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Attentional Processes

Victor S. Finomore, Jr., Tyler H. Shaw, Joel S. Warm, Gerald Matthews, and David B. Boles. *Viewing the Workload of Vigilance Through the Lenses of the NASA-TLX and the MRQ*. S. 1044-1063.

Objective: The objective of the paper is to understand leadership in an online community, specifically, Wikipedia. **Background:** Wikipedia successfully aggregates millions of volunteers' efforts to create the largest encyclopedia in human history. Without formal employment contracts and monetary incentives, one significant question for Wikipedia is how it organizes individual members with differing goals, experience, and commitment to achieve a collective outcome. Rather than focusing on the role of the small set of people occupying a core leadership position, we propose a shared leadership model to explain the leadership in Wikipedia. Members mutually influence one another by exercising leadership behaviors, including rewarding, regulating, directing, and socializing one another. **Method:** We conducted a two-phase study to investigate how distinct types of leadership behaviors (transactional, aversive, directive, and person-focused), the legitimacy of the people who deliver the leadership, and the experience of the people who receive the leadership influence the effectiveness of shared leadership in Wikipedia. **Results:** Our results highlight the importance of shared leadership in Wikipedia and identify trade-offs in the effectiveness of different types of leadership behaviors. Aversive and directive leadership increased contribution to the focal task, whereas transactional and person-focused leadership increased general motivation. We also found important differences in how newcomers and experienced members responded to leadership behaviors from peers. **Application:** These findings extend shared leadership theories, contribute new insight into the important underlying mechanisms in Wikipedia, and have implications for practitioners who wish to design more effective and successful online communities.

- **Keywords:** shared leadership; online communities; Wikipedia; feedback; transactional leadership; aversive leadership; directive leadership; person-based leadership

Biomechanics, Anthropometry, Work Physiology

Jennie A. Jackson, Priyanka Banerjee-Guénette, Diane E. Gregory, and Jack P. Callaghan. *Should We Be More on the Ball?: The Efficacy of Accommodation Training on Lumbar Spine Posture, Muscle Activity, and Perceived Discomfort During Stability Ball Sitting*. S. 1064-1076.

Objective: The aim of this study was to evaluate the efficacy of a 9-day accommodation protocol on reducing perceived discomfort while sitting on a stability ball (SB); trunk muscle activity levels and lumbar spinal postures were also considered. **Background:** Previous studies have compared SB sitting with office chair sitting with few observed differences in muscle activity or posture; however, greater discomfort during SB sitting has been reported. These findings may indicate an accommodation period is necessary to acclimate to SB sitting. **Method:** For this study, 6 males and 6 females completed two separate, 2-hr sitting sessions on an SB. Half the participants completed a 9-day accommodation period between the visits, whereas the other half did not use an SB during the time. On both occasions, self-reported perceived discomfort ratings were collected along with erector spinae and abdominal muscle activity and lumbar spinal postures. **Results:** Discomfort ratings were reduced in female participants following the accommodation; no effects on muscle activation or lumbar spine postures were observed. **Conclusion:** Accommodation training may reduce perceived low-back discomfort in females. Trunk muscle activity and lumbar spine postures during seated office work on an SB did not differ between groups; however, greater sample power was required to conclusively address these variables. **Application:** Regarding whether to use an SB in place of a standard office chair, this study indicates that females electing to use an SB can decrease discomfort by following an accommodation protocol; no evidence was found to indicate that SB chair use will improve trunk strength or posture, even following an accommodation period.

- **Keywords:** sitting; low-back pain; spine biomechanics; office work; ergonomics; chair design; discomfort

Sue A. Ferguson, W. Gary Allread, Peter Le, Joseph Rose, and William S. Marras. *Shoulder Muscle Fatigue During Repetitive Tasks as Measured by Electromyography and Near-Infrared Spectroscopy*. S. 1077-1087.

