Seeking A New Way to Detect Human Impairment in the Workplace

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Objective: Human impairment in the workplace can have various causes, including fatigue, alcohol and drugs, with fatigue being the leading cause of accidents in the transportation industry. Traditional fitness-for-duty screening mostly targets alcohol and drug abuse through testing of urine, blood, hair, or breath analysis. These traditional tests are expensive, invasive and don't give instant results. They also require staff supervision and cannot be applied on a daily basis. However, newer concepts of impairment testing target fatigue and impairment, regardless of its cause, with instant results. Related development efforts include technologies based on cognitive and ocular measures. Here, we present a new cognitive impairment test. The BLT impairment test (developed by Bowles-Langley Technology, Inc.) is a brief, inexpensive, computerized shape recognition test (SRT) that requires the user to make a Yes/No decision about whether all items in a given screen are the same. After a series of 50 screens the resulting speed/accuracy-based score is compared to the user's baseline. For refinement and evaluation of the SRT, three studies were conducted: 1) a stability trial, 2) a laboratory sleep deprivation trial, and 3) a workplace feasibility trial with emergency department doctors. The goals were to optimize test design, to assess validity, reliability and sensitivity of the SRT, to refine the scoring algorithm, and to evaluate feasibility and acceptability in a workplace situation.

Methods: 1) Stability Trial: A total of 100 healthy subjects (aged 21 to 60 years) completed ten SRT sittings of about 15 minutes each using all of 100 different shapes. During each sitting, the subjects were presented with 250 screens including identical and different shape combinations. 2) Laboratory Sleep Deprivation Trial: Fifteen subjects (aged 25-50 years) participated in a two-day sleep restriction trial with three hours of sleep in the morning before the second test day. On each test day, they completed ten bi-hourly test sessions (starting at 1200). Each test included several subjective alertness/mood tests (e.g., Visual Analog Scales, Thayer Activation-Deactivation Adjective Checklist, Karolinka Sleepiness Scale), performance tests (5-min performance vigilance task, 25-min driving simulation task, 50-screen four-choice reaction time test), and four SRTs. 3) Workplace Feasibility Trial: Twenty physicians of a medical emergency department participated in testing on ten consecutive work shifts. Test sessions were conducted before, during and after each shift and included subjective alertness/mood tests, four-choice reaction time test, and two SRTs. Participants also completed sleep diaries and daily operational performance questionnaires, and post-study operational feasibility questionnaires.

Results and Conclusion: Using Item Response Theory analyses, the stability trial helped optimize the test design by adjusting for item difficulty. The results of the ongoing analysis of the laboratory and workplace trials suggest some association between the SRT and circadian factors. Correlations between the SRT and other measures were used to refine the SRT scoring algorithm (adjust the impact of accuracy and speed, of correct and incorrect responses, and of screens with similar and dissimilar items). Based on the observed variability it is concluded that the current test version may be more sensitive to severe impairment rather than reflect gradual alertness changes, and further test refinements aim to increase validity, reliability, and sensitivity. The workplace feasibility assessment indicated that the majority of the participating emergency doctors would find routine impairment screening acceptable, and that they believe such testing may encourage other fatigue management actions by employers.

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ABSTRACTS

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