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To cite this article: Anne-Kathrin J. Fett, Clara Isabel González Berdugo, Esther Hanssen, Imke Lemmers-Jansen, Sukhi S. Shergill & Lydia Krabbendam (2015) I spy with my little eye – the detection of intentional contingency in early psychosis, *Cognitive Neuropsychiatry*, 20:6, 473-481, DOI: [10.1080/13546805.2015.1088824](https://doi.org/10.1080/13546805.2015.1088824)

To link to this article: <http://dx.doi.org/10.1080/13546805.2015.1088824>



Published online: 14 Oct 2015.



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## I spy with my little eye – the detection of intentional contingency in early psychosis

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(Received 9 June 2015; accepted 26 August 2015)

*Introduction:* Paranoid delusions have been associated with a tendency to over-attribute intentionality and contingency to others' actions and incidental events in individuals with chronic psychosis. However, this hyper-associative perception bias has not been investigated in the early illness stages of psychosis, during which it may play a particularly crucial role in the formation of symptoms.

*Method:* We used an experimental paradigm with 20 short film clips of simple animate and inanimate shapes that either moved in a contingent or non-contingent manner to investigate the perception of contingency in 38 adolescents with early psychosis and 93 healthy control adolescents. Participants rated the contingency between the shapes' movements on a scale from 0 to 10. The data were analysed with multilevel regression analyses to account for repeated measures within subjects.

*Results:* There were no significant differences between patients and controls; both perceived the contingency of the shapes' movements similarly across all conditions and patients' contingency perception was unrelated to their levels of paranoid delusions.

*Conclusion:* Contingency perception was unimpaired in patients with early psychosis, suggesting that it might still be intact in the early illness stages. Future studies should set out to determine whether the early illness stages could offer a window for interventions that counteract the development of hyper-associative perceptions of contingency.

**Keywords:** early psychosis; paranoid delusions; contingency perception; causality perception

### Introduction

Detecting the presence and understanding the intentions of others is crucial for humans to function in their social environments. It has been suggested that in response to the complexities of social life, mechanisms to detect animacy and agency have developed to be highly sensitive in our species and that the origins of beliefs in supernatural things might be rooted in this development (Giroto, Pievani, & Vallortigara, 2014;

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Vallortigara, 2012). Mechanisms of agency detection seem innate in humans (Mascalzoni, Regolin, Vallortigara, & Simion, 2013), yet may become problematic if they overshoot. In line with this, some theories postulate that paranoid delusions; fixed, false beliefs that one is persecuted by others, arise from aberrant agency detection with a hyper-associative cognitive style, that is, the tendency to perceive meaning in unrelated events or other's actions. This phenomenon of aberrant salience has been explained in the light of aberrant dopamine signalling in psychosis (Frith, 2004; Kapur, 2003).

Several experimental studies associated paranoid delusions with an increased propensity to perceive causality in human actions described in vignettes and in movements of animated shapes in simpler, language-free paradigms that do not involve overt social stimuli (Blakemore, Sarfati, Bazin, & Decety, 2003; Fyfe, Williams, Mason, & Pickup, 2008; Horan et al., 2009; Montag et al., 2011; Peyroux, Strickland, Tapiero, & Franck, 2014; Russell, Reynaud, Herba, Morris, & Corcoran, 2006; Wende et al., 2015). Russell et al. (2006), for example, used a paradigm that required the interpretation of random movements of shapes that did not interact (i.e. they moved purposelessly), goal-directed motion where one shape chased/lead the other, and movements of shapes that were implying theory of mind, that is, the shapes were tricking/coaxing each other. The results showed that patients with persecutory delusions misperceived random animations as contingent in comparison to controls and patients in remission. Blakemore, Sarfati, et al. (2003) used a similar paradigm to investigate the inference of contingency between movements of two shapes that were moving in an animate or inanimate way that was either contingent (related) or non-contingent (unrelated). Patients with paranoid delusions perceived no difference in relatedness between contingent and non-contingent movements of shapes if the shapes moved in an animate way, possibly they perceived contingency where there was none. Patients without paranoid delusions and healthy controls, in contrast, perceived a stronger relationship between animate contingent shapes compared to animate non-contingent shapes. In sum, these findings suggest that the aberrant perception of contingency might play a role in the instantiation and maintenance of paranoid delusions.

