



## Common psychotic symptoms can be explained by the theory of ecological perception

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### ABSTRACT

The symptoms of psychiatric illness are diverse, as are the causes of the conditions that cause them. Yet, regardless of the heterogeneity of cause and presentation, a great deal of symptoms can be explained by the failure of a single perceptual function – the reprocessing of ecological perception.

It is a central tenet of the ecological theory of perception that we perceive opportunities to act. It has also been found that perception automatically causes actions and thoughts to occur unless this primary action pathway is inhibited. Inhibition allows perceptions to be reprocessed into more appropriate alternative actions and thoughts. Reprocessing of this kind takes place over the entire frontal lobe and it renders action optional. Choice about what action to take (if any) is the basis for the feeling of autonomy and ultimately for the sense-of-self. When thoughts and actions occur automatically (without choice) they appear to originate outside of the self, thereby providing *prima facie* evidence for some of the bizarre delusions that define schizophrenia such as delusional misidentification, delusions of control and Cotard's delusion.

Automatic actions and thoughts are triggered by residual stimulation whenever reprocessing is insufficient to balance automatic excitatory cues (for whatever reason). These may not be noticed if they are neutral and therefore unimportant or where actions and thoughts have a positive bias and are desirable. Responses to negative stimulus, on the other hand, are always unwelcome, because the actions that are triggered will carry the negative bias.

Automatic thoughts may include spontaneous positive feelings of love and joy, but automatic negative thoughts and visualisations are experienced as hallucinations. Not only do these feel like they emerge from elsewhere but they carry a negative bias (they are most commonly critical, rude and are irrationally paranoid).

Automatic positive actions may include laughter and smiling and these are welcome. Automatic behaviours that carry a negative bias, however, are unwelcome and like hallucinations, occur without a sense of choice. These include crying, stereotypies, perseveration, ataxia, utilization and imitation behaviours and catatonia.

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### Introduction

Psychiatric illness may strike anywhere and in any demographic. And even though some syndromes are somewhat treatable, they are often utterly debilitating. For generations researchers and clinicians have been attempting to grapple with these syndromes. The effort is impressive, and with more than 7000 peer-reviewed articles for schizophrenia alone being published per year [1], there is no shortage of high quality empirical data. But like the data, most hypotheses relate to a small aspect

of a single syndrome – a single symptom perhaps. Very few hypotheses or studies look broadly at psychiatric disorders, despite the murky boundaries between the syndromes and the reoccurrence of common symptoms in diverse conditions. Take *imitation behaviour* for instance. This is common in conditions as diverse as biological lesions, schizophrenia, and Alzheimer's disease [2,3].

### Psychotic disorders: the effect of unmoderated ecological perception

#### Ecological perception

Until mirror neurons were first explained using the ecological theory of perception [4,5], the theory had no traction at all in

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neuroscience or medicine, even though the theory has robust support and is relatively well accepted in the field of perceptual psychology [6]. But mirror neuron theory remains a relatively isolated curiosity in medicine, where naïve belief in serial and qualia oriented perception still dominates. As long as this belief is maintained, it is hard to imagine that the Cartesian divide between the studies of ‘mental’ psychotic states and ‘physical’ stereotypes will be bridged or that the overlap of symptoms of psychiatric illness will ever be understood holistically.

The ecological theory claims that perception is action [4]. A person does not just interpret sense-data (qualia) to compile an array of conclusions – the senses work holistically to excite or inhibit the actions and thoughts that we find ourselves continually engaged with. A ‘delicious’ smell is delicious because it invites eating. A smell is repulsive when, prior to any subsequent rationalisation, an impulse to retreat is triggered. A chair is not a composite of visual and tactile information; it is foremost an opportunity to sit, the colour and shape of the chair may never even register.

Evolutionarily advanced animals are able to moderate action/thought perceptions with ‘self-control,’ a secondary process that allows a person to moderate (accept or transform) perception/action. The ability to choose how we react forms the basis for autonomy (as much as there is such a thing) [7]. Simple creatures have no such discretion. For them perception does not suggest nor demand behaviour, it is indistinguishable from behaviour. A frog has no choice but to eat a moving object of a certain size, and a barnacle has no choice but to stick to a hard surface, at which point it begins to consume its own brain [6].

Just as a cue for action is automatic, so too is self-control, at least for animals that have a frontal lobe which is developed enough to enable self-control [6]. In healthy adults, the force of self-control opposes undesirable automatic behaviour with an equal opposite. In most cases, reprocessing is so well balanced that people will not realize when they have ‘acted’ or ‘behaved’ (refrained from action). People sometimes notice after the fact: for example when they have just swallowed the strawberry that was meant to decorate a cake. People may also recognize the impulse ‘telling’ them to jump when they reach a cliff’s edge, but equally so, they recognize the impulse to self-control: the recoil of alarm at the thought of plummeting of a cliff, or the guilty thought: ‘I couldn’t resist,’ regarding the strawberry for the cake. As Gibson points out, the ecological theory makes sense of impulses triggered by perception: “Fruit says ‘eat me’” [4]. And a cliff says “jump!”

