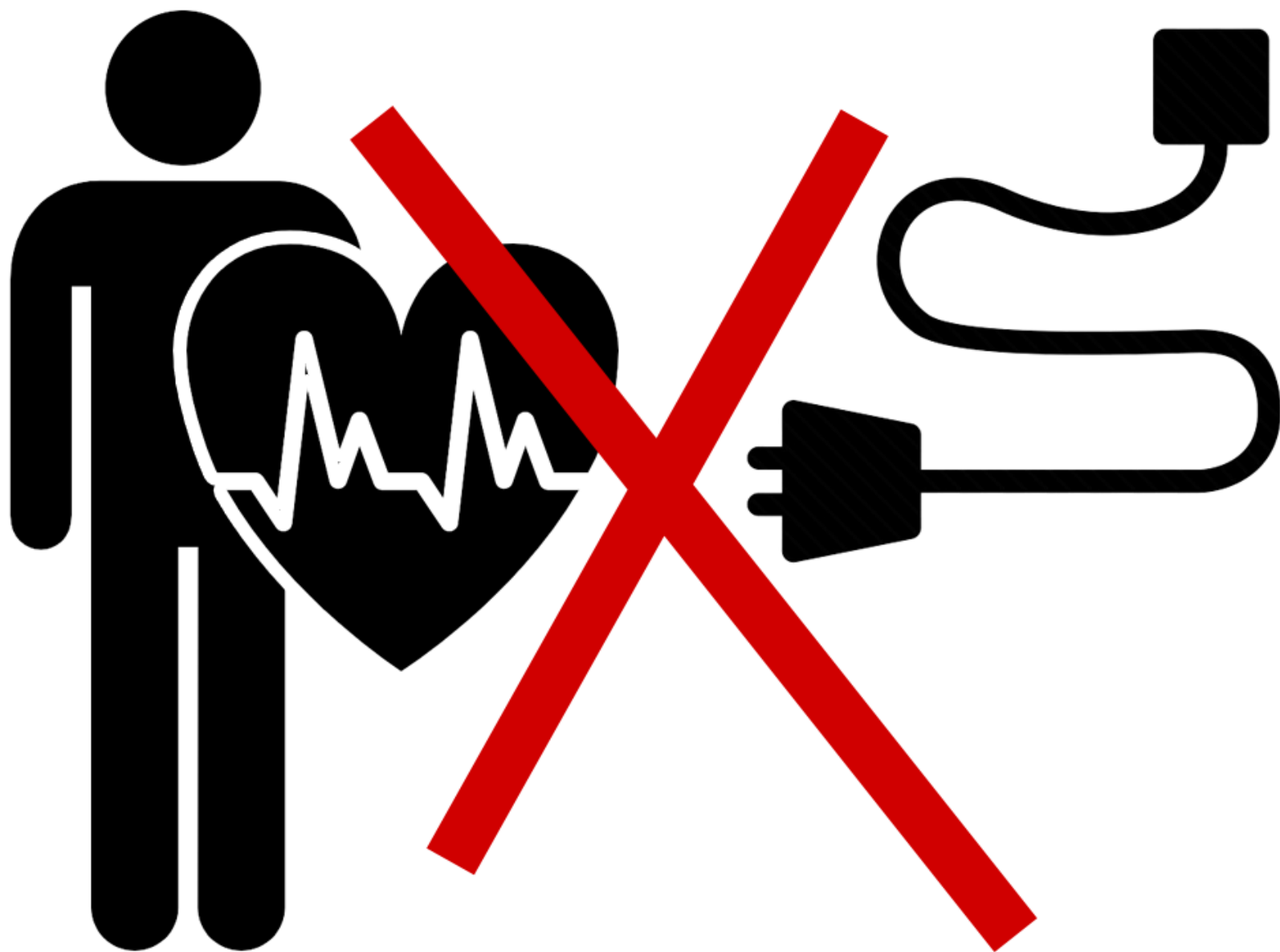
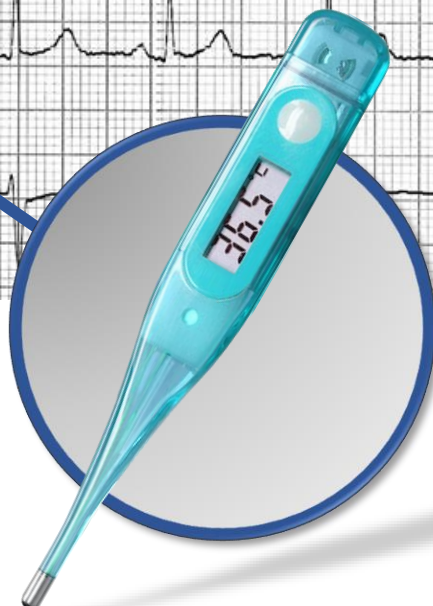
