Biological Psychology 128 (2017) 1–10

Contents lists available at ScienceDirect

Biological Psychology

journal homepage: www.elsevier.com/locate/biopsycho

Neural correlates of prosocial behavior towards persons in pain in healthcare providers

Michel-Pierre Coll[a,b,c], Mathieu Grégoire[a,b,c], Fanny Eugène[b,c], Philip L. Jackson[a,b,c,*]

[a] École de psychologie, Faculté des sciences sociales, Université Laval, Québec, QC, Canada
[b] Centre interdisciplinaire de recherche en réadaptation et en intégration sociale, Québec, QC, Canada
[c] Centre de recherche de l'Institut en universitaire en santé mentale de Québec, Québec, QC, Canada

ARTICLE INFO

Keywords:
Healthcare providers
Pain
DLPFC
Prosocial

ABSTRACT

Pain perceived in others can be a stressful signal that elicits personal distress and discomfort that can interfere with prosocial behaviors. Healthcare providers (HCPs) have to be able to regulate these self-oriented feelings to offer optimal help to patients in pain. However, previous studies have documented a tendency in HCPs to underestimate the pain of patients that could interfere with optimal help to these patients. The aim of this study was to compare HCP and control (CTL) participants' prosocial behavior towards persons in pain and their associated brain responses. HCPs and CTL participants took part in a newly developed prosocial task during which they were asked to choose how much time they wanted to offer to help patients in pain. It was shown that compared to CTL participants, HCPs offered more help to persons in pain and reported less trait personal distress when facing suffering in others. Additional evidence was provided by the fMRI results, which indicated that compared to CTL participants, HCP participants showed different pattern of activity in the dorsolateral prefrontal cortex, bilateral precuneus and the posterior cingulate cortex during the prosocial task, suggesting that the underlying mechanisms of the difference in prosocial behaviors could vary according to the degree to which processes such as mentalizing and cognitive control are solicited.

1. Introduction

Working on a daily basis with patients in pain can be a trying experience for healthcare providers (HCPs). Indeed, witnessing others in pain can elicit a self-focused aversive reaction called personal distress (Batson, 1987; Eisenberg & Eggum, 2009; Eisenberg & Fabes, 1990). This negative response to the suffering of others often motivates behavioral responses aimed at rapidly diminishing one's own discomfort instead of offering help to alleviate the other person's suffering (Batson, 1991; Cialdini et al., 1987; Tice, Bratslavsky & Baumeister, 2001). Successful regulation of personal distress is therefore necessary to feel concern for others and offer optimal help to persons in pain (Eisenberg & Eggum, 2009; Eisenberg & Fabes, 1990). Consequently, HCPs in charge of treating pain in patients need to be able to adequately regulate this self-oriented response in order to produce other-oriented prosocial responses. A study on HCPs' neural response to pain in others has validated this idea by showing that HCPs had, compared to control participants, increased hemodynamic responses in regions associated with self-regulation when witnessing painful stimulations applied to patients, that is the medial prefrontal cortex (MPFC) and the dorsomedial prefrontal cortex (Cheng et al., 2007). Using a similar design, Decety and collaborators (Decety, Yang & Cheng, 2010) observed that physicians did not show the typical differentiation observed in control participants between electrocortical responses to pictures depicting painful and non-painful stimulations to patients. The authors interpreted this result as a down-regulation in HCPs of affective processing when perceiving pain in others, allowing them to allocate cognitive resources to the assistance of others. It is therefore plausible that this increased self-regulation of personal distress when confronted with others' suffering could make HCPs more able to offer help towards persons in pain than individuals with no clinical experience.

On the other hand, clinical expertise has also been linked with a tendency to underestimate the pain of patients compared to the patients' own estimation or the estimation of control participants (Cheng et al., 2007; Decety et al., 2010; Kappesser, de C. Williams & Prkachin, 2006; Prkachin, Solomon & Ross, 2007). This underestimation bias has been shown to extend across different settings and to increase with the amount of clinical experience (Gleichgerrcht & Decety, 2014; Solomon, 2001). The fact that more experienced clinicians tend to underestimate the pain of patients to a greater extent suggests that repeated exposure

* Corresponding author at: École de psychologie, Pavillon Félix-Antoine-Savard, 2325, rue des Bibliothèques Université Laval, Québec, Québec, G1V 0A6, Canada.
E-mail address: philip.jackson@psy.ulaval.ca (P.L. Jackson).

http://dx.doi.org/10.1016/j.biopsycho.2017.06.005
Received 20 May 2016; Received in revised form 27 April 2017; Accepted 29 June 2017
Available online 30 June 2017

to patients in pain could contribute to this bias (Prkachin et al., 2007). Several studies (Coll, Gr & goire, Prkachin, & Jackson, 2016; Gr & goire, Coll, Tremblay, Prkachin, & Jackson, 2016; Prkachin, Mass, & Mercer, 2004; Prkachin & Rocha, 2010) added support to this hypothesis by showing that participants with no healthcare experience briefly exposed to intense expressions of pain are subsequently less willing to consider moderate pain expressions as painful. One immediate consequence of this bias in HCPs could be the inadequate management of pain in patients. Indeed, if the pain of the other is perceived as less intense, it is likely that the observer will be less motivated to help relieve it (Prkachin, Kaseweter & Browne, 2015).

Based on studies indicating that HCPs show increased emotional regulation when witnessing pain, one would expect that they would offer more prosocial behavior towards persons in pain than non HCP individuals because they can regulate self-oriented feelings of distress more effectively. However, based on studies suggesting an underestimation of others' pain intensity in HCPs, one would expect that HCPs would offer less prosocial behavior to persons in pain because they perceive the pain of others as less intense than individuals with no healthcare experience. In order to shed light on these conflicting hypotheses, the present study compared HCPs and healthy control participants with no healthcare experience (CTL) on prosocial behavior towards persons in pain.

