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Taking a break in response to pain. An experimental investigation of the effects of interruptions by pain on subsequent activity resumption

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HIGHLIGHTS

- Activity interruptions by pain impair subsequent resumption of the activity.
- This impairment is similar to that caused by interruptions by non-painful stimuli.
- Pain catastrophizing did not appear to influence the results.

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ABSTRACT

Background and aims: Interrupting ongoing activities with the intention to resume them again later is a natural response to pain. However, such interruptions might have negative consequences for the subsequent resumption and performance of the interrupted activity. Activity interruptions by pain may be more impairing than interruptions by non-painful stimuli, and also be subjectively experienced as such. These effects might be more pronounced in people high in pain catastrophizing. These hypotheses were investigated in two experiments.

Methods: In Experiment 1, healthy volunteers ($n = 24$) performed an ongoing task requiring a sequence of joystick movements. Occasionally, they received either a painful electrocutaneous or a non-painful vibrotactile stimulus, followed by suspension of the ongoing task and temporary engagement in a different task (interruption task). After performing the interruption task for 30 s, participants resumed the ongoing task. As the ongoing task of Experiment 1 was rather simple, Experiment 2 ($n = 30$) included a modified, somewhat more complex version of the task, in order to examine the effects of activity interruptions by pain.

Results: Participants made more errors and were slower to initiate movements (Experiment 1 & 2) and to complete movements (Experiment 2) when they resumed the ongoing task after an interruption, indicating that interruptions impaired subsequent performance. However, these impairments were not larger when the interruption was prompted by painful than by non-painful stimulation. Pain catastrophizing did not influence the results.

Conclusions: Results indicate that activity interruptions by pain have negative consequences for the performance of an activity upon its resumption, but not more so than interruptions by non-painful stimuli. Potential explanations and avenues for future research are discussed.

Implications: Interrupting ongoing activities is a common response to pain. In two experiments using a novel paradigm we showed that activity interruptions by pain impair subsequent activity resumption and performance. However, this effect seems to not be specific to pain.

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1. Introduction

Pain is a signal of bodily threat that motivates action and urges us to interrupt ongoing activities in order to control the pain [1,2]. Indeed, when feeling pain we often take a break from what we are doing, whilst planning to resume our activity later [3]. Despite the fact that such activity interruptions by pain are common, their effects on subsequent activity resumption remain unclear.

Although there is substantial research showing that task performance is impaired *during* pain [4–8], the research on whether task performance is impaired when pain forces the suspension of the activity *for longer time* is sparse [3]. People with pain complaints report continuing work outside working hours when their work-related goals were interrupted because of pain [9], indicating that various compensatory strategies may be used to counter the effects of interruptions by pain. Further, evidence suggests that healthy people scoring high in pain catastrophizing spend less time on a task when they are required to take breaks because of pain, compared to when they continue uninterrupted [10]. Systematic research regarding how activity interruptions by pain influence performance after the interruption, however, is missing.

Studies from the field of human factors and ergonomics have shown that interruptions caused by demands other than pain often impair performance of the interrupted task [11,12], for instance by increasing completion time and error rate [13,14]. The general premise is that, in order to resume a task successfully, one needs to encode task-related information in (prospective) memory when the interruption occurs and to further retain this information during the interruption [15,16]. Just as with interruptions by non-painful external stimuli (e.g., [11,12], interruptions by pain are expected to impair subsequent task resumption [3]. Further, given the biological relevance and urgency of pain, we expect that painful interruption cues interfere to a larger degree with the encoding of task-state information and are thus more disruptive than non-painful interruption cues. Moreover, an enhanced threat value of pain enhances its attentional capture [2,6] and might further impair the encoding at interruption and thus the subsequent resumption of the interrupted activity [3,10].

The present manuscript describes two experiments aiming at shedding light on the effects of interruptions by pain on activity resumption. In both experiments, healthy volunteers were interrupted while performing an ongoing task. Participants were interrupted by either painful (electrocutaneous) stimulation or non-painful (vibrotactile) stimulation (within-subjects), followed by temporary engagement in a different task. We hypothesized that receiving painful stimuli as interruption cues would impair task performance after task resumption, and that this impairment would be greater than the impairment caused by non-painful stimuli. We expected to see negative effects of interruptions by pain in task performance, and in subjective ratings of resumption difficulty and resumption motivation. Differences were expected to be more pronounced when pain was perceived as threatening, which is the case in people high in pain catastrophizing. Task difficulty might be a factor determining interruption effects. Therefore, in Experiment 2 we used a more complex ongoing task than in Experiment 1.

