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Assessing the Reliability and Validity of a Modified Stop Signal Task with Sport-Specific Visual Stimuli in Measuring Inhibitory Control in Athletes

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Abstract

This study evaluated the reliability and validity of a Modified Stop Signal Task (mSST) specifically designed to measure inhibitory control in athletes. Unlike the traditional Stop Signal Task (SST), which relies on abstract arrow cues, the mSST incorporated sport-specific visual stimuli using colored teammate avatars (red and blue) as go signals and an opponent as the stop signal. A total of 21 male university students from UiTM Shah Alam participated, classified into three groups: sport-specific athletes, non-specific athletes, and non-athletes. Participants completed both the SST and mSST. Data were analyzed using SPSS Version 29, with reliability tested via Intraclass Correlation Coefficient (ICC) and validity assessed through Pearson correlations. Results indicated strong reliability for the mSST, with an average ICC of 0.818 ($p < 0.001$). Construct validity was also supported, with significant correlations between mSST and SST variables, particularly goRT_all and goRT_correct ($r = 1.000$, $p < 0.001$). However, SSRT did not show significant alignment ($p = 0.136$). These findings suggest that the mSST is a reliable and valid instrument for measuring inhibitory control, with enhanced ecological validity due to its sport-specific visual modifications. The task holds promise for cognitive testing in athletic populations, providing a more representative measure of inhibitory control in dynamic sporting contexts.

Keywords: athletes, inhibitory control, reliability, sports psychology, validity

1. Introduction

Inhibitory control, the ability to suppress prepotent responses in favor of goal-directed actions, is a key cognitive skill underpinning athletic performance. The Stop Signal Task (SST) is a widely used paradigm to measure inhibitory control. However, its reliance on abstract arrow cues limits ecological validity when applied to athletes, who typically respond to sport-specific visual information in fast-paced environments. To address this limitation, the Modified Stop Signal Task (mSST) was developed by replacing abstract cues with sport-relevant visual representations: teammates in colored jerseys served as go signals, while an opponent blocking the path acted as the stop signal. This modification was intended to improve ecological validity while maintaining the theoretical foundation of the SST. The present study aimed to evaluate the reliability and validity of the mSST among university students with varying athletic backgrounds. It was hypothesized that the mSST would demonstrate high reliability and strong construct validity compared to the traditional SST.

1. Methods

2.1 Research Design
This study employed a quantitative, experimental design to assess the psychometric properties of the mSST.

2.2 Participants and Procedures
Twenty-one male students (aged 18–25) from UiTM Shah Alam were recruited through convenience sampling. Participants were divided into three groups: sport-specific athletes, non-specific athletes, and non-athletes. Each participant completed both the General SST and the mSST in a controlled laboratory setting.

2.3 Instruments and Materials Used
The General SST presented arrow-based cues, while the mSST utilized teammate avatars in colored jerseys (red/blue) as directional go signals and an opposing avatar as the stop signal. Both tasks recorded measures such as goRT_all, goRT_correct, usRT, SSD, SSRT, and error rates.

2.4 Data Analysis
Statistical analyses were conducted using SPSS Version 29. Reliability was evaluated with the Intraclass Correlation Coefficient (ICC), while validity was tested using Pearson correlation between SST and mSST measures.

2.5 Ethical Considerations
Participation was voluntary, with informed consent obtained prior to testing. Confidentiality and the right to withdraw were guaranteed. Ethical approval was obtained from UiTM's Research Ethics Committee.

1. Results and Discussion

3.1 Demographic Overview
All participants (n = 21) were male students aged 18–25. The sample comprised 7 sport-specific athletes (33.33%), 7 non-specific athletes (33.33%), and 7 non-athletes (33.33%).

3.2 Reliability
The ICC for the mSST demonstrated strong reliability, with an average measure of 0.818 ($p < 0.001$). This indicates that the task consistently measured inhibitory control across participants, supporting its use in athletic populations.

3.3 Validity
Pearson correlation analysis revealed strong construct validity between the SST and mSST, with significant positive correlations across most variables. The strongest correlations were observed for goRT_all and goRT_correct ($r = 1.000$, $p < 0.001$), followed by usRT ($r = 0.968$, $p < 0.001$) and SSD ($r = 0.961$, $p < 0.001$). However, SSRT did not yield a significant relationship ($p = 0.136$), suggesting variability in how inhibition latency is captured between the two tasks.

These findings align with prior studies demonstrating the utility of task modifications to enhance ecological validity while maintaining psychometric robustness. By integrating sport-specific visual stimuli, the mSST better reflects the perceptual and cognitive demands athletes face in competition, where inhibitory control is critical for decision-making under pressure.

1. Conclusion

The Modified Stop Signal Task (mSST) demonstrated strong reliability and validity in assessing inhibitory control among university students, particularly athletes. With an ICC of 0.818 and significant correlations with the General SST on key measures, the mSST offers a robust and contextually relevant tool. The lack of alignment in SSRT suggests further refinement may be needed for latency-based metrics.

Nevertheless, the incorporation of sport-specific visual stimuli enhances ecological validity, making the mSST particularly valuable for research and practice in sports psychology. Future studies should include larger, more diverse samples, including female athletes, to strengthen generalizability and explore its application across different sporting contexts.

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