



Assessing Functional Needs of Outdoor Climbing Pants

Dawn Michaelson, Karla P. Teel, Ph.D., Veena Chattaraman, Ph.D., Auburn University, AL,
and Helen Koo, Ph.D., University of California, Davis, CA

Keywords: Functional apparel, climbing pants, FEA model

Rock climbing, an extreme sport, has been increasing in participation by 9.5% over the past ten years, and currently the United States has over 11.2 million participants (Outdoor Foundation, 2014; U.S. Department of Agriculture Forest Service, 2012). Climbing pants are a cross-functional garment that need to fit properly, protect the climber, not restrict mobility, provide comfort, and be easy to don and doff (Gerrard, 1990; Gupta, 2011a; Gupta, 2011b). However, limited studies have undertaken research for developing climbing pants to meet these requirements. Functional considerations are paramount for rock climbing consumers since the garment is made to protect the climber during the activity, while providing proper fit, comfort, and mobility (Gupta, 2011a). Therefore, an exploratory study with mixed-methods was employed to gain in-depth understanding of functional needs of climbers for climbing pants by investigating fit, mobility, comfort, protection, and donning/doffing. The functional category of the Functional, Expressive, Aesthetic (FEA) Consumer Needs Model (Lamb & Kallal, 1992) formed the conceptual framework for this study.

The questionnaire utilized a mixed-methods approach with 5 questions pertaining to lower body fit (fit satisfaction, 8 items), mobility (wearer acceptability, 9 items) for 9 climbing techniques (belay, chimney, face, ledge/overhang/roof, lieback, mantle, rappel, stem, and traverse), comfort (subjective thermal comfort, 11 items), protection (durability; 6 items), and don/doff (2 items) with corresponding open-ended questions. Face validity of the questionnaire was determined with a climbing instructor and researchers. A total of 185 usable questionnaires were collected at two rock climbing events in the U.S. The sample included 126 males (68.1%) and 59 females (31.9%), representing 30 U.S. states and 10 countries, with an age range of 19 to 67 years ($M_{\text{male}} = 30$ years, $M_{\text{female}} = 27$ years). The sample was 63.8% single, 89.2% Caucasian, 45.4% had 3-5 years of climbing experience, 74.1% had an intermediate to advanced climbing skill level (74.1%), and 91.4% had climbed in the past week.

Scales revealed good reliability with Cronbach's alpha levels ranging from .737 to .869. Open-ended questions were analyzed with grounded theory and had good reliability with Kappa values ranging from 0.74 to 1.00. Repeated measures ANOVA's revealed a significant effect for fit (Wilks's $\Lambda = 0.796$, $F(7, 171) = 6.279$, $p < .001$, multivariate $\eta^2 = .20$), mobility (Wilks's $\Lambda = 0.751$, $F(8, 93) = 3.845$, $p < .001$, multivariate $\eta^2 = .249$), and comfort (Wilks's $\Lambda = 0.557$, $F(5, 173) = 27.478$, $p < .001$, multivariate $\eta^2 = .443$) on pant satisfaction. Tukey HSD post hoc tests on fit satisfaction using Bonferroni correction found six pairs were significantly different ($p < .05$); 1) length and calf, 2) waist and hip, 3) waist and calf, 4) crotch and calf, 5) thigh and calf, and 6) calf and ankle; mobility found fourteen pairs were significantly different based on the climbing technique ($p < .05$); comfort found all pairs but 1) stickiness and clinginess and 2)

roughness and prickliness to be significantly different ($p < .05$). Descriptive statistics revealed protection as ‘somewhat durable’ for abrasion and ‘very durable’ for rips and tears, seam failures, zipper failures, and fastener failures with problematic areas being knees (26.7%), seat (16.7%), and crotch (13.7%) with the ease of donning and doffing as ‘very good’. Open-ended questions revealed participants wanted improved pant fit in waist/crotch/hip (35%), more mobility in crotch/hip (33%), better comfort with fabric (43%), and improved donning/doffing with closures (37%) and fabric (30%). Additionally, participants suggested a functional pockets and fabric with more stretch and protection for improved fit/range of motion.

These results revealed climbers have only mild satisfaction with pant fit, slightly satisfying mobility that was impacted by the climbing technique, were uncomfortable after climbing and current pants only somewhat protected their knees, seat, and crotch. Findings from this study could be used by outdoor apparel designers and manufacturers to make improvements in their climbing pants. Improvements in climbing pant fit, design, and fabric performance would improve the overall functional pant performance and meet the needs of rock climbers.

- Bye, E., & Hakala, L. (2005). Sailing apparel for women: A design development case study. *Clothing and Textiles Research Journal*, 23(1), 45-55.
- Casselmann-Dickson, M. A., & Damhorst, M. L. (1993). Female bicyclists and interest in dress: Validation with multiple measures. *Clothing and Textiles Research Journal*, 11(4), 7-17.
- Chae, M., & Evenson, S. (2014). Prototype development of golf wear for mature women. *International Journal of Fashion Design, Technology and Education*, 7(1), 2-9.
- Dickson, M. A., & Pollack, A. (2000). Clothing and identity among female in-line skaters. *Clothing and Textiles Research Journal*, 18(2), 65-72.
- Gerrard, L. (1990). Non-technical gear. *Rock gear: Everybody's guide to rock climbing equipment* (pp. 333- 341). Berkeley, CA: Ten Speed Press.
- Gupta, D. (2011a). Functional clothing — Definition and classification. *Indian Journal of Fibre & Textile Research*, 36(December), 321–326.
- Gupta, D. (2011b). Design and engineering of functional clothing. *Indian Journal of Fibre & Textile Research*, 36(December), 327–335.
- Jin, H., & Black, C. (2012). Assessing functional and aesthetic clothing needs of young male tennis players. *International Journal of Fashion Design, Technology and Education*, 5(2), 145-150.
- Lamb, J. M., & Kallal, M. J. (1992). A conceptual framework for apparel design. *Clothing and Textiles Research Journal*, 10(2), 42-47.
- Outdoor Foundation. (2014). *Outdoor participation report 2014*. Retrieved from <http://www.outdoorfoundation.org/research.participation.2014.html>
- U.S. Department of Agriculture Forest Service. (2012). *Outdoor recreation trends and futures: A technical document supporting the forest service 2010 RPA assessment* (General Technical Report SRS-150). Retrieved from <http://www.srs.fs.usda.gov/pubs/40453>