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Letter to the Editors

Logical reasoning deficits in schizophrenia

There is a history of testing schizophrenic patients on logical reasoning tasks (Domarus, 1964; Goldman 1969; Hartlage and Garber, 1976; Watson and Wold, 1981; Watson et al., 1976). The data have been mixed, but there is some evidence that patient reasoning ability is adversely affected by situations that involve salient, meaningful beliefs (Ho, 1974, 1976; Mujica-Parodi et al., 2000). To test this hypothesis, we administered syllogisms, varying in beliefs, to 23 schizophrenic patients ($M=19$, $F=4$) and normal controls and asked them to determine whether the conclusion followed logically from the premises.

Patients were diagnosed as fulfilling DSM IV criteria for schizophrenia by a consultant psychiatrist (one of the authors: DSC). All had a history of positive symptoms and 15 of them also showed negative symptoms. Patients were in remission at time of testing, and had no cognitive or behavioural defects that prevented them from giving informed consent and fully cooperating in the tests. All patients were receiving neuroleptic medication either in oral or depot form (average 425 mg, SD 339 mg chlorpromazine equivalent per day, range 50–1200 mg). Other additional medications included: regular anticholinergics ($N=5$), mood stabilisers (lithium $N=2$, carbamazepine $N=1$) and antidepressants ($N=1$). Cognitive baselines were established with the Raven Coloured Progressive Matrices (RCPM), the National Adult Reading Test (NART) (Nelson and Reed 1976) and the Vocabulary subtest from the Wechsler Adult Intelligence Scale-III (WAIS-III).

Belief-laden (24) belief-neutral syllogisms (24), encompassing 14 different logical forms were presented to both groups of participants. The belief-laden arguments contained content sentences that

subjects could be expected to have beliefs about (A). The belief-neutral arguments contained sentences that subjects would not have beliefs about (because they would not know the meaning of one or more key terms), as in (B). The belief-laden arguments were equally subdivided into salient and non-salient arguments. The salient arguments contained emotionally charged sentences (C) while the non-salient arguments contained emotionally neutral sentences (D).

- (A) All female horses are deaf; No deaf horses are fast runners ∴ No fast animals are female horses.
- (B) Some ploms are not dihedral; No moduluses are ploms ∴ Some moduluses are dihedral.
- (C) No drunks are saints; Some Irishmen are saints ∴ Some Irishmen are not drunks
- (D) All crunchy tubers are vegetables; Some carrots are crunchy tubers ∴ Some carrots are not vegetables.

A multivariate analysis of variance with repeated measures, using education and scores on the NART and the Vocabulary subtest as covariates was carried out on accuracy scores. This analysis was done to test for the main effects of Group and Belief, and for the Group (patients and controls) by Belief (salient belief, non-salient belief, and non-belief) interaction. There was a main effect of group, $F_{(1,41)} = 16.87$, $p < 0.001$. Overall controls performed more accurately on the reasoning task than the schizophrenics (mean 65.16%, SD = 12.98 for the controls versus mean 48.14%, SD = 31.83 for the patients). There was no main effect of Belief, nor any significant Group by Belief interaction.

An examination of means in Table 1 suggests that performance in the control group improved in the non-salient trials while patient performance was unaffected by saliency. This suggests that while there was no effect of belief, there may be an effect of saliency. To explore

Table 1

Mean accuracy (and SD) and mean response time (and SD) scores for salient belief, non-salient belief, and non-belief trials

	Salient belief		Non-salient belief		Non-belief	
	Accuracy (%)	Time (ms)	Accuracy (%)	Time (ms)	Accuracy (%)	Time (ms)
Patients	52.56 (11.90)	14,048 (6065)	49.28 (10.48)	14,501 (6660)	42.39 (19.12)	17,290 (9910)
NC	63.41 (13.63)	12,840 (3746)	71.20 (11.78)	12,599 (3454)	60.87 (13.63)	16,149 (4849)

this latter effect, we discarded the non-belief condition from further analysis and ran a multivariate analysis of variance with repeated measures, using education and scores on the NART and the Vocabulary subtest as covariates. There was a significant main effect of group, with controls outperforming patients (mean 67.30%, $SD=12.62$ vs. mean 50.91, $SD=11.19$), $F_{(1,41)}=18.71$, $p<0.001$. There was no main effect of saliency, but there was a significant Group (patients and controls) by Saliency (salient belief and non-salient belief) interaction, $F_{(1,41)}=4.33$ $p=0.04$.

In summary, schizophrenic patients were impaired in all reasoning conditions, but more critically, patient performance failed to improve in the non-salient belief condition (resulting in a significant Group by Belief interaction) suggesting that they are unable to fully mobilize the belief-laden reasoning mechanism, associated with the frontal-temporal lobe system (Goel et al., 2000).

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References

- Domarus, E.V., 1964. The specific laws of logic in schizophrenia. In: Kasanin, J.S. (Ed.), *Language And Thought In Schizophrenia*. University Of California, Berkeley, pp. 104–114.
- Goel, V., Buchel, C., Frith, C., Dolan, R.J., 2000. Dissociation of mechanisms underlying syllogistic reasoning. *NeuroImage* 12 (5), 504–514.
- Goldman, J., 1969. Syllogistic reasoning in normals and schizophrenics. Proceedings of the 77th Annual Convention of the American Psychological Association. APA, Washington DC, pp. 579–580.
- Hartlage, L.C., Garber, J., 1976. Spatial vs. nonspatial reasoning ability in schizophrenics. *J. Clin. Psychol.* 32 (2), 235–237.
- Ho, D.Y., 1974. Modern logic and schizophrenic thinking. *Genet. Psychol. Monogr.* 89 (1), 145–165.
- Ho, D.Y., 1976. Medication, logic, and schizophrenic thinking: a reply to Marini. *J. Genet. Psychol.* 129 (1st Half), 93–95.
- Mujica-Parodi, L.R., Malaspina, D., Sackeim, H.A., 2000. Logical processing, affect, and delusional thought in schizophrenia. *Harv. Rev. Psychiatry* 8 (2), 73–83.
- Nelson, D.L., Reed, V.S., 1976. On the nature of pictorial encoding: a levels-of-processing analysis. *J. Exp. Psychol. Hum. Learn. Mem.* 2 (1), 49–57.
- Watson, C.G., Wold, J., 1981. Logical reasoning deficits in schizophrenia and brain damage. *J. Clin. Psychol.* 37 (3), 466–471.
- Watson, C.G., Wold, J., Kucala, T., 1976. A comparison of abstractive and nonabstractive deficits in schizophrenics and psychiatric controls. *J. of Nerv. Ment. Dis.* 163 (3), 193–199.

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