantage to win or lose for any reason.

But, recent research draws questions about whether uniform color in sport

competition is in fact associated with bias. Almost 20 years ago Frank and Gilovich demonstrated a performance bias in sports as a function of uniform color<sup>3)</sup>; football and hockey teams wearing black uniforms were penalized more, and laboratory studies confirmed that players actually became more aggressive when they wore black, and were judged as being more aggressive by others.

Hill and Barton recently extended these findings into more contemporary sports, by showing that more matches in the 2004 Athens Olympic Games were won by fighters in boxing, taekwondo, and wrestling when athletes wore red uniforms than when they wore blue<sup>2)</sup>. These scientists attributed these findings to a possible color-preference for aggression that is evolutionary-based. They noted that bright colors such as red are often associated with more aggression in animals, and especially among the males.

But what about judo? In fact, Rowe et al. showed that the winning bias also occurred in judo, with players wearing the blue judogi significantly more likely to win matches than the white player<sup>4)</sup>. Their findings, therefore, were the first to suggest that judogi color may be associated with a bias in performance outcomes in judo.

Rowe et al.'s findings were compromised, however, by their methodology. They analyzed all matches, and only matches from the first round, reckoning that athletes were placed into the draw randomly. They made an incorrect assumption, however, about the draw. The seeded athletes are often *required* to wear the blue judogi. Thus the first round of competition is precisely the round in which a winning bias may occur, because stronger players are the ones who are seeded and thus more likely to wear blue. Moreover, they only analyzed the

results from a single tournament (the Athens Games); thus their findings may be specific to that tournament and not characteristic of judo tournaments in general.

In this study, we corrected these limitations in Rowe et al.'s analysis to examine whether or not blue judogis were associated with a performance bias in international competition. We analyzed the win-loss ratios across several tournaments in three ways: (1) for the entire tournament, (2) excluding the first round, and (3) only in the gold and bronze medal matches. Moreover, we analyzed the data separately for males and females, and across the last four major tournaments conducted in this format to examine whether the bias was consistent across tournaments. Based on the fact that judogi color assignment is random in competition, we expected to find no evidence for such bias.

## II. Method

### 1. Tournaments Analyzed

We obtained the completed brackets of the 2005, 2003, and 2001 World Championships, and the 2004 Olympic Games. These were the last four largest major international competitions in which the blue judogis were used. The rules of judo competition are such that the player in the top position in a bracket always wears blue; thus, bracket position confounds color assignment. One way to address this issue is to examine the win ratios for players in the top and bottom of the brackets in tournaments in which judogi color was held constant, that is, in which both contestants wore the white judogi. The rules instituting blue judogis began in 1997; thus we also examined five international tournaments that used only the white judogis: the 1996 Atlanta Olympic Games, and the 2005 and

2006 Kano Cup, and the 2004 and 2005 All Japan Championships. These latter tournaments are world class events on a level comparable to the world championships and Olympic Games. If there was a win bias for the top players in these tournaments, then we would know that any win bias for blue players occurred not because of the color of the judogi but because of bracket placement.

### 2. Methods of Analysis and Statistical Techniques

In each tournament analyzed, we counted the number of times the player wearing the blue judogi, or the top player in the bracket for tournaments using only the white judogi, won the match. We tabulated these results three ways: (1) across the entire tournament, (2) the entire tournament but excluding the first round, and (3) only in the medal rounds. Excluding the first round eliminates any possible influence of non-randomized placement of players into the top (blue) or bottom (white) of the brackets. Examining the win ratios at three different points in time allows us to gauge if any bias becomes stronger during the tournament.

Also, it is possible for strong players to lose in the first round and drop to the repechage. When strong players lose early and climb out of the repechage, the brackets require them to continually wear the blue judogi. Thus, we also counted the number of times the player wearing the blue judogi won in the repechage and subtracted these totals from the overall totals to eliminate the possibility that these matches confounded the results.

The tallies were converted into percentages, separately for the entire tournament, only after the first round, and then only in the medal rounds. These percentages were then compared to that which

would be expected by chance alone (50%) using the binomial test. The binomial test is a test that compares the observed percentage of any dichotomy to what would be expected by chance, relative to the sample size. With large sample sizes, the distribution of the binomial test approximates a normal distribution; thus the statistical significance of the binomial test can be assessed using a z statistic, which is what we used here. Alpha was set at .05.