In a first experiment a behavioral paradigm was developed, in which participants were asked to decide the amount of help they would offer patients expressing various levels of pain, knowing that offering more help would help reduce the patients' pain but would have the undesirable consequence of lengthening the experimental task. In a second experiment, functional neuroimaging was used in order to provide additional insights into the cognitive mechanisms underlying this effect. New groups of HCP and CTL participants performed the same prosocial task in a functional magnetic resonance imaging (fMRI) setting. It was hypothesized that compared to CTL participants, HCP participants would show more prosocial behavior towards patients in pain and that this would be linked to reduced self-reported personal distress when witnessing others in pain and increased activation, during the observation of patients in pain, in regions associated with self-regulation such as the DLPFC and the MPFC and decreased activation in regions associated with affective responses to pain in others such as the anterior cingulate cortex (ACC) and the anterior insular cortices. It was also predicted that increased hemodynamic responses when witnessing pain in others in the DLPFC and MPFC would be linked with reduced self-reported personal distress and increased prosocial behavior.

2. Materials and methods

2.1. Participants

HCP and CTL participants were recruited through advertisements sent to a university e-mail list, and all participants gave written informed consent to take part in these studies. The *Institut de réadaptation en déficience physique de Québec* Research Ethics Committee approved both studies and participants received a monetary compensation for their involvement. All participants received a fixed monetary compensation independently of the time they spent helping during the experimental task. Exclusion criteria for both studies included any reported history of painful, neurological or psychiatric disorder. Additional exclusion criteria for the fMRI experiment included any contraindication to the MRI magnet, being over 40 years of age and being left-handed. Inclusion criteria for the HCP groups included having practiced a certified healthcare profession with direct contact with patients in pain for at least two years. All HCPs recruited in this study were either licensed physiotherapists or nurses that worked in a hospital or rehabilitation setting. Participants included in the CTL groups had not studied in, and had no previous work experience in a healthcare related field.

2.1.1. Behavioral experiment

Fourty-four participants took part in the behavioral version of the experiment. Twenty-two were HCP (two males, 20 females) aged on average 32.64 years (SD = 12.85); range: 21–57 years). There were six physiotherapists and 16 registered nurses with an average of 11 years of experience in their field (SD = 10.58, range: 2–35 years) and 14.90 years of education (SD = 1.44, range 12–18 years). The CTL group was composed of 22 participants (five males, 17 females) with an average of 31.50 years of age (SD = 9.012, range: 20–50) and 15.18 years of education (SD = 1.81, range: 12–18 years). For the analyses of the behavioral variables, data collected during the behavioral and fMRI experiments were pooled due to the similarity of the design performed. According to the G*Power 3 software (Faul, Erdfelder, Lang & Buchner, 2007), with an alpha significance threshold of 0.05 and 80% power, an effect size of d = 0.66 is necessary to find a group difference (two-tailed) using this sample size. This sample size was thus considered sufficient considering the larger effect sizes observed in previous studies comparing vicarious pain perception between HCP and CTL participants (Cheng et al., 2007; Decety et al., 2010).

2.1.2. fMRI experiment

Thirty new participants took part in the fMRI version of the experiment. HCP (five males, 10 females) were aged on average 28.47 years old (SD = 4.64, range: 23–38 years). Four were physiotherapists and 11 were registered nurses. The HCPs in the fMRI experiment had an average of 6.30 years of experience in their field (SD = 3.93, range: 3–15 years) and 15.53 years of education (SD = 1.64, range 13–18 years). The CTL sample was composed of 15 participants (five males, 10 females) with an average of 25.27 years of age (SD = 4.07, range: 20–35 years) and 15.37 years of education (SD = 1.36, range: 14–18 years). Participants in the HCP group were thus older than participants in the CTL group but this difference did not reach statistical significance [$t(28) = 2.01$, $p = 0.06$]. One participant in the CTL group was a replacement participant for a participant that moved excessively during fMRI scanning (over 20% of volumes removed due to motion-related artifacts, see below). This sample size was chosen based on a previous study successfully showing differences in brain responses during vicarious pain perception between HCP and CTL participants (Cheng et al., 2007).

2.2. Visual stimuli

The visual stimuli consisted of still frames extracted from 1 s clips from the University of Northern British Columbia-McMaster Shoulder Pain Archive (Lucey, Cohn, Prkachin, Solomon, & Matthews, 2011; Prkachin & Solomon, 2008). These clips consist in facial expressions of actual patients doing painful (affected limb) or non-painful (non-affected limb) shoulder range of motion tests in a supine position. The large majority of the patients selected (93%) were of Caucasian ethnicity, which is very similar to the population of Quebec and the recruited sample.

2.2.1. Behavioral experiment

Twenty clips of different patients (10 males, 10 females; 14 pain stimuli, 6 neutral stimuli [i.e., neutral facial expressions]) were used from the archive for the purpose of the behavioral study. For pain stimuli, six frames were extracted from each clip. A *test frame* was first chosen by visually inspecting the clip and selecting the peak in the pain expression of the patient. Four *feedback frames* were then visually selected from the same clip in order to illustrate a gradual decrease in the pain expressions. Finally, a *neutral frame* with the same patient expressing no pain was extracted from the same clip. For neutral stimuli, only a neutral frame was chosen. Stimuli were presented with E-Prime 2.0 software (Psychology Software Tools Inc., Sharpsburg PA, USA) on a 17-inch computer monitor located at approximately 60 cm from the participant, at a resolution of 704 × 480 pixels.