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JUMPING TO CONCLUSIONS AT FIRST ONSET OF PSYCHOSIS PREDICTS LONGER ADMISSIONS, MORE COMPULSORY ADMISSIONS AND POLICE INVOLVEMENT OVER THE NEXT 4 YEARS; the GAP Study.

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ABSTRACT

Background. Jumping to Conclusions (JTC), which is the proneness to require less information before forming beliefs or making a decision, has been related to formation and maintenance of delusions. Using data from the GAP case-control study of first-episode psychosis (FEP), we set out to test whether the presence of JTC would predict poor clinical outcome at 4 years.

Methods. 123 FEP patients were assessed with the positive and negative syndrome scale (PANSS), Global Assessment of Functioning (GAF), and the probabilistic reasoning “Beads” task at the time of recruitment. The sample was split into two groups based on the presence of JTC bias. Follow-up data over an average of 4 years were obtained concerning clinical course and outcomes (remission, intervention of police, use of involuntary treatment – the Mental Health Act (MHA) -, and inpatient days).

Results. FEP who presented JTC at baseline were more likely during the follow up period to be detained under the MHA [adjusted OR=15.62, 95% confidence interval (CI) 2.92-83.54, p=0.001], require intervention by the police (adjusted OR=14.95, 95% CI 2.68-83.34, p=0.002) and have longer admissions (adjusted IRR=5.03, 95% CI 1.91-13.24, p=0.001). These associations were not accounted for by socio-demographic variables, IQ and symptom dimensions.

Conclusions. JTC in FEP is associated with poorer outcome as indicated by defined by more compulsion police intervention, and longer periods of admission.. Our findings raise the question of whether the implementation of specific interventions to reduce JTC, such as Metacognition Training, may be a useful addition in early psychosis intervention programs.

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1 1. INTRODUCTION

2 Psychosis especially schizophrenia may be a disabling condition and classically is associated
3 with poor clinical outcome. Nonetheless, recent findings confirm that prognosis is not
4 universally poor and that the course need not be one of inexorable decline (Hopper *et al.*,
5 2007; Morgan *et al.*, 2014; Revier *et al.*, 2015). Interest has therefore shifted towards
6 identifying predictors of outcome for treatment planning in order to ameliorate the adverse
7 impact of the illness (White *et al.*, 2009; Juola *et al.*, 2013; Friis *et al.*, 2016) .

8 Neurocognitive deficits and negative symptoms are important drivers of disability in psychosis
9 (Breier *et al.*, 1991; Wieselgren, Lindström and Lindström, 1996; Ho *et al.*, 1998; Green *et al.*,
10 2000; Lipkovich *et al.*, 2009; Faber *et al.*, 2011), as is social cognition (Couture, Penn and
11 Roberts, 2006; Fett *et al.*, 2011; Pinkham, 2014). However, which aspects of cognition are
12 most predictive of prognosis remains elusive.

13 One area to attract attention in this regard is reasoning and cognitive biases (van Hooren *et al.*
14 *et al.*, 2008). Jumping to conclusions (JTC) defines a tendency to form beliefs and to make a
15 decision about an event without having enough information about it, sometimes referred to as
16 data-gathering bias (Freeman, Pugh and Garety, 2008). JTC plays a central role in
17 psychological and neuropsychological theories of delusions as it is considered to lead to the
18 rapid acceptance of implausible ideas and to prevent consideration of more realistic alternative
19 explanations of events (Freeman and Garety, 2014). A recent meta-analysis (Dudley *et al.*,
20 2016) summarized evidence that people with psychosis make decisions on the basis of little
21 evidence, have a more extreme reasoning style than people with other mental health
22 conditions or healthy controls and that JTC is linked with a higher probability of having
23 delusions. Moreover, there is evidence that such hasty reasoning is predictive of less
24 improvement over time in delusions (So *et al.*, 2014).

