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Unconscious priming dissociates 'free choice' from 'spontaneous urge' responses

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ABSTRACT

Advances in neuroscience offer the exciting prospect of understanding 'free' choices – the subject of the free will debate in philosophy. However, while physiological techniques and analysis have progressed rapidly to meet this challenge, task design has not. The challenge is now to develop laboratory tasks that adequately capture 'free' picking or choosing. To isolate 'internally' generated intentions from those impelled by external stimulus, observers are asked to 'choose freely' or to wait for a felt 'urge'. However, no previous work has explicitly distinguished between instructions that refer to 'urges' versus to 'choosing'. The philosopher Alfred Mele (e.g., 2009; 2014) has argued that the distinction is of crucial conceptual importance, but the two have not yet been empirically distinguished. Here, we show that conscious and unconscious, task-irrelevant primes, bias observers' binary choices when they are instructed to 'choose freely', not when they 'wait for an urge', underscoring the practical importance of Mele's conceptual distinction. Neuroscience must incorporate this distinction if we are to understand processes underpinning free choice.

1. Introduction

Human decision-making is accompanied by a compelling, subjective sense of being able to do otherwise: that our choices are not exhaustively determined by the reasons we cite for them, but rather are 'up to us' (e.g., Searle, 2001a, 2001b; Haggard, 2008; Griffith, 2005, 2010). The philosophical problem of 'free will' is a debate, rooted in antiquity, about how such subjective freedom is best reconciled with our understanding of human agents as physical systems – how our decisions are related to their non-conscious antecedents and, separately, in what sense the brain's conscious processes hold authorship of our choices. In philosophy, libertarian views hold that choices are not exhaustively pre-determined by their psychological- or physiological- antecedents (e.g., Kane, 1998; Searle, 2001b; Clarke, 2006; Tse, 2013). Conversely, most modern perspectives assume that choices *are* predetermined and that this is either *compatible* with choices being in some senses 'free' and 'up to us' (Dennett, 1984, Frankfurt, 1969; Holton and Will, 2006; Holton, 2009) or the two claims are *incompatible* and our choices are not free (e.g., Honderich, 1988; Wegner, 2002, Harris, 2012; Pereboom, 2001). Philosophy has articulated the limitations of each view, but a firm resolution will require measurement of those brain processes responsible for choice.

For > 30 years, to address this debate, neuroimaging and stimulation techniques have been exploited to predict, and to manipulate, choices. The essential logic of those studies was that if physiological measures could be used to predict (or to control) which choice a person would make, before they themselves reported being aware of making the choice, their choice would likely have been pre-determined, contrary to libertarian views. Moreover, if it could be demonstrated that processing *akin to intention* could be

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measured prior to conscious intention emerging, this may undermine the association of intentional-action and conscious awareness.

Libet's pioneering experiments used readiness potentials (Bereitschaftspotentials, BPs; Kornhuber & Deecke, 1965; a slowly rising signature in EEG preceding voluntary movement) to predict *when* observers would choose to make a button-press with their index finger (e.g., Libet, Gleason, Wright, & Pearl, 1983; Libet, 1985). In those studies, the instructions to observers made reference to letting 'the *urge* [our italics] to act appear on its own at any time without any preplanning or concentration on when to act'. Subjects were also asked to note the earliest awareness of the specific *urge or intention* to act, and to note the 'clock' position of a dot travelling in a circular path at 1 rotation every 2.5 s. The RP began around 350 ms prior to the estimated time of conscious awareness of the *urge, wish*, or decision to move, prompting Libet to suggest that, contrary to lay understanding of conscious free-will, the urge or choice to move had been determined by unconscious processes prior to the apparent moment of conscious choice.

While initial reaction to Libet's work was mixed, those tasks were a pioneering attempt to target internally generated responses in a task, rather than those elicited and controlled by external stimulus. Only *internally* generated responses could satisfy the requirement (for addressing 'free will') of unambiguously being 'up to' the observer. Self-evidently, the *general* type and timing of choices in the laboratory will never be free of task demands - the experimenters clearly want observers to make *some* responses during the session, and for responses to be of a very particular kind (index-finger button presses). However, the *specifics* of observers' responses in the task (the timing, and in later examples, the nature specific response) *were* effectively up to the observer.