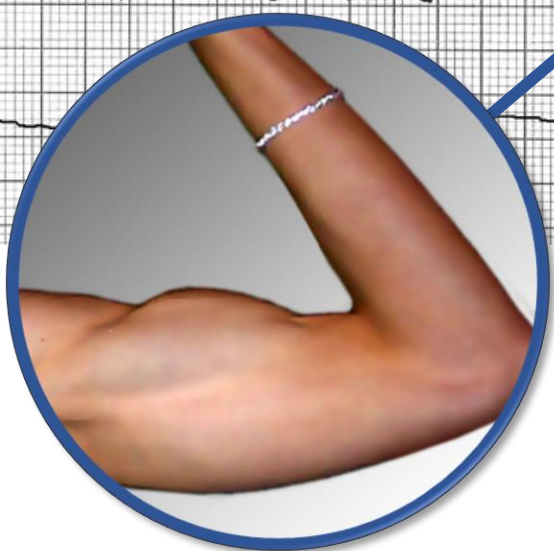
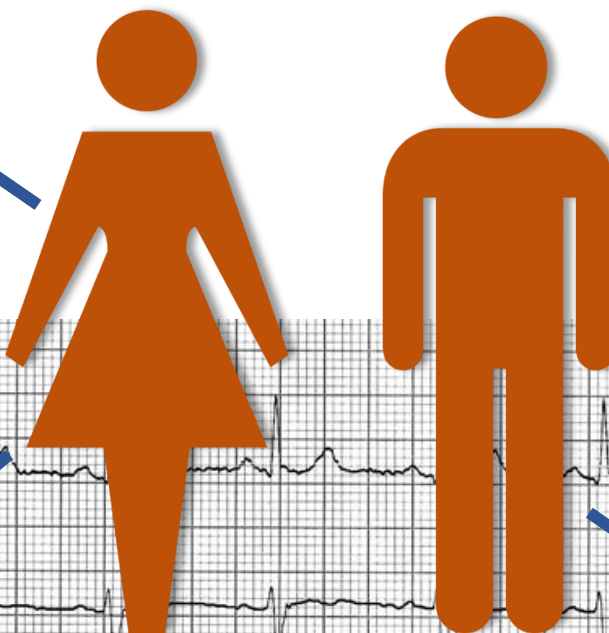