25 In her theoretical model of psychosis, Garety *et al.* (2001) proposed JTC as one of the biased
26 conscious appraisal processes which are crucial in contributing to the perception of anomalous
27 experiences as personally significant and externally caused when the subject is in search for
28 an explanation (Garety *et al.*, 2001). Garety and Freeman (1999) found empirical support for
29 JTC, externalizing attributional biases and deficits in understanding social situations and the
30 intentions of others, to be specific biases in these processes (Garety and Freeman, 1999).
31 Interestingly, these biases and deficits, which are considered to be part of social cognition, are
32 also included in similar constructs as metacognition (Lysaker *et al.*, 2005, 2013), which has
33 led to the development of specific intervention programmes, as the Metacognition Training
34 designed by Moritz, which has specific modules dedicated to the bias (Moritz and Woodward,
35 2007). This latter intervention has been reported to improve positive symptoms (Aghotor *et al.*
36 *et al.*, 2010; Moritz *et al.*, 2011, 2013; Favrod *et al.*, 2014) in patients with schizophrenia, which
37 renders the JTC bias as especially interesting for research into the outcome of the disorder.

38 There is also evidence of a link between JTC and the more classic construct of neurocognition.
39 JTC has been shown to be negatively associated with neuropsychological performance in FEP
40 samples (Falcone *et al.*, 2015; González *et al.*, 2017), but also with lower IQ scores among
41 healthy relatives of patients with schizophrenia (Van Dael *et al.*, 2006) and controls with high
42 levels of psychotic experiences (Mortimer *et al.*, 1996; Van Dael *et al.*, 2006). Nonetheless,
43 whether the relationship between neurocognition and JTC moderate the link with positive
44 symptoms remain elusive (Andreou *et al.*, 2015).

45 To the best of our knowledge, only one study has examined whether JTC moderates outcome
46 of the disorder by measuring its impact on functional outcome (Andreou *et al.*, 2014). The
47 results did not support a predictor role of the bias, although this may have been because of
48 the length of follow-up was only 6 months and the sample was small. We decided to examine
49 reasoning bias as a possible predictor of the course and clinical outcome in the medium to
50 long term, using data from a well-characterized sample of patients presenting to psychiatric
51 services for the first time with psychosis. The aim of our study was to examine independent
52 associations between JTC and clinical outcome at 4 years after the first contact with mental
53 health services. For this purpose, we selected remission and several clinical outcomes of
54 service use such as days of admissions, use of the Mental Health Act (MHA) for involuntary
55 treatment and instances of police involvement during an admission to a psychiatric unit.

56 As JTC has been related in several studies to the presence of delusions (Falcone *et al.*, 2015;
57 McLean *et al.*, 2016), and to a lesser extent to persistence of delusion severity (Falcone *et al.*,
58 2015), we hypothesized that those patients who presented more severe reasoning bias at
59 baseline would have worse clinical prognosis.

60 **2. METHODOLOGY**

61 **2.1. Participants**

62 Participants for this study were recruited as part of the National Institute of Health Research
63 Biomedical Research Centre Genetics and Psychosis (GAP) study conducted in South
64 London, UK. Further details of the study are available in Di Forti *et al.* (Di Forti *et al.*, 2015).
65 Briefly, the GAP study comprised individuals aged 18-65 years who presented to the
66 psychiatric services of the South London and Maudsley (SLaM) National Health Service (NHS)
67 Foundation Mental Health Trust between December 2005 and October 2010 with a first
68 episode of psychosis (FEP) (International Classification of Diseases (ICD)-10; F20-F29 and
69 F30-F33; and Diagnostic and Statistical Manual of Mental Disorders (DSM)-IV; 295.1-298.9)
70 (WHO, 1992; American Psychiatric Association, 2000). Diagnosis at the moment of
71 recruitment was determined by administration of the Schedules for Clinical Assessment in
72 Neuropsychiatry (SCAN) (WHO, 1994) and was later validated by using the computerized
73 Operational Criteria system (version 2004) (McGuffin *et al.*, 1991). Cases were excluded if
74 there was evidence of: 1) psychotic symptoms precipitated by an organic cause; 2) transient
75 psychotic symptoms resulting from an acute intoxication as defined by ICD-10; 3) head injury
76 causing clinically significant loss of consciousness; and 4) learning disability (IQ<70) as
77 assessed by the Wechsler Adult Intelligence Scale—Third Edition (Wechsler, 1997). The
78 original GAP sample comprised N=431 FEP cases; of these, information on JTC at baseline
79 was available for 123 cases (28% of the original GAP sample (Falcone *et al.*, 2015)). This
80 subsample with information on JTC did not differ significantly from the full GAP sample in
81 terms of gender, age, education level, diagnosis or ethnicity (Supplementary Table 1). Further,
82 83% (N=102) of the subsample (N=123) was successfully traced four years after first contact
83 with mental health services. Therefore, data presented here are based on these 102 cases.
84 Ethical permission was obtained from the SLaM and the Institute of Psychiatry Research
85 Ethics Committee. All patients gave informed written consent after reading a detailed
86 information sheet.

