



THE SCHOOL OF PHYSICAL EDUCATION, SPORT AND EXERCISE SCIENCES  
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## **Behavioural analysis of human response following sudden water immersion**

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This project was funded (99,475 NZ\$) by the Water Safety New Zealand federation ([www.watersafety.org.nz](http://www.watersafety.org.nz)) with the accreditation number 11/076. Sudden immersion in cold water represents a significant risk factor and a precursor associated with many drowning and near-drowning injuries. Whilst the physiological response to sudden cold water immersion (i.e., cold shock) is well established much less is known about the behaviours of humans experiencing this response. Initial indications suggest that the cold shock response is modifiable through habituation and mental skills training. The Phase 1 examined the effect of swimming ability upon the physiological and behavioural response to sudden water immersion (at either 27 °C or 10 °C within an aquatic flume). 44 participants were recruited for Phase 1, comprising 11 inexperienced, 17 recreational and 11 competitive swimmers. In Phase 2, the influence of cold water habituation and mental skills training on the cold shock response was examined for inexperienced swimmers.

The main current results show that participants experienced a sudden increase in breathing frequency upon immersion in the water and hyperventilation was much more pronounced in the cold water (i.e., on average from 39 to 59 breaths per second). Whilst swimming ability did not influence the presence of a cold shock response there was considerable variation in the severity particularly amongst the recreational and competitive swimmers. Cold water immersion also decreased brain blood flow velocity although this did not vary according to swimming ability. Participants were unable to swim as far, or for as long, in the cold water compared to the temperate water. The ventilation and brain blood flow responses appeared to be related but in general the behavioural data were not strongly associated with the physiological response. The behavioural intervention employed in Phase 2 resulted in marked improvements in participants' ability to suppress cold shock. The intervention group subsequently managed to swim further following the training. The self-perception of exertion while treading water decreased following training but only in the intervention group. As might be expected swimming ability did contribute to better performance in the simulated survival swim. However, even competitive swimmers could only manage on average to swim about 70 m having already been immersed in the cold water for up to 3 minutes. Cold water habituation combined with mental skills training is a powerful strategy to train inexperienced swimmers to suppress hyperventilation.