Neuroscience and Biobehavioral Reviews 81 (2017) 29–42

Contents lists available at ScienceDirect

Neuroscience and Biobehavioral Reviews

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

Review article

What's in a word? How instructions, suggestions, and social information change pain and emotion

Leonie Koban[a,b,*], Marieke Jepma[c,d], Stephan Geuter[a,b], Tor D. Wager[a,b]

[a] Institute of Cognitive Science, University of Colorado Boulder, United States
[b] Department of Psychology and Neuroscience, University of Colorado Boulder, United States
[c] Cognitive Psychology Unit, Institute of Psychology, Leiden University, The Netherlands
[d] Leiden Institute for Brain and Cognition, Leiden University, The Netherlands

ARTICLE INFO

Article history:
Received 8 November 2016
Received in revised form 6 February 2017
Accepted 14 February 2017

Keywords:
Placebo
Social conformity
Social influence
Observational learning
Hypnosis
fMRI
Fear
Emotion regulation
dlPFC
vmPFC
Appraisal
Expectation

ABSTRACT

Instructions, suggestions, and other types of social information can have powerful effects on pain and emotion. Prominent examples include observational learning, social influence, placebo, and hypnosis. These different phenomena and their underlying brain mechanisms have been studied in partially separate literatures, which we discuss, compare, and integrate in this review. Converging findings from these literatures suggest that (1) instructions and social information affect brain systems associated with the generation of pain and emotion, and with reinforcement learning, and that (2) these changes are mediated by alterations in prefrontal systems responsible for top-down control and the generation of affective meaning. We argue that changes in expectation and appraisal, a process of assessing personal meaning and implications for wellbeing, are two potential key mediators of the effects of instructions and social information on affective experience. Finally, we propose a tentative model of how prefrontal regions, especially dorsolateral and ventromedial prefrontal cortex may regulate affective processing based on instructions and socially transmitted expectations more broadly.

Contents

* Corresponding author at: Institute of Cognitive Science, Muenzinger Psychology D244, Boulder, CO, 80309-0345, United States.
E-mail address: leonie.koban@colorado.edu (L. Koban).

http://dx.doi.org/10.1016/j.neubiorev.2017.02.014
0149-7634/

1. Introduction

Instructions and suggestions are quintessential forms of everyday social influence. Using language, complex relationships in the environment can be described in an incredibly precise and nuanced way. With verbal instructions, humans can direct other humans' behavior much faster and more efficiently than any reinforcement schedule would allow in other species (Cole et al., 2013; Roepstorff and Frith, 2004). Other people's words can "plant" a very specific idea in someone's mind and—together with the right receptivity and mindset—they can constitute powerful influence on subjective experience. These ideas form the basis of multiple theories of conceptual learning (e.g. De Houwer, 2009; Kirsch, 2004) and related therapeutic approaches like acceptance and commitment therapy (e.g., Hayes, 2004). They go back to early theories on expectations and conceptual processes such as the 'New Look' (Bruner and Postman, 1948) and resonate with related contemporary ones emphasizing the role of expectations and conceptual thought in experience, such as levels of construal theory (Liberman and Trope, 2008), evaluative priming (Bargh et al., 2012), hierarchical Bayesian models of learning and decision-making (Tenenbaum et al., 2006), and predictive coding accounts (Friston, 2010; Rao and Ballard, 1999).

A dramatic case of how suggestions can affect experience and behavior is voodoo death: the observation that in primitive tribal societies people subjected to ritualistic spells and black magic can die within a couple of days or weeks, despite having previously been without any symptoms of disease (Cannon, 1942). In modern societies, people might be less susceptible to die from pure suggestion. Yet, there is accumulating evidence that different forms of instructions, suggestions, social observation, and other socially transmitted information can influence what we experience, how we interpret the world around us, and what we value. In this review, we focus on the "socially instructed" modulation of emotion and pain, which has been studied across different fields and using different paradigms.

We focus on four areas: First, learning by observing others ('observational learning') has long been studied in developmental psychology, including the development of aggression (Bandura et al., 1963), fear, and pain (Colloca and Benedetti, 2009; Goubert et al., 2011; Vögtle et al., 2013), and might be an important phylo- and ontogenetic precursor of more abstract forms of instructions and social influence effects. Recent brain imaging studies have addressed how adults learn about fear and reward by observing others (Olsson and Phelps, 2007). Second, social influence and conformity effects have been described extensively in social psychology, starting with the experiment of Asch (1951). Those influences can be based on observation of others' behavior or symbolic information about others' behaviors and preferences. During the last few years, social influence has been addressed in cognitive and social neuroscience using brain imaging methods, with a novel focus on affective processes such as valuation and emotion (Campbell-Meiklejohn et al., 2010; Klucharev et al., 2009; Zaki et al., 2011). Third, instructions about task goals and the structure of what participants should experience, usually given by an experimenter, are integral to most psychological experiments. Yet, cognitive psychology and cognitive neuroscience have often taken them for granted, and only recently have researchers turned their attention to how human brains learn about pain and emotion from direct verbal instructions (e.g., Atlas et al., 2016; Grings et al., 1973; Phelps et al., 2001). As specific examples of instruction effects, a literature on the brain correlates of placebo effects has been emerging (e.g., Petrovic et al., 2002; Wager et al., 2004), as well as a growing interest in understanding the neurophysiological processes underlying hypnosis (Rainville et al., 1999)—both of which are fascinating examples of how social instructions and suggestions can have deep impact on the experience of emotion and pain. Finally, recently, researchers have started to study how top-down instructions and social information may interact with bottom-up experience-based learning (e.g., Atlas et al., 2016; Biele et al., 2011; Jepma and Wager, 2015; Li et al., 2011; Staudinger and Büchel, 2013).

These topics are studied in different literatures, which in many cases make surprisingly little contact with each other. Here, we argue for a common basis, in socially transmitted conceptual thought. With socially transmitted, we mean that the source of the information is usually one or more other agents. Thus, transmission occurs via direct observation, but also via symbolic communication (e.g., language, signs). Conceptual thought refers to the activation and manipulation of interrelated concepts or patterns of concepts. They are typically conscious and relationships among different concepts can change depending on the context. Expectations are an example—thoughts about future outcomes. The topics discussed here are not the only instances in which socially transmitted conceptual thought may be important, but particularly informative for our understanding of emotion and pain. The aim of this review is therefore to describe these phenomena from an integrative perspective.

Across these topics, several key questions emerge. First, to what degree are the experience and physiology of pain and emotion influenced by ***instruction or social information alone?*** Some suggestion-related effects could be partially due to more experience-based associative learning such as classical conditioning. As we will discuss below, this point may be especially (but not only) important for placebo effects, during which instructions are often reinforced using conditioning procedures. Second, ***how deeply does socially transmitted information*** influence the fundamental processes that give rise to pain and emotion? Instructions may just lead to compliance, i.e. responding in line with the instructor without deeper changes in attitudes and experience (Asch, 1951; Cialdini and Goldstein, 2004; Milgram and Gudehus, 1978), or they may also change deeper levels of affective processing. This question has elicited considerable debate in the research on social conformity, but also in placebo and other social suggestion effects. Third, what are the ***underlying brain mechanisms*** and is there any common basis in brain systems across these different effects? We will argue that despite their differences, various types of social information effects may share some common mediators, especially changes in expectations and appraisal processes, which may be implemented in prefrontal brain systems and their interactions with limbic and subcortical brain circuits.