87 **2.2. Measures at baseline**

88 *2.2.1. Socio-demographic characteristics*

89 Demographic data were collected using the Medical Research Council (MRC) Socio-
90 demographic Schedule modified version (Mallett *et al.*, 2002) and supplemented by clinical
91 records. For educational level, we divided the sample into three categories: No qualification,
92 school education (GCSE, 'O' levels and 'A' levels) and tertiary education (vocational, college,
93 university or professional qualification). We dichotomized the domains of employment
94 (employed vs. unemployed), marital (in a stable relationship vs. no relationship) and living
95 arrangements status (independent living vs. no independent living). For lifetime use of alcohol
96 and illegal drugs, we collected data from the GAP baseline measures, and split both into ever
97 used (1) vs. never used (0). Lifetime use of cannabis was assessed with the Cannabis
98 Experience Questionnaire modified version (Di Forti *et al.*, 2009), dividing patients into those
99 who reported ever having used cannabis (1) and those who reported never having used it (0).
100 Ethnicity was self-ascribed using categories employed by the 2001 UK Census
101 (<http://www.ons.gov.uk/ons/guide-method/census/census-2001/index.html>). Due to small
102 numbers in some ethnic categories, we combined them into three broad ethnic groups: white
103 (all white groups); black (all black groups); and other (encompassing Asian, mixed ethnicity
104 and other ethnicities).

105 2.2.2. *Clinical assessments at baseline.*

106 Duration of untreated psychosis (DUP) was defined as the difference between the date of the
107 appearance of the first positive psychotic symptom and the date of initiation of treatment with
108 antipsychotics, in weeks (Norman and Malla, 2001).

109 The baseline diagnoses were made from interviews and mental health records utilizing the
110 Operational Criteria Checklist (McGuffin *et al.*, 1991) and were grouped using ICD-10 into:
111 affective psychosis group (patients diagnosed with codes F30-33) or schizophrenia-spectrum
112 disorders group (ICD-10 codes F20-29) (Trotta *et al.*, 2016). For those who did not meet
113 criteria based on ICD-10 we extracted the diagnosis from the same OPCRIT assessment
114 based on DSM-IV, grouping them into: affective psychosis (patients diagnosed with bipolar
115 disorder, manic episode with psychosis or major depression with psychotic features - codes
116 296-296.9-) or schizophrenia-spectrum disorder (for schizophrenia, schizoaffective disorder,
117 delusional disorder and psychotic disorder NOS - codes 295.1-295.9 and 297.1-298.9-).

118 Symptomatology at baseline was rated on the Positive and Negative Syndrome Scale
119 (PANSS) (Kay, Fiszbein and Opler, 1987), from face-to-face interviews in the week
120 preceding the assessment. The 30 items that comprise the scale are divided into positive,
121 negative and general psychopathology scales. A confirmatory factor analyses (CFAs) was
122 conducted of the Wallwork/Fortgang five-factor model (Wallwork *et al.*, 2012). This
123 Wallwork/Fortgang five-factor model has been shown to be the most robust PANSS factorial
124 solution for exploring symptom profiles in FEP patients (Langeveld *et al.*, 2013) and has
125 previously used in this sample (Ajnakina *et al.*, 2016, 2017). Global Assessment of
126 Functioning (GAF) was used to measure both overall symptoms severity and disability
127 associated with the illness at the study entry (Endicott *et al.*, 1976). We complimented the
128 GAF with the Clinical General Impression scale (CGI) (Guy, 1976).