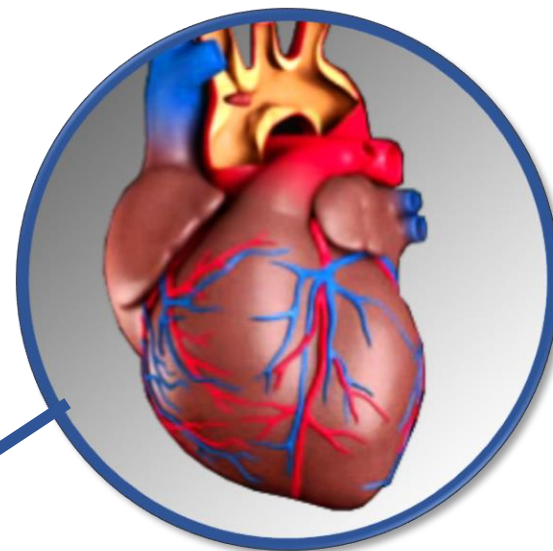
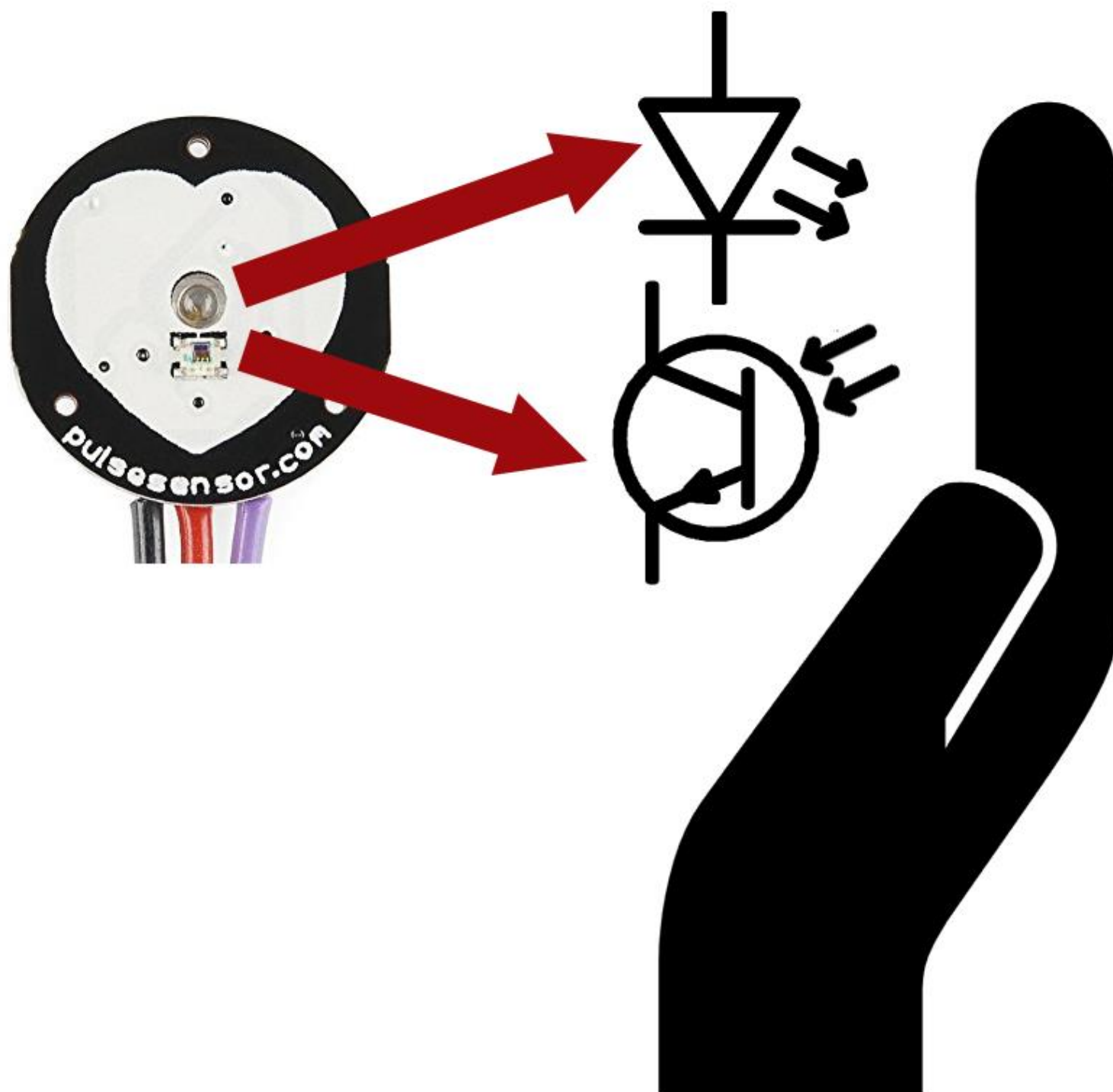