Objective: The objective of this study was to quantify shoulder muscle fatigue during repetitive exertions similar to motions found in automobile assembly tasks. **Background:** Shoulder musculoskeletal disorders (MSDs) are a common and costly problem in automotive manufacturing. **Method:** Ten subjects participated in the study. There were three independent variables: shoulder angle, frequency, and force. There were two types of dependent measures: percentage change in near-infrared spectroscopy (NIRS) measures and change in electromyography (EMG) median frequency. The anterior deltoid and trapezius muscles were measured for both NIRS and EMG. Also, EMG was collected on the middle deltoid and biceps muscles. **Results:** The results showed that oxygenated hemoglobin decreased significantly due to the main effects (shoulder angle, frequency, and force). The percentage change in oxygenated hemoglobin had a significant interaction attributable to force and repetition for the anterior deltoid muscle, indicating that as repetition increased, the magnitude of the differences between the forces increased. The interaction of repetition and shoulder angle was also significant for the percentage change in oxygenated hemoglobin. The median frequency decreased significantly for the main effects; however, no interactions were statistically significant. **Conclusions:** There was significant shoulder muscle fatigue as a function of shoulder angle, task frequency, and force level. Furthermore, percentage change in oxygenated hemoglobin had two statistically significant interactions, enhancing our understanding of these risk factors. **Application:** Ergonomists should examine interactions of force and repetition as well as shoulder angle and repetition when evaluating the risk of shoulder MSDs.

- **Keywords:** shoulder muscle fatigue; NIRS; EMG; musculoskeletal disorders

Cognitive Processes

Kanji Tanaka and Katsumi Watanabe. *Interference Between Accustomed Number–Space Mappings and Unacquainted Letter–Space Mappings in a Button Press Task.* S. 1088-1100.

Objective: We aimed to investigate how ordered mappings (e.g., left-to-right and right-to-left order representations) would interfere with each other. **Background:** Mental representations of numbers and letters are linked with spatial representation and can be changed intentionally. **Method:** The experiment consisted of three sessions. In the digit-alone session, two digits randomly selected from [1], [2], and [3] were shown. If the two digits were the same, participants pressed the button corresponding to the digit, and if the digits differed, they pressed the remaining button. The response buttons were ordered [1][2][3] from the left. In the letter-alone session, three different button configurations were prepared: sequential [A][B][C], reversed [C][B][A], or partially reversed [B][A][C]. The same-versus-different rules were basically identical to those in the digit task. In the mixed session, trials of the digit task and those of the letter task were randomly mixed. **Results:** We found that two ordinal representations did not interfere with each other when they shared the same direction of order ([1][2][3] vs. [A][B][C]), two ordinal mappings interfered with each other when they had different directions of order ([1][2][3] vs. [C][B][A]), and an ordinal mapping ([1][2][3]) was affected by a nonordinal mapping ([B][A][C]), but the nonordinal mapping was less affected by the ordinal mapping. **Conclusion:** The mapping between ordinal information and space can be modulated by top-down processes, and it is prone to interference depending on the nature of another coexisting mapping. **Application:** Our findings may be used in designing response assignments for input devices for multiple functions.

- **Keywords:** order representation; interference; number; letter; button configuration

Bum chul Kwon, Ji Soo Yi, and Yu Zhu. *ReadingMate: The Effect of the Content Stabilizing Technique, Font Size, and Interline Spacing on the Letter-Counting Task Performance of Treadmill Runners.* S. 1101-1111.