129 Baseline General intelligence was assessed using a brief version of the Wechsler Adult
130 Intelligence Scale—Third Edition (WAIS-III) (Wechsler, 1997) which includes a standardized
131 set of 5 tasks (Information, Block Design, Matrix Reasoning, Digit Symbol Coding and Digit
132 Span) to give a prorated intelligence quotient (IQ)..

133 2.2.3. *Jumping to conclusions*

134 For the measurement of the Jumping to Conclusions (JTC) bias participants had to complete
135 both versions of the probabilistic reasoning 'Beads' Task (Garety *et al.*, 2005), with beads in
136 85:15 and 60:40 ratios. Participants are shown two jars containing coloured beads in opposite
137 ratios (e.g., in one of them the proportion was 85 black versus 15 orange and in the other the
138 ratio was reversed). Beads are then drawn from one of the two jars (randomly chosen by the
139 computer), one at a time. After each draw the participants can either make a guess about
140 which jar the beads come from or request a new bead. Participants will only have a single trial
141 in which they can ask as many beads as they need to make their final decision. The two main
142 variables classically extracted from the "Beads Task" are: a continuous variable defined as the
143 numbers of draws before making a decision, so-called "draws to decision" (DTD); and a
144 dichotomous variable (JTC/no JTC), in which JTC bias has been operationally defined as
145 reaching a decision after fewer than three beads (Garety *et al.*, 2005).

146

147 In this study, dichotomous rating was preferred since the distribution of the DTD variable is
148 not normal, the colour of each drawn and the sequence could influence the next decision; and
149 there is better fit with clinical validity of the dichotomous approach, as we are mainly interested
150 in identifying the extreme responders from the rest. Moreover, the use of dichotomous scoring
151 seems to be superior in predicting change in delusion conviction (So *et al.*, 2012).
152 Consequently, and based on previously published papers using different types of Beads
153 Tasks, we considered a hasty decision on any of the two versions of the task, to be evidence
154 of the tendency to JTC (Garety *et al.*, 2005; Ross *et al.*, 2011; Jolley *et al.*, 2014; So *et al.*,
155 2014; So and Kwok, 2015).

156

157 **2.3 Tracing patients at follow-up**

158 Approximately 4 years (mean=4.0, S. D=0.13) after first contact with psychiatric services for
159 psychosis, we sought to trace all FEP cases included in the original GAP study with JTC
160 scores available at baseline and who had given consent for their clinical records to be
161 accessed at follow-up. A thorough database search was carried out using the electronic
162 psychiatric records that are the primary clinical record keeping system within the SLAM Trust
163 (Electronic Patient Journey System (ePJS)). To trace those patients who dropped out from the
164 services we contacted their last known General Practitioners via mail seeking further
165 information about the patient's whereabouts and health; then patients themselves were
166 contacted wherever possible. All deaths and emigrations up to and including those that
167 occurred during the final year of follow-up were identified by a case-tracing procedure with the
168 Office for National Statistics for England and Wales and the General Register Office for
169 Scotland Further details are available in Ajnakina *et al* (Ajnakina *et al.*, 2017).

170 **2.4 Data at follow up**

171 At follow-up, extensive information was extracted across clinical and social domains, and
172 patterns of care, from electronic psychiatric clinical records using the WHO Life Chart
173 Schedule (LCS) extended version (Sartorius *et al.*, 1996).

174 *2.4.1 Clinical outcomes*

175 Remission was defined as an absence of overt psychotic symptoms for ≥ 6 months similar to
176 earlier work conducted in the same geographical region (Morgan *et al.*, 2014; Revier *et al.*,

177 2015) and in line with operational criteria (Andreasen *et al.*, 2005) using information extracted
178 from clinical records. This measure of remission was neither dependent on absence of non-
179 psychotic symptoms (e.g. depressed mood, neurotic manifestations), nor on whether patients
180 were receiving treatment with antipsychotic medications during remission.