**III. Results**

There were several findings of note. Across all four tournaments using the blue judogi, there was a significant win bias for athletes who wore blue (53.54%), but only for males:

that is, male judo players who wore the blue judogi were significantly more likely to win their matches than the player wearing the white (Table 1). Second, the win bias was larger after the first round (54.55%), and especially in the medal rounds (60.22%). Thus the win bias got larger as matches proceeded in the tournament. Third, the win ratio has increased over the four years analyzed. Even when the matches from the repechage were dropped, the overall winning percentage for males was still 56.65%,  $z = 2.58$ ,  $p < .01$ ; the win ratio for females was not different than chance.

Examining the win ratios for top and

**Table 1** *The Win-Bias for Athletes who Wear the Blue Judogi*

<b>All Athletes</b>				
	Number of Matches	Percentage of Matches Athletes Wearing Blue Won	Percentage of Matches Athletes Wearing Blue Won after 1 <sup>st</sup> Round	Percentage of Matches Athletes Wearing Blue Won in the Medal Rounds
2005 World Championships	745	53.69*	55.14*	56.25
2004 Athens Olympic Games	507	54.44*	53.00	54.76
2003 World Championships	782	50.13	50.23	47.92
2001 World Championships	760	51.05	52.71	52.08
<b>Total</b>	<b>2794</b>	<b>52.11</b>	<b>52.64*</b>	<b>52.69</b>
Total After 1 <sup>st</sup> Round	2213			
Total in the Medal Rounds	186			
<b>Male Athletes Only</b>				
2005 World Championships	438	54.11	55.76*	62.50
2004 Athens Olympic Games	297	58.25**	55.32+	61.90
2003 World Championships	435	51.72	52.23	54.17
2001 World Championships	453	51.66	55.32*	62.50
<b>Total</b>	<b>1623</b>	<b>53.54**</b>	<b>54.55**</b>	<b>60.22*</b>
Total After 1 <sup>st</sup> Round	1252			
Total in the Medal Rounds	93			
<b>Female Athletes Only</b>				
2005 World Championships	307	53.09	54.32	50.00
2004 Athens Olympic Games	210	49.05	49.71	47.62
2003 World Championships	347	48.13	47.84	41.67
2001 World Championships	307	50.16	49.18	41.67
<b>Total Winning Percentage</b>	<b>1171</b>	<b>50.13</b>	<b>50.16</b>	<b>45.16</b>
Total After 1 <sup>st</sup> Round	961			
Total in the Medal Rounds	93			

+  $p < .10$   
 \*  $p < .05$   
 \*\*  $p < .01$

bottom players in competition that utilized only the white judogis, we found that males in the top position did *not* have a significant winning bias, 51.86% overall (total number of matches analyzed = 884), and 52.71% after the first round (total number of matches analyzed = 745) (both not significant). This suggests that the win bias for males when wearing the blue judogi occurred because they wore the blue judogi, and not because they were the top player in the bracket.

#### IV. Discussion

The results indicated that males, but not females, who wore the blue judogi, had a winning bias across the four international competitions examined. This bias got stronger as the tournament progressed, and increased across the four years analyzed. This bias was not existent for females, was not confounded by position effects for the top player, and did not occur because of the repechage.

Why might this bias exist? Ten years ago we predicted that such bias may occur because of several factors<sup>7)</sup>. Previous studies had already demonstrated that colors affect peoples' moods, physical strength, and performance on tasks<sup>1,6)</sup>. Color also affects object discrimination and judgments of objects<sup>4,5)</sup>. These factors may play a role in judo matches.

