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Thinking about semantic concepts in schizophrenia: the more familiar the less deviation

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Dear Editor,

Numerous tasks have been employed to examine putative semantic deficits in schizophrenia. In a semantic sentence verification task, patients made more errors and were slower establishing veridicality ("Desks wear clothes" - Tamlyn et al., 1992), and when knowledge of living and human-made items was probed performed worse on most tests (MacKay et al., 1996). Other studies suggest semantic knowledge is represented equivalently (Cohen et al., 2005). Furthermore, some techniques (multidimensional scaling and clustering techniques to analyze category fluency and triad comparison data) employed to suggest increased variability is attributable to semantic deficits fail statistical requirements concerning consistent and reliable variability across participants (Elvevåg & Storms, 2003). This renders many techniques ill-suited for clinical populations where there is an implicit assumption about more variance (Prescott et al., 2006; Storms et al., 2003). Although such findings do not refute the hypothesis of semantic deficits in schizophrenia, they highlight the need for tests better suited where variability within and between patients exists.

Therefore we collected typicality ratings of categories (e.g., how typical is milk of the category food) to establish whether patients and controls agree on how representative an item is of its category (Elvevåg et al., 2005). Typicality predicts performance on category-related tasks, such as speed of categorization (Smith & Medin, 1981) and inductive inference (Osherson et al., 1990). Our examination of consistency and reliability of typicality ratings (i.e., interindividual consistency within patients and controls and between control and patient groups) revealed similar correlations both between and within each group. The inter-patient consistency derived was high compared to that from fluency and triad tasks, and semantic representations in schizophrenia paralleled those in healthy participants.

However, this begs the question of what aspect of semantics accounts for the unusual speech and comprehension deficits in schizophrenia. It is possible that anomalies are present in more value-laden concepts. Therefore, we examined concepts differing in variance (i.e., more variance in less well defined and value-laden categories), and adopted feature verification to directly assay core semantic knowledge (as compared with category fluency which is susceptible to pragmatic influences; Medin et al., 1983).

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Patients were from the NIMH and met schizophrenia criteria (Structured Clinical Interview for DSM-IV). Healthy controls were recruited through the NIH volunteer office. The study was approved by the NIMH internal review board and informed consent was obtained.

First, eight patients and eight controls produced between twelve and fifteen examples of 'mammals', 'vehicles', 'furniture', 'illnesses', 'professions', and members in a 'family', and then listed ten to twelve features best describing these categories. These data were used to create a matrix for each category - of exemplars by features - that was equivalent for patients and controls.

Second, the matrices were presented via paper to 27 patients and 21 controls. To illustrate, for 'mammals' some of the exemplars (listed vertically) were 'cat', 'human' and 'dog', and some features (listed horizontally) were 'nose', 'fur' and 'eyes'. The task was to specify whether each feature was present (1) or not (0) in each exemplar.

Despite patients' overall lower intelligence (WAIS-R), verbal output (verbal fluency) and memory (WMS-R) (all p 's < 0.05), patients' and controls' conceptual structure was strikingly comparable. However, individual differences must be examined since group - especially patient - data may look very different from individual data. Thus, for each concept, a goodness-of-fit (product-moment) correlation was calculated between raw matrices of every pair of participants (patients-patients (PP), controls-controls (CC), patients-controls (PC)) thus forming the dependent measure, and independent variable was type of pair from which the value originated. The ANOVA (randomized factorial design) consisted of two independent variables: group (CC, PC, and PP) and concepts ('family', 'furniture', 'illnesses', 'mammals', 'professions', 'vehicles').

A main effect of group ($F(2,5920)=328.77$, $p<.0001$) revealed correlations in the CC group significantly higher than in the PC group, and the latter significantly higher than in the PP group (as in Ellevåg & Storms (2003); Ellevåg et al. (2005)). The main effect of semantic concept ($F(5,5920)=440.12$, $p<.0001$) showed correlations from high to low for 'vehicles', 'mammals', 'illnesses', 'furniture', 'professions', and 'family' (all pairwise contrasts significant). Group $\times$ concept ($F(10,5920)=2.86$, $p<.0015$) revealed differences between the CC and PP group the differences for 'family' larger than for other concepts ($F(1,5920)=15.85$, $p<.0001$), but for 'professions' and 'mammals' smaller than for other concepts ($F(1,5920)=4.48$, $p=.0343$; and $F(1,5920)=10.44$, $p=.0012$. respectively) (see Figures 1 and 2).

As expected, patients performed worse than controls and this varied depending upon concept: less for familiar concepts (mammals), average for most, but increasingly worse for value-laden concepts (family). In summary, this method provides a direct and robust assay of semantics. Additionally, our findings highlight that methods adopting statistical 'averaging' run the risk of being flawed in clinical populations.

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Figure 1.

The average correlation values for the six concepts for the CC and the PP group. The concepts are ordered on the X-axis according to how large the difference between the CC and PP group is, and thus the first two are significantly smaller than average, and the last one is significantly larger than average.

[PANEL A]

[PANEL B]

Figure 2.

The size of the difference between CC and PP groups (Panel A) and the size of the average correlation (averaged over the three groups) in the main effect of concept (Panel B). Thus, although at first glance it would seem from Figure 1 that the correlations run parallel - as is evident in the contrast analysis - this is in fact not the case.