181 2.4.2 Service use

182 Utilising the LCS extended version (Sartorius *et al.*, 1996) and excluding hospital admission
183 on first contact with mental health services for psychosis, we extracted detailed information
184 on circumstances of each re-admission including all compulsory admissions (i.e., admissions
185 exercised under MHA legislation) and instances when police was involved at the time of, or
186 shortly before, hospital admissions throughout the 4-year follow up period. Compulsory
187 admission under the MHA has been previously used for analysing pathways of care in similar
188 samples of the area of South London (Davies *et al.*, 1996; Morgan *et al.*, 2005b); and more
189 recently instances of police involvement has been also applied to measure pattern of care in
190 this same sample (Ajnakina *et al.*, 2017). Using the admission and discharge dates for each
191 re-admission, we calculated the total length of inpatient stays in psychiatric wards during the
192 entire follow up period.

193 2.5 Analyses

194 All analyses were conducted in STATA release 14 (STATA Corp, 2015).

195 *Descriptive statistics.* The basic characteristics of the sample including socio-demographics
196 (gender, age, ethnicity and educational level) and clinical information (DUP, diagnosis and
197 length of follow-up) were described using frequencies, percentages, mean and standard
198 deviations (SD), median and interquartile ranges (IQRs). The comparisons between FEP
199 groups based on the presence or not of the bias were made using chi-square, Student's t test
200 or Wilcoxon-Mann-Whitney tests when appropriate. Normality of all variables was assessed
201 computing Shapiro-Wilk normality test. . For the investigation of cross-sectional relationships
202 at follow-up between JTC and clinical outcome, we ran Wilcoxon-Mann-Whitney tests for "days
203 of hospitalization" as it is not normally distributed, and Chi-square for the three dichotomous
204 categorical variables: MHA intervention, police intervention and remission (yes/no). Effect
205 sizes were calculated for all the statistical tests using Cohen's *d* for t-test and Cramer's V (Φ_c)
206 for chi-square. When Mann-Whitney test is used, effect sizes from z values were calculated.

207 *Confirmatory Factor Analysis (CFA).* The detailed description of methods employed to conduct
208 CFA using this sample is available in Ajnakina *et al.* (Ajnakina *et al.*, 2016). Briefly, CFA was
209 conducted to evaluate the statistical fit (Stefanovics *et al.*, 2014) of the Wallwork/Fortgang five-
210 factor model of psychosis (Wallwork *et al.*, 2012) in this sample. This model includes positive
211 (P1, P3, P5, G9), negative (N1, N2, N3, N4, N6 and G7), excited (P4, P7, G8 and G14),
212 disorganised/concrete (P2, N5, G11), and depressed (G2, G3, G6) factors; which were used
213 as confounders for regression analyses.

214 Association analysis. The main hypothesis was tested by four regressions with the
215 dichotomous rating of JTC as the dependant variable (JTC=1; no JTC=0). a Negative Binomial
216 regression for the not normally distributed count dependent variable "days of hospitalization"
217 as it was over dispersed; and logistic regression analyses for the binary variables (clinical
218 remission, MHA intervention and police intervention). These regressions were calculated both
219 unadjusted and adjusted for age, gender, ethnicity, IQ, symptom dimensions and functional

220 level measured by GAF. In the regression model for predicting days of admission, we
221 performed further adjustment of the model including the dichotomy variables of MHA and
222 police intervention, as they both could be confounders for longer admission.

223 **3. RESULTS**

224 Follow-up was successfully completed for 82.9% (n=102) of baseline patients, with a total of
225 17.1% lost (n=21). Of those 21, 2 (1.6%) had died, 6 (4.9%) had emigrated, 4 (3.3%) were
226 excluded as we did not have available information on follow-up and in 9 (7.3%) the attempt
227 at contact was unsuccessful. When comparing baseline sociodemographic characteristics of
228 those subjects lost at follow-up with those included, we did not find any significant difference
229 in age, gender, educational level, ethnicity nor diagnosis (please refer to the Supplementary
230 Table 2). Nonetheless we found significant differences in baseline symptomatology, with
231 more severe symptoms in the lost subjects compared with those who completed follow-up
232 (positive subscale of PANSS 16.6 vs 13.52 respectively; $t(113)=.21$, $p=0.03$; GAF symptom
233 subscale 42.22 vs 52.8 respectively, $t(105)=2.11$, $p=0.04$). Hence, it is not possible to reject
234 the possibility of attrition bias.