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Smartphone Applications Utilizing Biofeedback Can Aid Stress Reduction

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Introduction: Stress is one of the leading global causes of disease and premature mortality. Despite this, interventions aimed at reducing stress have low adherence rates. The proliferation of mobile phone devices along with gaming-style applications allows for a unique opportunity to broaden the reach and appeal of stress-reduction interventions in modern society. We assessed the effectiveness of two smartphone applications games combined with biofeedback in reducing stress.

Methods: We compared a control game to gaming-style smartphone applications combined with a skin conductance biofeedback device (the Pip). Fifty participants aged between 18 and 35 completed the Trier Social Stress Test. They were then randomly assigned to the intervention (biofeedback game) or control group (a non-biofeedback game) for thirty minutes. Perceived stress, heart rate and mood were measured before and after participants had played the games.

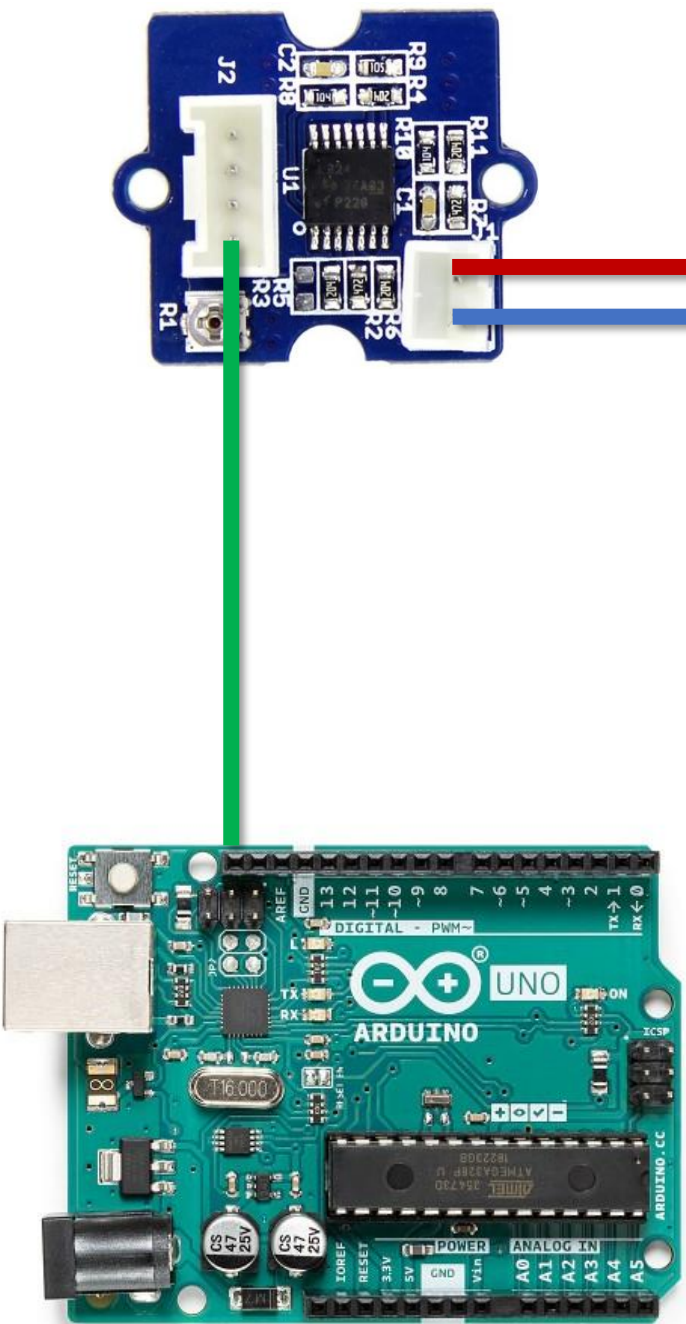
Results: A mixed factorial ANOVA showed a significant interaction between time and game type in predicting perceived stress [$F(1,48) = 14.19, p < 0.001$]. Participants in the biofeedback intervention had significantly reduced stress compared to the control group. There was also a significant interaction between time and game in predicting heart rate [$F(1,48) = 6.41, p < 0.05$]. Participants in the biofeedback intervention showed significant reductions in heart rate compared to the control group.

Discussion: This illustrates the potential for gaming-style smartphone applications combined with biofeedback as stress reduction interventions.

Keywords: stress, biofeedback, technology, skin conductance, electrodermal activity

INTRODUCTION

Stress is a major health problem (Kalia, 2002) which is associated with multiple causes of death including heart disease, cancer, and stroke (Cohen et al., 2007) and with most major mental health problems including depression, PTSD and anorexia (Marin et al., 2011). A recent paper from Harvard and Stanford Business Schools on mortality relating to stress, found that problems associated with job stress such as hypertension, cardiovascular disease and decreased mental health lead to 120,000 deaths in America each year (Goh et al., 2015). This makes work related stress and its associated maladies a greater source of morbidity than diabetes, Alzheimer's Disease or influenza. Additionally the study found that stress-related problems could be responsible for between 5 and 8% of annual healthcare costs in the US amounting to about \$180 billion per annum.





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