Hill and Barton, in fact, suggest exactly so<sup>2)</sup>. They suggest that color signals that are biologically programmed, sexually-selected, and testosterone-dependent are associated with dominance and aggression, especially in males. The face of angry humans, for instance, is flushed with color, while the face of fearful humans is pale. Similarly many males in the animal kingdom display vibrant colors associated with their dominance in social hierarchies. Because of these innate effects,

Hill and Barton argue that the color of uniforms can influence performance and outcomes, especially in combat sports such as judo, taekwondo, boxing, and wrestling. Such a theory could explain why the win bias occurs for players wearing the blue judogi, and only for the males but not females – males who wear the blue may become more aggressive during matches. Because the contest rules of judo are designed to reward more aggressive players, this might account for the win bias for males wearing the blue. The fact that the win bias for blue increases within tournaments and across years also supports the sexual selection hypothesis, because matches become more emotionally-charged as tournaments progress. Note in particular the overall win percentage at the Athens Games. The Olympics is more emotionally-charged than the world championships, and such a situation would, according to Hill and Barton's<sup>2)</sup> sexual selection hypothesis, exacerbate the win bias.

Another reason why the win bias might occur may be because color provides differential ability for object discrimination. In judo, this might work in several ways. Players may be able to sense action better when observing a white gi, giving the blue player an advantage. Conversely the blue gi against the colored background of the tatami might make blue's actions more difficult for the white player to discriminate. Thus there may be differential object discrimination bias occurring for the players.

Also, players who wear the blue judogis may also be viewed as more aggressive by referees. This would be consistent with the results of Frank and Gilovich, who showed that teams wearing black were judged as more aggressive by referees and laypersons<sup>3)</sup>. If players wearing the blue judogi are viewed as

more aggressive by spectators, their outcries during competition may influence referee calls and judgments.

Future research efforts should be directed to teasing these effects out experimentally. Studies may be conducted to alter judogi color in matches and have them viewed by referees and the lay public and judged for aggressiveness. Other studies may examine if wearing the blue or the white judogi indeed does produce the differences in mood, physical strength, and performance of the players. We strongly encourage those interested in this topic to conduct such studies to tease out these effects.

Moreover, if these findings are reliable, they suggest that judo leaders reconsider the use of blue v. white judogis in competition in order to level the playing field. To be sure, we do *not* argue in this article for a reversion back to the use of white judogis only. We agree that the use of different colored judogis has made international competition easier to watch for spectators, and easier to judge for referees. We do advocate, however, the support of the continued study of this issue by judo organizations around the world to examine these effects and their bases closely, and to make rational, informed decisions concerning these aspects of the contest rules to ensure the

safety and principles of fair play.

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## ブルーの柔道着は競技結果に影響をもたらすか

デビット・マツモト (サンフランシスコ州立大学)

金野 潤 (日本大学)

ステファニー・ハタ (カルフォルニア大学デイビス校)

武内 政幸 (大東文化大学)

### 要 約

柔道は名実共に世界の柔道に発展した。しかし、この柔道の国際化は競技における体重制の導入、さらにその細分化を進め、試合のルールにしても次第に微細な制約を設け、勝負の基準ブレイクダウンした柔道のスポーツ化、競技化の傾向に拍車がかかり、今日では柔道の哲学や価値観、モラル等の伝統的な考え方と相反することにもなっていると危惧を抱く議論も多い。中でも特に論議を呼んだのがカラー柔道着問題であった。

国際柔道連盟は試合をする選手的一方にブルーの柔道着を着用させることによって、審判や観客などが試合中の選手の動きや技の効果をより鮮明に見分けることが出来るように、国際大会においてブルー柔道着の導入を提案し、種々論議の結果、1997年に議決し、1998年1月より実施した。

我々は10年近く前のこの議論のなかで、レトリックや討論に頼るのではなく、科学的にこの問題を分析することが重要と考え「柔道におけるリーダーシップと科学の重要性—カラー柔道衣問題—」題し、本誌に発表した。

本研究は、国際大会においてブルー柔道着の導入後、柔道着の色によって試合の結果にバイアスがあるかどうかを社会心理学的に検討すべく、2001年、2003年、2005年の柔道世界選手権、そして、2004年アテネオリンピックという4つの大きな国際試合において、ブルーの柔道着を着ている選手の試合の勝率を分析した。

その結果、ブルーの柔道着を着ている男子の選手には勝率の高いバイアスが統計的に有意を得たが、女子にはなかった。さらに、このバイアスは試合の一回線から最後まで、そして2001年から2005年まで高くなった。

キーワード：柔道、柔道着の色、試合、偏りの結果