To date, research on the perception of contingency and its relationship with paranoid delusions has been conducted in chronic patients. This study investigated whether a hyper-associative perception bias is already present in the early stages of the illness, during which it may play a particularly crucial role in the formation of paranoid symptoms and whether there is a dose-response relationship between the degree of this perception bias and levels of paranoia in patients.

## Method

### *Participants*

The sample consisted of 38 adolescents with early psychosis and 93 healthy control adolescents. Adolescents with early psychosis were recruited via consultant psychiatrists and the Mental Health Research Network in the SLAM, NELFT, Oxleas and SEPT NHS Foundation Trusts. Inclusion criteria for patients were (1) age between 13 and 19 years, (2) having had a psychotic episode according to ICD-10 criteria, (3) good command of English and (4) being able and willing to give informed consent. Twenty-seven patients had a diagnosis of non-affective psychosis and 11 patients had a diagnosis of affective psychosis. Diagnoses of non-affective psychosis were 7 × schizophrenia, 10 × acute and transient psychotic disorder, 3 ×

schizoaffective disorder and 7 × unspecified non-organic psychosis. Diagnoses of affective psychosis were 1 × mania with psychotic symptoms, 6 × bipolar affective disorder with psychotic symptoms and 4 × depressive episode with psychotic symptoms. Adolescents in the control group were recruited from local schools, the volunteer database “Mindsearch”, via colleagues and previous participants. Additional inclusion criteria for controls were (5) no psychiatric illness and no personal or family history of psychosis. Participants and their parents/guardians gave written informed consent if participants were under 16. The study was approved by the South West London Research Ethics Committee.

## Measures

### *Contingency task*

We used the *Contingency task* as described in Blakemore, Sarfati, et al. (2003). The task instructions and stimuli were provided to us by Blakemore. The task entails two motion factors (animate and inanimate) and two contingency factors (contingent and non-contingent), yielding four conditions: (1) *animate contingent* (AC) – a prime mover shape moves across the screen and a reactive mover, which is positioned behind a window in a vertical wall, starts to rotate in the direction of the prime mover’s motion when it passes by the window; (2) *animate non-contingent* (AN) – a prime mover moves across the screen and a reactive mover rotates before the prime mover reaches the window (i.e. was “out of sight”); (3) *inanimate contingent* (IC) – a prime mover collides with a reactive mover, that is, the prime mover’s movement launches the reactive mover’s; and (4) *inanimate non-contingent* (IN) – a prime mover moves across the screen, passing by the reactive mover without any contact.

Each stimulus image consisted of 512 × 512 pixels and 256 colours. The position of the prime mover’s exit point (top, middle or bottom of the screen), the colour of the shapes (blue, green or red), the form of the shapes (spiked or smooth-edged) and the direction of motion (horizontal or vertical) were varied. The variation of these factors was counter-balanced between conditions. The order of stimulus presentation was pseudo-randomised and counter-balanced. Participants saw 20 different 4 second film clips, including 5 of each condition, on a computer screen. Each clip was presented twice. After the first clip the participants were asked whether they thought that the movements of the two shapes were related. After viewing the clip for a second time they rated the relationship strength on a scale from 0 (not at all) to 10 (very much; see Figure 1).

### *Positive and negative syndrome scale*

The *Positive and Negative Syndrome Scale* (PANSS) was used to assess patients’ paranoid delusions (suspiciousness/persecution item) and overall positive, negative and general symptom levels. The PANSS consists of 30 items that are rated on a scale from 1 (absent) to 7 (extreme; Kay, Fiszbein, & Opler, 1987).

