**////Title: Revealing How Table Tennis Could Be Transformed into a Popular Spectator Sport**

**////Standfirst:**

Rapid-fire rallies of short, fast shots are a defining feature of professional table tennis – but for many audiences, the excitement of these matches isn’t easily conveyed on the TV screen. Using a combination of computer simulations and statistical analysis, Professor Ralf Schneider and his colleagues at the Institute of Physics of the University of Greifswald, Germany, explore how slight changes to the game’s equipment could slow matches down, and make them more interesting to viewers. Karl Lüskow, Marc Marschall and Stefan Kemnitz produced and optimised the simulation code, while Lars Lewerentz performed statistical analysis of the data.

**////Main text:**

On a professional level, table tennis is one of the fastest-paced sports in the world. To gain an edge over their opponents, players must display lightning-fast reactions, as well as remarkable physical strength, as they aim to strike the ball as quickly and accurately as possible.

Despite the extraordinary skills of the world’s best players, table tennis is rarely followed as a spectator sport outside of Asia. Part of the problem is that the ball moves extremely fast, so it can be very difficult for spectators to follow its motion on a TV screen – ultimately making the sport less interesting to watch.

To raise the international appeal of table tennis, regulators have tried out several methods for slowing the pace of matches, allowing viewers to observe the skilful plays taking place. In their research, Professor Ralf Schneider and his colleagues use cutting-edge simulation techniques to assess the effects these changes have had on the game, and whether they could really help to popularise competitive table tennis for a global audience.

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In the year 2000, the size of a standard table tennis ball changed from 38 millimetres, with a mass of 2.5 grams, to a 40-millimetre, 2.7-gram ball. This larger size induces slightly larger drag forces as the ball moves through the air, causing it to slow down more quickly. In addition, a change to the ball’s mass distribution has made it more difficult for players to induce larger spins – which cause the ball to change its trajectory in mid-air.

Even after this change took place, the pace of competitive table tennis matches showed very little change. To compensate for the larger ball, players simply adapted their training programs to improve their physical fitness, allowing them to deliver stronger shots and larger spins.

One other proposed strategy for reducing match speeds is to increase net heights. This would make it difficult for players to deliver the straight, extremely fast shots which are characteristic of traditional rallies. However, since such a change could drastically alter the character of the game, many players are opposed the use of higher nets.

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Because of the limited success of larger balls in slowing the game down, and the potential controversy caused by an increase to net heights, discussions over how to reduce the breakneck pace of professional table tennis have become complex.

To study the impact of these changes, the usual approach would be to study their effects on real players. However, since players take time to adapt their strategies to new situations, the results of these studies couldn’t accurately reflect any long-term changes to the game.

To shed new light on the issue, Professor Schneider and his colleagues instead turn to computer simulations, which can solve equations describing the speeds, spins, and trajectories of balls across a vast array of starting conditions. The team’s study involved the use of graphics processing units. These specialised electronic circuits can rapidly manipulate the graphics displayed on a computer screen, making them ideally suited for processing large datasets with high efficiency.

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This approach allowed the researchers to analyse a vast database of table tennis ball trajectories, and assess the influence of both ball sizes and net heights on the mathematical equations governing their motion. In total, they simulated half a billion starting conditions – encompassing a diverse range of hitting locations, initial spins, and ball speeds.

Given these starting conditions, Prof. Schneider’s team used statistical analysis of the ball trajectories calculated by their graphics processing units to determine the likelihood of a successful shot – where the ball clears the net, and lands on the opponent’s side of the table. The team’s datasets considered three different ball sizes: 38 millimetres, 40 millimetres, and an even larger size of 44 millimetres. This ball has previously been used in Japan, and has a lighter weight of just 2.3 grams.

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As the team expected, their simulations revealed that the 38- and 40-millimetre balls displayed nearly identical trajectories across a broad range of starting conditions – meaning the likelihood of a successful shot displayed little change. Yet for the 44-millimetre ball, even when its initial speed was higher, reduced speeds induced by higher drag forces made it more likely for shots to succeed.

In addition, the smaller masses of these balls made it more difficult for players to induce both larger spins, and very high speeds – exceeding 35 metres per second. For Professor Schneider and his colleagues, this result presented a promising potential approach for slowing the game down. But just like after 2000, they predicted that players could still compensate for the change by improving their physical fitness, to deliver shots with even faster initial speeds.

For the 40-millimetre ball, a 3-centimetre increase in net height resulted in very clear changes to the character of the game. With starting speeds of roughly 10 metres per second, the researchers found that shots were far more likely to fail. Yet for very low starting speeds, where drag had very little impact on ball trajectories, chances of success significantly rose. In a real match, this would give opponents far more time to react, so to prevent them from returning shots, players would need to induce stronger sidespins, causing balls to move diagonally through the air. In addition, a slightly higher net would also reduce the influence of the serve.

Compared with existing tactics, where fast, straight trajectories are a key characteristic of long rallies, the team’s results clearly show how changes to ball sizes and net heights could transform the strategies required of successful players.

With a reduction in fast trajectories, rallies could become longer and more interesting to watch – though the question remains over whether players would be willing to change the very nature of their sport, simply to please viewers. All the same, Professor Schneider and his team hope that their results could help table tennis to become a popular spectator sport across the globe.

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