2009

The Neuroscience of Preferences

Samuel M. McClure

Jason Riis
University of Pennsylvania

The Neuroscience of Preferences

Abstract
The expression of preference reflects the influence of two broad modes of judgment—intuition and deliberation (Kahneman and Frederick 2002). The intuitive mode includes emotional reactions (e.g. Loewenstein 1996), but it also includes heuristic process which are largely perceptual or cognitive in nature. Intuitive processes occur early in a judgment process; they are fast and largely automatic. This is in contrast with deliberative processes which tend to occur later in a judgement process, are slower, and are more controlled. Intuitive and deliberative processes interact with each other, although they are often in conflict, and there is some evidence that they are anatomically separated in the brain.

Disciplines
Business | Cognition and Perception | Cognitive Psychology | Marketing

Risk factors

Among people exposed to trauma, certain variables are associated with risk for PTSD. Prospective longitudinal studies indicate that above average intelligence is not only associated with decreased risk of trauma exposure, it is associated with decrease risk of PTSD among the trauma-exposed (Breslau *et al.* 2006). Other variables associated with heightened risk of PTSD include smaller hippocampi (Gilbertson *et al.* 2002), elevated *neuroticism, and a family or personal history of anxiety disorders (Bowman and Yehuda 2004).

Psychobiological correlates of PTSD

About two-thirds of patients with PTSD exhibit psychophysiological reactivity when listening to audiotaped scripts of their traumatic experiences (Orr *et al.* 2004). Several neuroimaging studies suggest that PTSD is characterized by a hyperresponsive *amygdala, hyporesponsive prefrontal cortical regions, or both (Shin *et al.* 2004, McNally 2006). Other correlates include selective processing of threat-related cues in the emotional Stroop paradigm (a quantitative index of intrusive cognition) and a tendency to experience difficulties retrieving specific memories from one's past—perhaps reflecting a tendency to avoid thinking about disturbing material.

Treatment

Attempts to prevent the emergence of PTSD by conducting psychological debriefing procedures requiring cathartic expression of one's trauma days after it has occurred have failed (McNally *et al.* 2003). However, clinical researchers have been reasonably successful treating PTSD via *cognitive behaviour therapy (CBT) methods, especially in civilian survivors of trauma (Keane 2006). Core elements include correction of misconceptions about symptoms (e.g. flashbacks mean impending insanity; symptoms signify moral weakness); provision of anxiety management skills; prolonged imaginal exposure to traumatic memories until distress wanes; and *in vivo* (real life) exposure to avoided activities and situations reminiscent of the trauma. One recent study, however, indicated that cognitive restructuring added to prolonged exposure to traumatic memories was no more efficacious than prolonged exposure alone (Foa *et al.* 2005b). Finally, selective serotonin reuptake inhibitors are modestly efficacious in PTSD, but apparently less so than CBT (Keane *et al.* 2006).

RICHARD J. MCNALLY

Brewin, C.R. (2003). *Posttraumatic stress disorder: malady or myth?* New Haven, CT: Yale University Press.

Dalgleish, T. (2004). Cognitive approaches to posttraumatic stress disorder: the evolution of multirepresentational theorizing. *Psychological Bulletin*, 130, 228–60.

McNally, R.J. (2003). *Remembering trauma*. Cambridge, MA: Belknap Press/Harvard University Press.

McNally, R.J. (2006). Cognitive abnormalities in post-traumatic stress disorder. *Trends in Cognitive Sciences*, 10, 271–7.

power *Power* is one of the appraisal dimensions that determine the elicitation and differentiation of an emotion (see APPRAISAL THEORIES). It is related to the evaluation of *coping potential, an individual's assessment of his or her capacity to deal with an event which might threaten the *well-being of the person.

The appraisal of one's power to deal with such an event and its consequences corresponds to an assessment of one's resources to change a situation and its outcomes according to one's interests (Scherer 2001a). This implies that a situation is controllable, and that the outcome depends on one's own power to exert control (see CONTROLLABILITY). Power can be derived from many different sources, such as physical strength, money, knowledge, or attractiveness (French and Raven 1959). Perception of one's power in a given situation will critically influence the selection of action alternatives. For example, in situations of aggressive conflict, the comparison between the estimate of one's own power and the power of the opponent is likely to decide between anger/fight and fear/flight behaviour.

It is important to distinguish between power and control. Control refers to the likelihood that an event or its outcomes can be influenced by any natural agent. Power, on the other hand, refers to the perceived potential of the appraising individual itself to influence a potentially controllable event (maybe with the help of others). Assessments of control and power may lead to different ensuing emotions: situations characterized by a lack of control be associated with emotions such as hopelessness, whereas a lack of power might lead to feelings of helplessness. When used in the literature, control and power are not always clearly distinguished; 'controllability' often seems to imply both aspects.

TOBIAS BROSCH

preferences The expression of preference reflects the influence of two broad modes of judgement—intuition and deliberation (Kahneman and Frederick 2002). The intuitive mode includes emotional reactions (e.g. Loewenstein 1996), but it also includes heuristic process which are largely perceptual or cognitive in nature. Intuitive processes occur early in a judgement process; they are fast and largely automatic. This is in contrast with deliberative processes which tend to occur later in a judgement process, are slower, and are more controlled. Intuitive and deliberative processes interact with each other, although they are often in conflict, and there is some evidence that they are anatomically separated in the brain.