2. Experiment 1

2.1. Methods

2.1.1. Participants

Twenty-four healthy volunteers participated in the study. Exclusion criteria were: pregnancy; history of psychiatric or neurological diagnosis; presence of (acute or chronic) pain, cardiovascular disease, or other serious medical conditions; use of electronic implants (e.g., cardiac pacemaker); use of anxiolytic and/or antidepressive medication; imperfect command of the Dutch language; and impaired (uncorrected) eyesight. Exclusion criteria were checked by means of self-report at the beginning of each experimental session. Participants were students from Maastricht University, who participated on an informed consent basis in return for monetary compensation (€ 20). The study protocol was approved by the Ethical Review Committee Psychology and Neuroscience (ERCPN) of Maastricht University (study number: ECP-127 11_04_2013).

2.1.2. Experimental task

Participants performed an ongoing joystick task (cf. [17]) during which they occasionally experienced interruptions, i.e. time intervals during which the task was suspended. Interruptions were prompted either by a painful or by a non-painful interruption cue (see below *Interruption cues*). During the interruptions, participants performed a different task (interruption task), which aimed at engaging them in a similar way during ongoing task suspension. After fixed time on the interruption task, participants resumed the ongoing task at the point where they had been interrupted. A detailed description follows (see also Fig. 1):

Ongoing task. Throughout the ongoing task, one blue circle was presented at each of four target locations (top, bottom, left, and right) on a grey computer screen background. Each target location corresponded to each of four possible joystick movements (to the screen, to the participant, to the left and to the right, respectively). The start of each trial was cued by a white cross appearing between the target locations. Participants were required to move the joystick with their dominant hand to one of the locations as fast and as accurately as possible. During the first trial, a red frame appeared around one circle and cued the correct direction of the first movement (Fig. 1a). In subsequent trials, participants were required to make movements in a clockwise fashion (Fig. 1b), but no locations were cued. After every completed movement, the

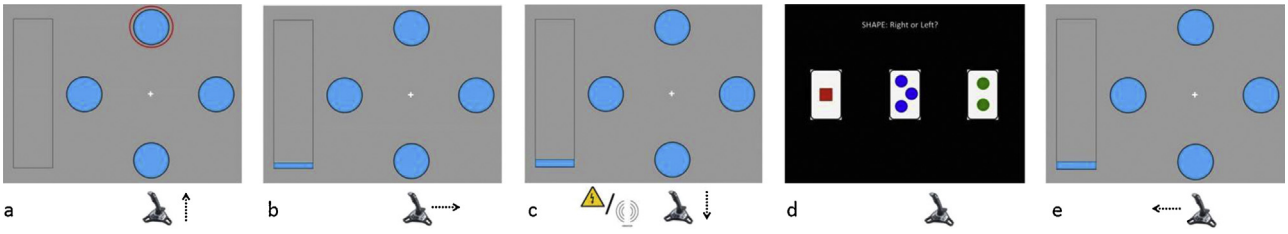

Fig. 1. Schematic representation of the Ongoing task and Interruption task trials (Experiment 1).
Four targets are presented on the screen. Participants are required to move a joystick towards the cued target in the first trial (panel a), and then continue making movements towards the targets in a way that follows a clockwise fashion (panel b). After each trial, a vertical bar that is presented on the left side of the screen and which indicates the total length of the ongoing task gets coloured in such a speed, that it is only completely coloured at the end of the task. An interruption cue, i.e. a painful electrocutaneous stimulus or a non-painful vibrotactile stimulus, is delivered on the wrist of the participant's dominant hand during randomly preselected trials (panel c). The interruption cue is followed by the suspension of the ongoing task and the initiation of the interruption task (panel d). On the first intertrial interval upon completion of 30 s on the interruption task, the screen configuration of the ongoing task is presented again (panel e). Participants are then required to resume the ongoing task with the next movement.