235 **3.1 Patient characteristics at baseline**

236 Sociodemographic and clinical information of the baseline sample is shown in Table 1. The
237 mean age at first contact was 29.4 years (S.D.=10.03); n=75 (61%) of the sample were men,
238 38% were of white ethnicity and n=58 (49%) had tertiary education. Of the total 123 patients,
239 n=63 (51.2%) had shown JTC and n=92 (74.8%) had received a diagnosis of a schizophrenia
240 spectrum disorder.

241 **[insert Table 1 here]**

242 Table 2a shows the comparison of baseline sociodemographic and clinical characteristics
243 between patients with and without JTC bias (JTC/no JTC groups). We found no statistically
244 significant differences in age, gender, DUP, follow-up time, ethnicity or educational level. In
245 terms of lifetime substance use, there was no statistically significant differences regarding
246 consumption of cannabis by JTC. As far as social functioning is concerned, no difference was
247 found in employment or marital status according to JTC, but there was a significant difference
248 in living arrangements, with a higher proportion of non-independent living in those presenting
249 the bias (46.8% vs 27.1%; $X^2(1)=5$, $p=0.03$).

250 **[insert Table 2a here]**

251 The baseline clinical status characteristics are presented in Table 2b. There was no statistically
252 significant difference in diagnosis between JTC groups ($p=0.72$). To our surprise,, we did not
253 find significant differences in scores on the Positive Symptoms subscale of the PANSS(14.78
254 ± 6.11 vs 13.27 ± 5.38 ; $p=0.22$). We found significant differences in IQ (mean of 85.95 ± 14.31
255 for those presenting JTC and 94.96 ± 13.94 for those without the bias; $d=0.64$ $p=0.001$).
256 Functionality measured by the GAF scale was worse in patients with JTC (mean of $55.38 \pm$
257 16.7) than the patients without it (mean of 61.92 ± 16.63 ; $t=2.02$ $d=0.39$ $p=0.05$).

258 **[insert Table 2b here]**

259 **3.2 Clinical presentation over the follow up period**

260 The comparison of clinical outcome domains during follow-up is presented in Table 3. Fifty-
261 eight percent (n=29 of 50) of the individuals with the bias and 64% (n=31 of 48) of those
262 without JTC achieved remission criteria in the long-term; this difference was not statistically
263 significant ($\chi^2=0.45$, $df=1$, $p=0.5$).

264 **3.3 Service use over the follow up period**

265 The comparison of service use variables during follow-up are also presented in Table 3.

266 In the follow-up period, on average, patients presenting JTC had more inpatient days
267 (median=56, IQR=20-158), than those without the bias (median=15.5, IQR=0-93.5; $U=-2.08$,
268 $p=0.04$). A higher proportion of patients with the JTC bias (N=27, 65.8%) were detained under
269 the MHA than those without JTC (N=13, 37.1%; $X^2(1)=6.24$; $p=0.01$) The percentage subject
270 to police involvement in compulsory admission during follow-up show a tendency to be higher
271 in the patients with JTC [N=23 (56.1%) out of 41] than in those without the bias [12 (34.3%)
272 out of 35], but this did not reach significance [$X^2(1)=3.62$; $p=0.06$].

273 **[insert Table 3 here]**

274 **3.4 Predicting effects of JTC on long-term clinical outcome.**

275 Predictors effects of JTC on long-term clinical outcome are presented in Table 4.

276 Regression analyses showed that the presence of JTC predicted more inpatient days
277 (IRR=2.18, 95% CI 1.01-4.72, $p=0.05$) and more proneness to intervention under the mental
278 health act (OR=5.9, 95% CI 2.04-17.05, $p=0.001$) and by the police (OR=4.18, 95% CI 1.46-
279 11.98 $p=0.008$) in the moment of admission. After adjusting for age, gender, ethnicity, IQ and
280 symptoms and disability measured by GAF, the effect remained significant for days of
281 hospitalization (adjusted IRR=5.03, 95% CI 1.91-13.24, $p=0.001$), use of the MHA (adjusted
282 OR=15.62, 95% CI 2.92-83.54, $p=0.001$) and police involvement (adjusted OR=14.95, 95%
283 CI 2.68-83.34, $p=0.002$). There was no predictive effect on remission.