### *Green paranoid thoughts scale*

The *Green Paranoid Thoughts Scale* (GPTS) was used as a more fine-grained measure of paranoid delusions (Green et al., 2008). The scale includes a “social reference” and

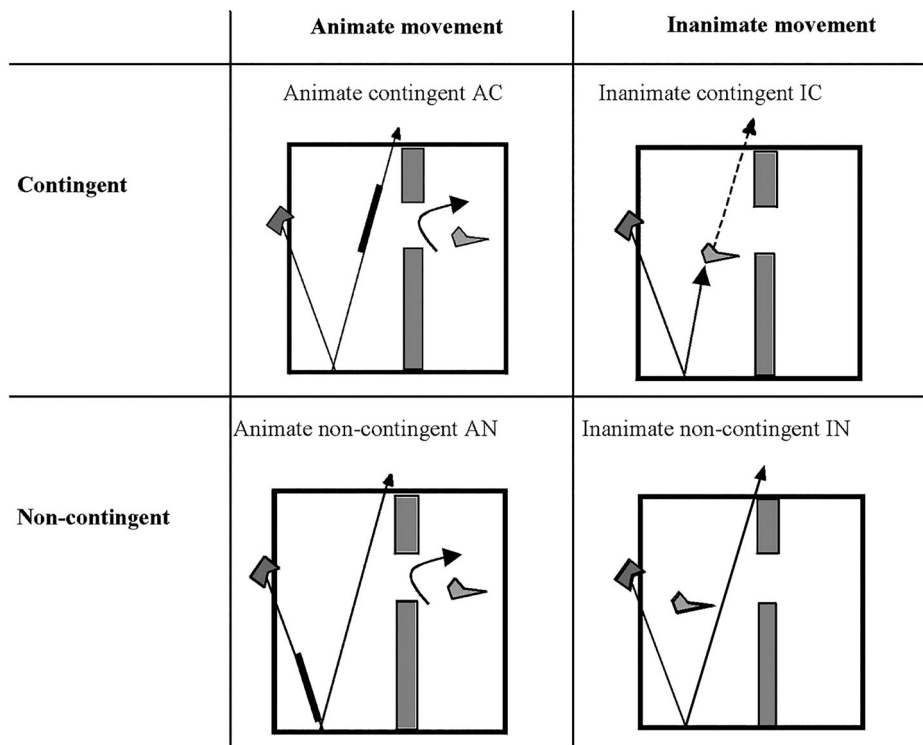


Figure 1. The Contingency task. Note: With permission of S.J. Blakemore from Blakemore, Boyer et al. (2003).

“persecution” paranoia subscale, which each comprise 16 items that are rated on a scale from 1 (not at all) to 5 (totally).

#### *Neuropsychological assessment*

The vocabulary subtest of the Wechsler Abbreviated Scale of Intelligence (WASI) was used as an estimate of general cognitive ability and to control for potential confounding effects of any group differences in the statistical analyses (Wechsler, 1999).

#### *Procedure*

Participants were tested individually at the Institute of Psychiatry. They completed the WASI vocabulary subtest, GPTS and several computer tasks, including the Contingency task. Patients were interviewed with the PANSS. Before the experiment, participants were given information about the procedure and the Contingency task was illustrated with an example clip of each of the four conditions.

#### *Data analysis*

The data analysis was conducted in STATA (version 11.2). Group differences in sample characteristics were analysed with chi-square tests and regression analyses.

Group differences in Contingency task performance and associations between the perceived relatedness of the shapes' movements and symptoms in the patient group were analysed by means of multilevel regression analyses (STATA XTREG command) to account for repeated observations (Level 1) that are nested within participants (Level 2). Analyses were conducted separately for the animate and inanimate condition. Contingency ratings were used as dependent variable contingency factor and group as predictors. To control for confounding age, gender and the WASI vocabulary score were added to the regression model.

Finally, we conducted multilevel regression analyses in the patient group only to investigate the associations between symptom levels and contingency ratings in patients.

## Results

There were significant differences between the patient and the control group in age, estimated cognitive ability, and gender composition and patients scored significantly higher on persecution paranoia and social reference paranoia than the control group (see Table 1).

