Effects of Music Engagement on Responses to Painful Stimulation

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Abstract

Background. Pain is a complex, unpleasant sensory and emotional somatic awareness normally associated with tissue trauma. Behavioral methods for modulating pain such as distraction have proven successful in both clinical and experimental settings but often with limited effect and with significant differences in benefit from individual to individual. The mechanisms by which distraction reduces pain are poorly understood.
Aims. We propose a theoretical framework for the behavioral modulation of pain based on constructivism, positing that task engagement, such as listening for errors in a musical passage, can establish a construction of reality that effectively replaces pain as a competing construction. Graded engagement produces graded reductions in pain as indicated by reduced psychophysiological arousal and subjective pain report.
Methods. Fifty-three healthy volunteers having normal hearing participated in four music listening conditions consisting of passive listening with no task or performing an error detection task varying in signal complexity and task difficulty. During all conditions, participants received normally painful fingertip shocks varying in intensity while stimulus evoked potentials (SEP) and pupil dilation responses (PDR), and retrospective pain reports (PR) were obtained.

Results. SEP and PDR increased with increasing stimulus intensity. Task performance decreased with increasing task difficulty. Mixed model analyses, adjusted for habituation/sensitization and repeated measures within person, revealed significant quadratic trends for SEP and PR ($P_{change}<0.001$) with large reductions from no task to easy task and smaller graded reductions corresponding to increasing task difficulty/complexity. PDR decreased linearly ($P_{change}<0.001$) with graded task condition.

Conclusions. We infer that these graded reductions in indicators of central and peripheral arousal and in reported pain correspond to graded increases in engagement in the music listening task. Engaging activities may prevent pain by creating competing constructions of reality that draw on the same processing resources as pain. Better understanding of these processes will advance the development of more effective pain modulation through improved manipulation of engagement strategies.
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