284 **[insert Table 4 here]**

285 Additionally, all the OR with 95% confidence intervals and p values for all covariates of four
286 full regression models are presented in the Supplementary material (Supplementary Table
287 3).

288 **4. DISCUSSION**

289 The presence of JTC at baseline was associated with subsequent greater risk of compulsory
290 admissions under the MHA and higher risk of police intervention at follow up, confirming our
291 preliminary hypothesis. Why that should be is as yet unclear. One possible explanation is that
292 JTC is related to behaviours such as impulsivity, beyond general cognitive and executive
293 impairments, although evidence for this association has not been demonstrated conclusively
294 (Moritz and Woodward, 2005; Rubio *et al.*, 2011; Lunt *et al.*, 2012); however, the studies
295 claiming to look at this association have not employed a specific measure of impulsivity.

296 Another possible explanation for our findings could be a relationship between data-gathering
297 bias and risk of aggressive behaviour or violence. The link between schizophrenia and
298 violence has been previously studied (Fazel *et al.*, 2009), but it has been challenging to identify
299 the processes underlying this association. Despite discrepancies in the literature,

300 neurocognition seems to be one of the core risk factors for violence, mediated by several
301 proximal and more direct risk factors(O'Reilly *et al.*, 2015). In addition, it has been shown that
302 positive psychotic symptoms, including persecutory ideation, increase the risk of minor and
303 serious violence (Swanson *et al.*, 2006). Given the relationship between JTC and the
304 proneness and maintenance of delusion ideation, this could also explain part of the association
305 of JTC and the higher need for police and MHA interventions in the moment of admission.

306 One mediating factor may be insight. Preliminary work on this cohort showed that JTC bias
307 and cognition were each associated with poorer recognition of illness (Wiffen *et al.*, 2010).
308 Furthermore, the relationship between JTC and insight has been explored in schizophrenia
309 patients in forensic settings and it was found a direct correlation between the information
310 patients consider in making decisions and their clinical insight (Kuokkanen *et al.*, 2016). Given
311 that poor clinical insight was found to be a risk factor for violence, and following the same
312 rationale (Alia-Klein *et al.*, 2007), lack of insight could be a possible additional explanation for
313 the need of police intervention in those presenting hasty-decision style; and indeed poor
314 insight is strongly associated with involuntary treatment in hospital(David *et al.*, 1992). Thus,
315 insight could have had an impact in the association between JTC and the intervention of police
316 and MHA, so further studies focusing on the relationship between JTC and insight should be
317 encouraged. Nonetheless, the interpretation of the need for police intervention as a proxy for
318 social or behavioural disruption should be cautious. Previous work from the same area found
319 that the higher police involvement at time of admission in the African Caribbean group was
320 explained by the greater likelihood of such families to seek help from police themselves in
321 these situations than White British families (Morgan *et al.*, 2005b).

322 The other effect predicted by JTC was number of days of hospitalization. This outcome is one
323 of the most employed markers of service use in order to study the clinical course of psychosis
324 (Johnstone *et al.*, 1990; Geddes *et al.*, 1994; Takei *et al.*, 1998; Lehtinen *et al.*, 2000; Cahn *et al.*,
325 2002; Möller *et al.*, 2002; Thara, 2004; Nordentoft *et al.*, 2010; Heslin *et al.*, 2016). As JTC
326 is thought to be critical in delusion formation by contributing to erroneous interferences
327 (Garety, Hemsley and Wessely, 1991), it is reasonable to expect an effect on inpatient length
328 of stay.

329 Contrary to our hypothesis, an association between JTC and remission rates at follow-up was
330 not significant. As noted above, JTC is linked to with the persistence of delusion ideation
331 (Falcone *et al.*, 2015) and hence less improvement in delusions over time (So *et al.*, 2014).
332 As our remission outcome was based on Remission in Schizophrenia Working Group (RSWG)
333 (Andreasen *et al.*, 2005) which includes delusions, we expected that the presence of
334 reasoning bias at baseline would have been inversely related to the achievement of remission
335 at follow-up. One of the reasons for the lack of effect could have been a ceiling effect for our
336 sample, as reported rates of RSWG remission range between 48-61% for first-episode
337 patients (Lambert *et al.*, 2010); and in our patients, the percentages of remission were above
338 that range.