In the animate motion condition ratings of relationship strength did not differ between contingent and non-contingent movements ( $b = 0.9$ ,  $p = .55$ ) and group ( $b = -0.41$ ,  $p = .33$ ), and the contingency factor by group interaction was non-significant ( $b = 0.3$ ,  $p = .26$ ). In the inanimate motion condition, the main effects of contingency factor and group on the perceived relationship strength were qualified by a significant interaction ( $b = -1.08$ ,  $p < .001$ ). The groups did not perceive the shape's movements as differently related in the IN condition ( $b = 0.23$ ,  $p = .56$ ), but patients rated the relationship strength as marginally weaker than controls in the IC condition ( $b = -0.86$ ,  $p = .07$ ; see Figure 2).

Patients' levels of paranoid delusions on the PANSS suspiciousness/persecution item and on both GPTS subscales, as well as the PANSS overall positive symptom score, were unrelated to the degree of perceived relatedness between the shapes' movements in all conditions (all  $p > .15$ ).

## Discussion

This study was the first to investigate the perception of contingency in patients with early psychosis. In contrast to previous research in patients with chronic psychosis (Blakemore, Sarfati et al., 2003; Russell et al., 2006), the current results showed a normal perception of contingency in adolescents in the early illness stages compared to healthy control adolescents. In addition, patients' levels of paranoid delusions were unrelated to the perceived degree of contingency between the shapes' movements in all conditions.

Interestingly, our results showed that neither healthy control adolescents nor adolescents with early psychosis perceived a difference in contingency between the animate contingent and animate non-contingent movements. The average rating was approximately 3 out of 10, suggesting that animate contingent and animate non-contingent motions were perceived as rather non-contingent. An investigation by Fyfe et al. (2008) who used the same Contingency task in 66 healthy controls with high and low levels subclinical paranoia found that individuals with low levels

Table 1. Sample characteristics.

Variables	Patients (n = 38) Mean (SD)	Controls (n = 93) Mean (SD)	Statistical test	p
Age (years)	17.53 (1.31)	16.74 (1.69)	$F(1, 129) = 11.3$	.001
% male	57.89	49.46	$\chi^2(1) = 15.37$	<.001
WASI vocabulary	45.89 (12.68)	53.51 (9.38)	$F(3, 125)^* = 8.2$	<.001
GPTS Social Reference	36.86 (15.67)	31.67 (10.02)	$F(3, 124)^* = 2.77$	.008
Paranoia				
GPTS Persecution	30 (14.65)	25.23 (9.87)	$F(3, 122)^* = 2.18$	.02
Paranoia				
PANSS Persecution item	2.56 (1.19), range 1–5			
PANSS Positive	1.9 (0.81), range 1–4.7			
PANSS Negative	2 (0.85), range 1–4.2			
PANSS General	1.71 (0.50), range 1–3.6			
<i>Contingency task</i>				
Animate contingent	3.25 (3.14)	3.35 (2.88)		
Animate non-contingent	2.86 (3.02)	3.27 (2.86)		
Inanimate contingent	5.65 (3.66)	6.5 (3.17)		
Inanimate non-contingent	1.68 (2.8)	1.44 (2.66)		
<i>Diagnoses</i>				
Non-affective psychosis	27			
Affective psychosis	11			
Illness duration (months)	16.5 (range 1–59)			
Hospital admissions	1.2 (range 0–4)			
<i>Medication</i>				
Antipsychotics	27			
Antipsychotics and antidepressants	4			
Antipsychotics and benzodiazepines	3			
Antidepressants only	2			
No medication	2			

Note: \*Controlled for age and gender.

of subclinical paranoia rated the degree of contingency similar for animate contingent and animate non-contingent movements. However, in line with the idea that beliefs in supernatural things might be rooted in an increased agency detection, Fyfe et al.'s findings also showed that individuals with high levels of subclinical paranoia perceived a substantially higher contingency between movements of animate contingent than animate non-contingent shapes. Thus in healthy individuals higher subclinical paranoia was associated with a higher perception of contingency of animate movements, but only when there actually was contingency.

