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Experimental Analysis of Human Dexterity Using the Purdue Pegboard Test

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Abstract

With the rapid advances in production technologies and modern manufacturing, manual operations still rely on human dexterity, making them susceptible to unexpected human errors. This study investigates human fine motor performance using the Purdue Pegboard Test (PPT), a standardized measure of manual coordination, speed, and precision. An experiment was conducted to examine the effects of participant characteristics such as gender, handedness, age, and prior fine motor experience on test performance. Fifteen student participants (aged 17-23) completed four test conditions: right, left hand, both hands, and assembly. Physiological data—including blood pressure (BP), body temperature (T), pulse rate (PR), and oxygen saturation (SpO_2)—were recorded before and after each task using vital signs monitor to examine possible correlations between physiological indicators and fine motor performance. Analysis revealed three distinct physiological response patterns: (1) strong cardiovascular reactors exhibited notable increases in blood pressure and pulse rate after the task, indicating elevated exertion or task-related stress (e.g., Participants 5, 9, and 13); (2) reversal or calming responders showed reductions in both blood pressure and pulse, suggesting adaptation or reduced anxiety following task engagement (e.g., Participants 1, 3, and 10); and (3) stable or mixed responders demonstrated minimal or inconsistent changes across measurements, reflecting physiological stability or individualized regulation (e.g., Participants 6–14). These patterns reflect individual differences in stress reactivity and concentration under fine motor performance conditions. Beyond industrial and manufacturing contexts, the findings also have relevance for healthcare settings, such as hospitals and clinical laboratories, where nurses and technicians rely heavily on fine motor skills and manual precision. Moreover, the collected data may also serve as abasis for future applications of artificial intelligence and machine learning aimed at optimizing human performance in industrial and healthcare settings.

Keywords
Human Dexterity, Fine Motor Skills, Purdue Pegboard Test, Physiological Responses

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