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Research report

Learning to be inflexible: Enhanced attentional biases in Parkinson's disease

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ABSTRACT

Impaired attentional flexibility is considered to be one of the core cognitive deficits in Parkinson's disease (PD). However, the mechanisms that underlie this impairment are contested. Progress in resolving this dispute has also been hindered by the fact that cognitive deficits in PD are heterogeneous; therefore, it is unclear whether attentional impairments are only present in a subgroup of patients. Here, we demonstrate that what differentiates PD patients from age-matched controls is an inability to shift attention away from previously relevant information (perseveration) and an inability to shift attention towards previously irrelevant information (learned irrelevance). In contrast, there was no evidence that PD patients, compared to controls, were impaired in being able to appropriately attend to, or ignore, novel information. Furthermore, when patients were stratified according to their level of executive impairment, the executively impaired group showed a selective deficit in set formation compared to the unimpaired group, a behavioural pattern reminiscent of cortical dopamine depletion. Cumulatively, these results suggest that cognitive inflexibility in PD relates to a specific form of attentional dysfunction, in which learned attentional biases cannot be overcome.

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1. Introduction

Efficient functioning in the world requires that we are able to form and shift attentional sets (Fig. 1). Impaired attentional set-shifting is thought to constitute one of the core cognitive

deficits found in Parkinson's disease (PD). Support for this claim comes from investigations that have utilised the Wisconsin Card Sorting Task (WCST) (Grant & Berg, 1948) and analogue tests, and reported that PD patients are impaired in the ability to form and shift an attentional set with aberrant frontostriatal processing (Downes et al., 1989; Gerrits et al.,

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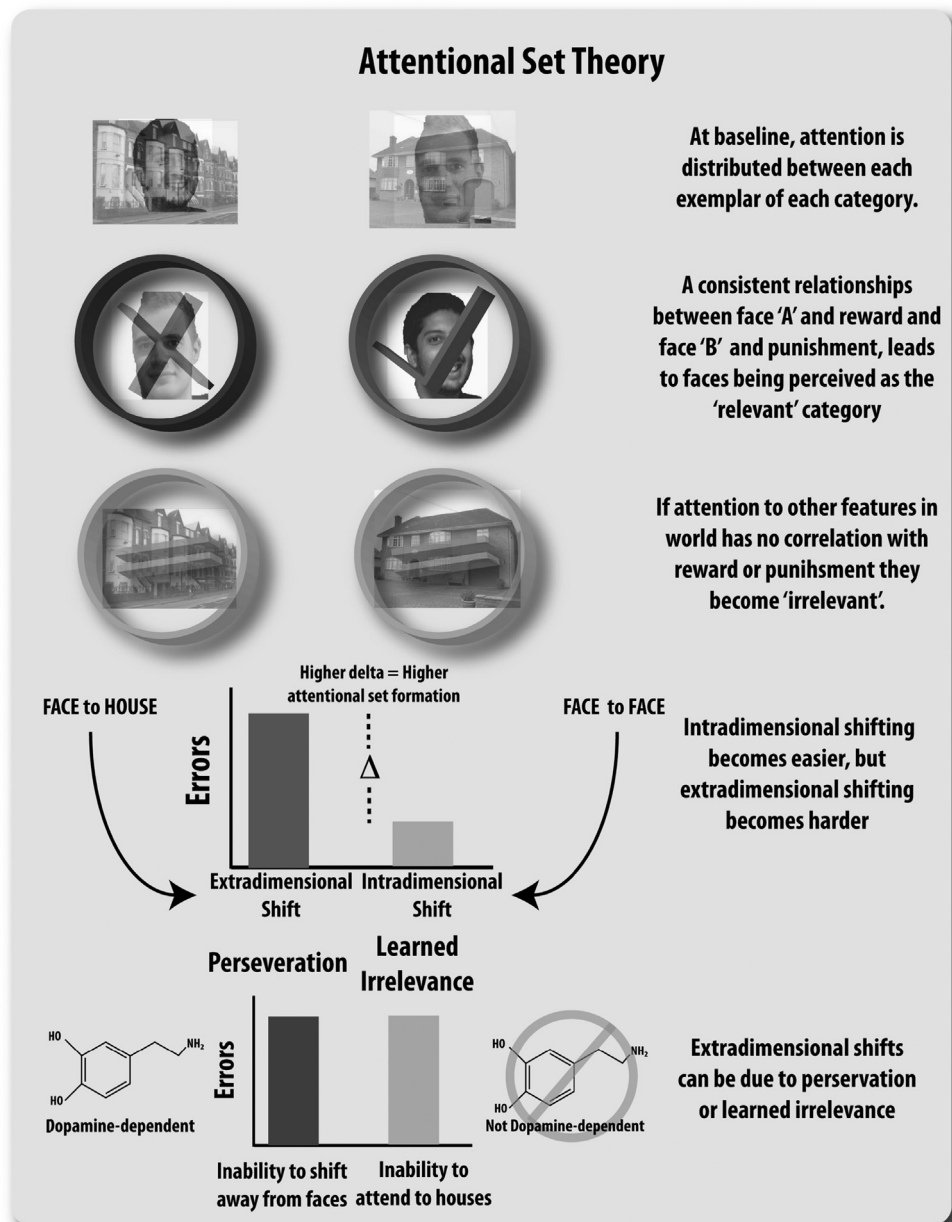


Fig. 1 – Attentional set theory describes how attentional allocation to certain features in the environment is established according to their correlation, or non-correlation with reward and punishment. Initially, there is no learned attentional bias towards one feature. However, if one face is consistently paired with reward and another face consistently paired with punishment, this means that attention towards faces is the crucial determinant in receiving either reward or punishment and therefore the dimension of ‘faces’ become the “relevant” dimension. In contrast, because there is no correlation between attention to houses and reward or punishment, the dimension of “houses” becomes irrelevant. This leads to the formation of an attentional set – the privileging of one class of information over another. The behavioural advantage of an attentional set is that it leads to a superior ability to switch attention within a dimension (face to face; intradimensional shift – IDS), but a relatively impaired ability to switch attention between different dimensions (face to house; extradimensional shift – EDS). However, extradimensional shifting is a heterogeneous process – it is comprised of perseveration and learned irrelevance. Perseveration, in this context, is the inability or reluctance to shift attention away from previously relevant information, and is thought to dopamine-dependent. Learned irrelevance, however, is the inability or reluctance to attend to previously irrelevant information. Learned irrelevance is not thought to be dopamine-dependent.

2015; Harrison & Owen, 2001; Monchi, Petrides, Mejjia-Constain, & Strafella, 2007; Monchi et al., 2004; Moustafa, Sherman, & Frank, 2008). Moreover, because most tasks in daily life involve focussing on some features whilst ignoring

others, attentional sets provide the filter through which other higher-level cognitive functions operate. Thus, impaired attentional set formation and shifting, if present, are likely to have detrimental effects on patients' lives. However, our

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