Objective: The aim of this study was to investigate the effects of font size, interline spacing, and a technology called ReadingMate on the letter-counting task performance of users running on a treadmill. **Background:** Few researchers have investigated how runners read text while running on a treadmill. Our previous studies showed that ReadingMate had positive effects on the reading-while-running experience; however, the effect of other text conditions (i.e., font size and interline spacing) and the interplay between ReadingMate and such text conditions on the letter-counting task performance are not clearly understood. **Method:** Fifteen participants were recruited for the experiment. There were three main factors: display types (normal and ReadingMate), font sizes (8, 12, 16, and 20 point), and interline spacing (1.0×, 1.5×, 2.0×, and 2.5×). The researchers employed a letter-counting task. The performance was measured regarding task performance time, success rate of counting the target letter *f*, and number of give-ups. **Results:** Overall, the letter-counting task performance while running on a treadmill improved as font size and interline spacing increased, as expected. ReadingMate was more effective than normal display particularly when text was displayed in a small font size and with dense interline spacing. **Conclusion:** When text must be displayed in a small font size and with dense interline spacing, ReadingMate can be used to improve the users' task performance. **Application:** Practical applications of ReadingMate include improving the text-reading experience in shaky environments, such as in aviation, construction, and transportation.

- **Keywords:** reading performance; reading while running; head tracking; font size; interline spacing; ReadingMate; treadmill; letter counting

Displays and Controls

Jing Chen and Robert W. Proctor. *Response–Effect Compatibility Defines the Natural Scrolling Direction*. S. 1112-1129.

Objective: We evaluated alternative scrolling methods on non-touch screen computer operating systems by comparing human performance in different scrolling conditions. **Background:** The scrolling directions on current operating systems are discrepant. Few researchers have investigated how scrolling method influences users' performance. The response–effect (R-E) compatibility principle can be used as a theoretical guide. **Method:** Experiments 1 and 2 involved two successive tasks (scrolling and target content judgment) to simulate how people scroll to acquire and use off-screen information. Performance in R-E compatible and incompatible conditions was compared. Experiment 3 involved a location judgment task to test the influence of target location. Experiments 4 and 5 included a scrolling effect following the location judgment task to test the sufficient role of the scrolling effect. **Results:** Overall, responses were facilitated when the response direction was compatible with the forthcoming display-content movement direction (an R-E compatibility effect), when the scrolling effect was task relevant or task irrelevant. A spatial stimulus–response (S-R) compatibility effect attributable to target location was also found. When the scrolling effect was present, there were both R-E and S-R components; the R-E effect was the larger of the two. **Conclusion:** Scrolling in the direction of content movement yielded the best performance, and the scrolling effect was the main source of the R-E compatibility effect. **Application:** These findings suggest that (a) the R-E compatibility principle may be used as a general design guideline for scrolling and (b) a consistent scrolling method should be available on various operating systems.

- **Keywords:** display–control compatibility; interface design; operating system; stimulus–response compatibility; non-touch screen scrolling; frame of reference

• Surface Transportation Systems

Johannes Beller, Matthias Heesen, and Mark Vollrath. *Improving the Driver–Automation Interaction: An Approach Using Automation Uncertainty*. S. 1130-1141.

Objective: The aim of this study was to evaluate whether communicating automation uncertainty improves the driver–automation interaction. **Background:** A false system understanding of infallibility may provoke automation misuse and can lead to severe consequences in case of automation failure. The presentation of automation uncertainty may prevent this false system understanding and, as was shown by previous studies, may have numerous benefits. Few studies, however, have clearly shown the potential of communicating uncertainty information in driving. The current study fills this gap. **Method:** We conducted a driving simulator experiment, varying the presented uncertainty information between participants (no uncertainty information vs. uncertainty information) and the automation reliability (high vs. low) within participants. Participants interacted with a highly automated driving system while engaging in secondary tasks and were required to cooperate with the automation to drive safely. **Results:** Quantile regressions and multilevel modeling showed that the presentation of uncertainty information increases the time to collision in the case of automation failure. Furthermore, the data indicated improved situation awareness and better knowledge of fallibility for

the experimental group. Consequently, the automation with the uncertainty symbol received higher trust ratings and increased acceptance. **Conclusion:** The presentation of automation uncertainty through a symbol improves overall driver–automation cooperation. **Application:** Most automated systems in driving could benefit from displaying reliability information. This display might improve the acceptance of fallible systems and further enhances driver–automation cooperation.

- **Keywords:** driving; reliability; cooperation; automation; symbol