339 The relationship between the presence of JTC and cognitive impairments has been widely
340 studied in both schizophrenia patients and healthy participants, especially with working
341 memory (Garety *et al.*, 2013), executive functions (Woodward *et al.*, 2009; Rubio *et al.*, 2011),
342 verbal memory (Keefe, Eesley and Poe, 2005; Lee and Park, 2005; Forbes *et al.*, 2009;
343 Fatouros-Bergman *et al.*, 2014), and cognitive processing speed (Ochoa *et al.*, 2014). The
344 potential effect of neurocognition on clinical outcome is well known (Lam, Raine and Lee,

345 2014). In our study, we found a negative association between IQ and JTC, but the associations
346 in the regressions models remain statistically significant when IQ was added as confounder in
347 the adjusted model. Nonetheless, the evidence supporting the association between some
348 neurocognitive domains and JTC talks in favour of encouraging new studies with bigger
349 samples to include not only IQ but also other cognitive measures as confounder factors in the
350 association of JTC and clinical outcome.

351 Our evidence that the presence of JTC appears to be linked to poor outcome variables makes
352 it a potential target for therapies aiming to improve the prognosis of the illness. There is a body
353 of literature showing that changes in JTC are directly linked with changes in symptomatology
354 (Dudley *et al.*, 2013; Sanford *et al.*, 2013; Garety *et al.*, 2015). Furthermore, psychotherapeutic
355 interventions have been developed for overcoming biases in metacognition, including JTC,
356 which have been proven to be effective in reducing the tendency to make hasty decisions and
357 in improving outcome for people with psychosis, such as the Maudsley Review Training
358 Programme (Waller *et al.*, 2011), Metacognitive Training (MCT) (Moritz *et al.*, 2014a, b) and
359 Social Cognition and Interaction Training (SCIT)(Roberts *et al.*, 2014). Our study raises the
360 question of whether the implementation of these specific interventions to reduce Jumping to
361 conclusions may be a useful addition in early psychosis intervention programs.

362 **Limitations and Strengths**

363 Among the main limitations in our study are the lack of inclusion of more neurocognitive
364 measures and the small sample size, which limited the inclusion of more confounders in the
365 regression models. Nonetheless, a general IQ measure was used as confounder. Another
366 limitation is the lack of information regarding co-morbid diagnosis at baseline and follow-up
367 that may have had an impact in clinical outcome. A potential methodological limitation is the
368 information bias arising from loss and missing data at follow-up. Although we completed follow-
369 up for 82.9% of patients, we found statistically significant differences in symptomatology
370 between those who completed the follow-up and those who were lost. Specifically, those lost
371 participants had higher scores in the subscale of positive symptoms of PANSS. Our findings
372 may therefore not be generalizable to the more severely affected patients. Lastly, it should be
373 noted that by only performing one trial per version, as widely used in JTC beads tasks, may
374 allow results to be affected by miscomprehension (Balzan *et al.*, 2012), with a tendency to
375 overestimate the presence of JTC.

376 On the other hand, one of the strengths of our study is the inclusion in the regression analyses
377 of ethnicity and other important socio-demographic confounders. It has been shown in
378 previous works with a sample from the same area that there exists a higher risk of compulsory
379 admission and longer admission among African–Caribbean and Black African patients
380 (Morgan *et al.*, 2005a; Ajnakina *et al.*, 2017), but a strong association between JTC and
381 compulsory admission remained in our study after adjusting by ethnicity.

382 **Conclusions**

383 JTC is a data-gathering bias that has been consistently proved to be associated to psychotic
384 patients. Our study found that its presence at FEP is associated with worse clinical outcome,
385 reflected by more days of admissions, greater need for compulsory hospitalization and police
386 intervention. This raises the question of whether more efforts should be devoted to developing
387 and applying therapies focusing on JTC as possible target.

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