Following Libet's example, subsequent work has predicted of observers' choices made on the basis of *urges*. For example, Soon, Brass, Heinze, and Haynes, (2008) used fMRI to predict 'free' decisions in a freely paced motor-decision task; observers were asked, when they felt the urge to do so, to freely choose between pressing one of two buttons with their left or their right index fingers. Brain activity of prefrontal and parietal cortex encoded which button would be pressed by up to 10 s before their estimate of observers' reported conscious decision (see also, Bode et al., 2011). This method was subsequently extended by Soon, He, Bode, and Haynes, (2013) to more abstract choices. Observers chose either to add or to subtract numbers *when they felt the urge* to do so.

There is also compelling evidence for a causal role of particular brain areas in generating either urges or free-choices. Fried et al., (1991) stimulated the supplementary motor area (SMA) in patients with intractable epilepsy, eliciting a subjective '*urge' to perform a movement*, or an '*anticipation*' that a movement was going to occur. Similar findings were obtained by Lim et al., (1994) and Desmurget et al., (2009); stimulation of posterior parietal cortex elicited spontaneous reports of "will," "desire," and "wanting to move".

As this brief review illustrates, there is substantial evidence that cortical activity predicts and influences *either* free choices or urges, or both of these. It has also become clear the distinguish responses on the basis of free-choice versus of felt urges; however, there has been no systematic effort, yet, to do so empirically (e.g., Mele, 2009; Roskies, 2010; Bayne, 2011). Exactly what observers understood by an 'urge' in free-choice paradigms has proven difficult to ascertain - perhaps a bodily sensation, perceptual correlates of a motor plan or of being 'about to move'. It is clear that an 'urge' to act, in everyday life, can be distinguished from forming an intention to act- someone who has quit smoking may feel a strong urge to smoke, but not decide to do so. However, in laboratory free-choice tasks that explicitly minimise stimulus-induced or bodily-state driven urges, this distinction becomes blurred. Perhaps, when a observer is asked to respond when they feel a *spontaneous* 'urge to do so', they interpret this as an instruction to make a spontaneous free choice of the type(s) that interest philosophers; perhaps not. Note, too, that this issue cannot be satisfactorily resolved by arguments about what observers understand by an 'urge'. Instead, only a clear *empirical* dissociation of the two tasks will suffice. If responses made under instructions to press one of two buttons when the observer 'feels an urge' to do so (an 'urge' instruction) were to differ markedly from those when the observer is asked simply to choose freely (a 'free choice' instruction), this would provide strong evidence that observers in previous studies had not processed urges in the same way as decisions. Here we report, to our knowledge, the first direct *objective* comparisons of responses made under urge and free-choice instructions, finding different effects of unconscious (or barely-perceptible) stimuli and conscious stimuli (in Experiment 3) upon performance in both of two experiments.

To anticipate our conclusions, the current experiments find clear behavioural evidence of a dissociation between responses when observers are instructed to make *free choices* to act versus when observers are instructed to act on the basis of felt *urges*. This dissociation is evident in the effect that task-irrelevant prime stimuli exert on behaviour. Previous reports suggested that such stimuli, even when unconsciously perceived, can influence volitional executive processes and responses when observers are asked to make free choices (Lau & Passingham, 2007; Kiesel et al. 2006; Ansorge, Kunde, & Kiefer, 2014; Manly et al., 2014). Such findings presented an opportunity to compare the effects of unconsciously-perceived stimuli on responses made under urge versus free choice instructions. In the first experiment, we sought to establish associations between each of two unconsciously-perceived prime shapes and a left or right hand response, then to measure the effect of presenting these primes on responses when observers were asked either (i) to make a *free choice* as to which finger to press with, or (ii) to wait for an *urge* to press with either finger and then act upon it. We expected the masked prime shapes to affect processing in the free choice task, given previous results, but did not make a prediction for the effect under urge instructions. In brief, the first experiment was designed to create the conditions in which actions on the basis of urge-based versus free-choice instructions might be dissociated.

2. Experiment 1 – Simple prime-response associations established in training phase

As outlined above, our first study exploited a procedure employed by Zhou & Davis (2012) to establish stimulus–response associations between arbitrary, unconsciously-perceived prime shapes and left or right index-finger button presses. These associations have been found to influence subsequent free choices – if the associated prime is presented prior to an instruction to choose freely between a left or right button press. As such effects can be highly labile and vulnerable to differences in displays and timing, we first ran a pilot experiment to establish that such effects would arise using the procedure and apparatus used in Experiment 1. This is not