Many intuitive systems are emotional in nature. These include *fear and *disgust responses, as well as

reward responses. In the brain, fear and disgust responses are closely linked to the *amygdala and anterior insula. These areas show increased activity when people are exposed to frightening stimuli, but also when they are exposed to unpleasant flavours, or when they make moral judgements of condemnable acts. *Reward responses are mediated by the nucleus accumbens (NAcc) and ventromedial prefrontal cortex (VMPFC). These areas universally coactivate to rewards. While reward responses appear to occur largely automatically, they may be altered by category information. In one study, Plassmann *et al.* (2008) found that the VMPFC responds more strongly when participants thought they were tasting a higher-quality beverage (i.e. a more expensive wine), suggesting that categorical knowledge (in this case pertaining to pricing) can affect the raw reward experience.

Another set of processes commonly described as 'intuitive' are cognitive heuristics. Several such heuristics were posited by Tversky and Kahneman (reviewed in Kahneman and Frederick, 2002) in their demonstrations that many human judgements showed systematic deviations from rationality (see BOUNDED RATIONALITY). Specifically, such heuristics have been shown to lead to inconsistencies in risk preferences and temporal preferences. There are some situations in which such heuristics can be overridden by deliberative processes, and there are individual differences in the likelihood of recruiting such deliberative processes.

Deliberatively derived preferences are believed to be mediated by a network of brain areas, principal among which is the dorsolateral prefrontal cortex (DLPFC). The DLPFC supports basic cognitive processes such as working memory and the initiation of behaviours based on long-term *goals (Miller and Cohen 2001). Damage to the prefrontal cortex in humans causes behaviour to be abnormally dependent on immediate environmental stimuli and leaves people unable to consider or maintain long-term goals.

While intuition- and deliberation-related brain areas can be separately identified, brain anatomy also indicates that they are not independent. The DLPFC is directly connected to the regions previously mentioned to be implicated in emotions. Some data indicate that regions in the medial prefrontal cortex appear to mediate between emotion and cognition. Patients with lesions in the medial prefrontal cortex show evidence of producing both emotional and rational valuations, but are unable to apply emotion in making decisions (Bechara *et al.* 1999) (see DECISION-MAKING).

It is not necessarily the case that preferences derived from deliberative processes are superior to those derived from intuitive processes. An early demonstration of this was by Wilson and Schooler (1991), who found that people were happier with product choices when they relied on first impressions (i.e. 'intuition'), rather than taking the time to think about reasons why one item might be better than another (i.e. 'deliberation').

At the same time, however, there is considerable evidence that more rational choices (i.e. those that maximize a person's utility) are derived through deliberative processing in the DLPFC. For example, Sanfey *et al.* (2003) found that choices to accept small awards in the ultimatum game we accompanied by greater DLPFC activation than were choices to reject equivalent offers. Rejections were predicted by greater activity in the insula, suggesting that these responses were based on an intuitive anger response rather than on a deliberative calculation of utility.

Deliberative choice processes are not triggered in all situations, and there is evidence that there are individual differences in the tendency for such processes to trigger. One anatomical region thought to be involved in this triggering is a brain region known as the *anterior cingulate cortex (ACC). Botvinick *et al.* (2001) suggested that the ACC is a conflict monitor, responsible for recognizing situations when decisions include conflicting response options. Upon detection of conflict, the ACC is believed to recruit deliberative decision processes of the DLPFC.

The 'systems' account of decision-making and preference has a long history in philosophy and psychology, and it is beginning to find support from neurobiology, but this latter effort is still in its infancy.

SAMUEL M. MCCLURE AND JASON RIIS

Plassmann, H., O'Doherty, J., Shiv, B., and Rangel, A. (2008). Marketing actions can modulate neural representations of experienced pleasantness. *Proceedings of the National Academy of Sciences USA*, 105, 1050–4.

Sanfey, A.G., Rilling, J.K., Aronson, J.A., Nystrom, L.E., and Cohen, J.D. (2003). The neural basis of economic decision-making in the ultimatum game. *Science*, 300, 1755–8.

pride Pride is the experience of one's positive social worth, a signal that one is likely to be socially accepted. Pride does not require the actual presence of approving others. It ensues from a favourable comparison between one's behaviours and one's self-standards (Lewis 2000a) (see IDEAL SELF). Self-standards are derived from internalized social standards.

The experience of pride is cognitively complex. It requires objective self-awareness, or the realization that you are being evaluated as a social object. Not surprisingly, the ability to experience pride occurs relatively late in development, as it coincides with the development of the self-concept. Children are about 2½ to 3 years of age when they show behaviours that

The Oxford Companion
—TO—
Emotion and the Affective Sciences

EDITED BY
DAVID SANDER AND KLAUS R. SCHERER

OXFORD
UNIVERSITY PRESS

OXFORD
UNIVERSITY PRESS

Great Clarendon Street, Oxford OX2 6DP

Oxford University Press is a department of the University of Oxford.
It furthers the University's objective of excellence in research, scholarship,
and education by publishing worldwide in

Oxford New York

Auckland Cape Town Dar es Salaam Hong Kong Karachi
Kuala Lumpur Madrid Melbourne Mexico City Nairobi
New Delhi Shanghai Taipei Toronto

With offices in

Argentina Austria Brazil Chile Czech Republic France Greece
Guatemala Hungary Italy Japan Poland Portugal Singapore
South Korea Switzerland Thailand Turkey Ukraine Vietnam

Oxford is a registered trade mark of Oxford University Press
in the UK and in certain other countries

Published in the United States
by Oxford University Press Inc., New York

First published 2009

British Library Cataloguing in Publication Data

Data available

Library of Congress Cataloging in Publication Data

Data available

Typeset by SPI Publisher Services, Pondicherry, India
Printed in Great Britain
on acid-free paper by
CPI Antony Rowe, Chippenham, Wiltshire

ISBN 978-0-19-856963-3

1 3 5 7 9 10 8 6 4 2

Contents