#### *An ecological hypothesis for the symptoms of psychiatric disorders*

Because the laws of physics govern action, they should also govern ecological perception because perception is *active*. Newton’s third law is particularly pertinent in this instance; to discharge an action/perception, an equal and opposite *self-control/reaction* is required. Perception always triggers action, although those actions may be transformed into alternative responses. Self-control can transform inappropriate action/perception impulses into alternative thoughts, feelings, desires or actions, just as energy can be transformed.

Stimulus may be desirable (positive), neutral or undesirable (negative). And untransformed actions should reflect these qualities. A raucous positive action may be permissible in specific contexts (a party for instance). It may be tempered to meet a social milieu, but the reprocessing of a positive stimulus need only be partial. Likewise for neutral stimulus. Action resulting from positive or neutral stimulation will rarely be harmful and unwanted. Negative stimulus, on the other hand, needs complete transformation, lest unwanted, unintended and unmoderated actions and thoughts occur. Although organic brain damage (particularly to the frontal lobe) may prevent reprocessing [2,8,9], a Bayesian func-

tion moderated by the dopamine system [10] also appears to be in place to restrict autonomous action in emergencies [11], allowing automatic behaviour free reign [12]. Because automatic processes are fast and accurate, the evolutionary purpose for this bypass function is presumably to allow much faster fight and flight instincts when needed [13].

Unmoderated reactivity is definitively automatic, regardless of whether a patient is aware of their behaviour or not. Because all unmoderated actions originate outside of the *autonomous domain*, they will appear to originate elsewhere. If primarily physical, unmoderated reactivity will present as *stereotyped behaviours*. Unmoderated *thoughts* are experienced as *hallucinations* when thoughts (internal voices) and visualisations (imagery) are experienced without the context of autonomy. The experience of continual automaticity will erode a sense of self, because actions are genuinely not autonomous. The primary exceptions being cases of severe frontal damage, where the sense of self cannot exist at all [14,15], but neither can choice [8]. Aside from these extreme situations, many of the bizarre beliefs and experiences that are common among psychiatric patients and characterise schizophrenia are related to the loss of autonomy of thought and action. (See Table 1).

When automatic reactions are predominantly physical, they will be classed as catatonic (DSM-IV 295.20). When excess automaticity primarily causes misidentification of action and thought, the paranoid classification is most appropriate (DSM-IV 295.30). If automatic behaviours interfere with normal trajectories of reason or behaviour, a disorganised classification (DSM-IV 295.10) will be applied. If perceptual reprocessing is overly applied to positive stimulus, schizoaffective disorder and affective flattening may be the diagnosis (DSM-IV 295.70). Thus, one solution addresses all the primary symptoms of psychiatric disorders.

#### *Evidence*

Reprocessing of action/perception is thought to occur over the entire frontal lobe of the brain. This area is subject to decreased connectivity in schizophrenia, [11] and is also the primary site for the processing of creativity, choice [16] and the sense-of-self [14,15]. The function of the frontal lobe in reprocessing of information is evident because whenever there is frontal damage, some degree of unusual automatic behaviour is ubiquitous. A study of frontal lesions showed that 100% of patients ( $n = 29$ ) eventually eventuated in imitation behaviour or a more severe disorder involving loss of autonomy. (at the time the study was conducted, there was one exception (4%,  $n = 1$ ), whom presented with headaches. This patient developed imitation behaviour shortly after the study period.) [2].

The reprocessing of negative stimulus was imaged by Northoff et al. [17]. In this study, akinetic catatonic patients (DSM-IV 295.20,  $n = 3$ ; bipolar 1 DSM-IV 296.54c,  $n = 7$ ), psychiatric patients (paranoid schizophrenia DSM-IV 295.30,  $n = 3$ ; bipolar 1 DSM-IV 296.54,  $n = 7$ ) and healthy controls ( $n = 10$ ) were exposed to emotionally positive, neutral and negative stimulus in the form of pictures (from the International Affective Picture System) while undergoing fMRI scans of their entire frontal lobes. For *positive* and *neutral* stimulus, *all* subjects showed processing imbalances (eccentricity) where excitation (+) exceeded inhibitory reprocessing (–) (see Fig. 1). For *negative* stimulus, however, *only the psychiatric cohorts showed any eccentricity* (see Fig. 2). They were unable to balance the negative impact of the stimulus over the areas the frontal lobe (the orbitofrontal, anterior cingulate, medial prefrontal, lateral prefrontal, premotor and motor cortices). In contrast, healthy controls did this nearly perfectly (variation = 0.63%  $n = 21$ ,  $p = 0.05$ ) (Figs. 1 and 2). All cases of eccentricity are speculated to relate to automatic behaviours, but this does require

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