Interestingly, this effect observed in individuals with high subclinical paranoia has not been found in the clinical sample of Blakemore, Sarfati, et al. (2003). Blakemore

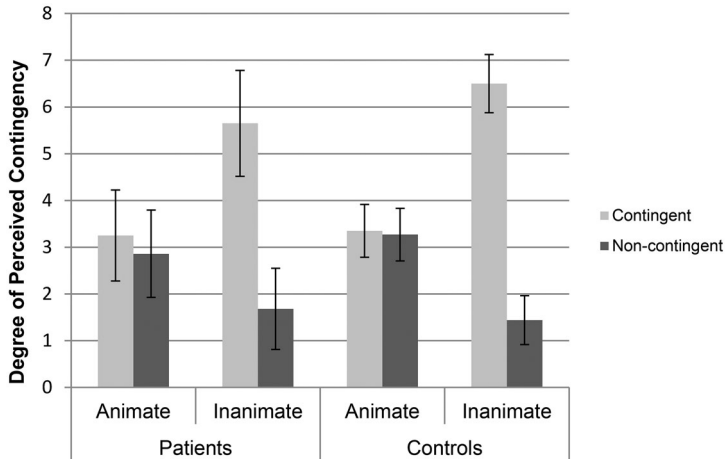


Figure 2. Contingency perception by motion factor, contingency factor and group. Note: Error bars represent 95% CI's.

et al.'s findings showed that patients with high levels of paranoid delusions ( $n = 12$ , PANSS suspiciousness/persecution item score = 5.36) perceived animate contingent and animate non-contingent movements equally. Patients without delusions ( $n = 10$ ) perceived a difference between the contingent and non-contingent movements, albeit to a lesser degree than controls. So here it seemed as if illness status and paranoia were linearly associated with difficulties to differentiate animate contingent and non-contingent movements. Unfortunately, only the mean difference, but not ratings of relationship strength, were reported, therefore the actual degree of perceived contingency in the adult patient sample remains unclear. However, Blakemore, Sarfati, et al. (2003) suggest that their finding was due to the fact that patients with delusions perceived contingency where there was none, namely in animate non-contingent movements. Despite an overall similar picture of absent differences in contingency ratings between the animate contingent and non-contingent condition, the finding in the current study seems to be due to the reverse reason, that is, patients and controls in the current did not perceive much contingency in the animate contingent condition where there actually was contingency between the shapes' movements.

Controls ( $n = 93$ , age = 16.74) in our study and controls ( $n = 30$ , age = 24.5) with low subclinical paranoia in Fyfe et al.'s study also did not perceive a difference in contingency between animate contingent and non-contingent movements. This contradicts the ratings of controls ( $n = 14$ , age = 29.7) in Blakemore et al.'s study, who perceived a large difference between the two. We used exactly the same paradigm as Blakemore, Sarfati, et al. (2003) and Fyfe et al. (2008). Hence, it is unlikely that the differential findings are due to the nature of the utilised task. It is possible that the differences in study findings could be due to sample composition, including factors such as nationality (French vs. English), gender and age differences, or differences in illness duration and differential effects of clinical and subclinical paranoid symptoms on the perception of contingency.

In conclusion, the current study showed no group differences in the perception of contingency between healthy adolescents and patients in the early stages of psychotic



illness, suggesting that perception of contingency might still be intact in early psychosis. Yet, the results should be interpreted with caution, as findings call for replication studies in larger samples that systematically investigate the effects of illness duration and dose–response relationships between levels of paranoid symptoms and the biased perception of contingency.

### Acknowledgements

We would like to thank the MHRN support team, the clinical studies officers at NELFT, SEPT, SLAM and OXLEAS and specifically Partha Banerjee, Uttom Chowdhury, Philip Collins, Sophia Frangou, Giovanni Giaroli, Daniel Hayes, Kah Mirza, Viviana Porcari, Kurinji Semmanpalayam, Derek Tracy and the local schools for their help with the recruitment of our participants, and Sarah-Jayne Blakemore for allowing us to use the Contingency task.

### Disclosure statement

No potential conflict of interest was reported by the authors.

### Funding

Anne-Kathrin Fett: supported by a Netherlands Organization for Scientific Research (NWO) VENI grant 451-13-035; Lydia Krabbendam: supported by a NWO VICI grant 453-11-005; Sukhi Shergill: supported by a Medical Research Council New Investigator Award Project grant 93641 and an ERC Consolidator Award.

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