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Conceptual combination and language in schizophrenia

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Dear Editor,

Unconventional discourse is a noteworthy feature in schizophrenia. Semantic priming methodology underlies the influential theory that abnormalities accessing semantic representations - through spreading activation within a network - is the core mechanism for subsequent problems forming meaningful and coherent speech (Goldberg & Weinberger, 2000). These tasks demonstrate faster responses to words (“orange”) preceded by associated words (“lemon”) than unrelated words (“desk”).

However, there are limitations with this framework. First, language involves processes other than spreading activation between associated words. For example, in both sentences “Marcella ate the spaghetti with the marinara sauce,” and “Marcella ate the spaghetti with a large fork,” “spaghetti” is associated with and primes “sauce” and “fork.” However, understanding the former sentence requires inferring Marcella ate “sauce” but understanding the latter sentence requires inferring Marcella used a fork to eat “spaghetti.” Also, most people understand “ladder box” as a “box containing a ladder” even though “box” is not highly associated with “ladder” and unlikely to prime “ladder.” Indeed, language understanding requires combining *familiar* concepts to create *novel* representations.

Second, the primary measure of reaction time differences is both larger and more variable in patients, and corrections (e.g., priming percentage) remain problematic to interpret (Faust et al., 1999).

Third, results from semantic priming studies in patients are variable, showing enhanced, impaired or normal spreading of automatic activation, or impaired controlled processing (Minzenberg et al., 2002), with thought-disordered patients showing enhanced priming compared to healthy controls, but not when compared to patients without thought disorder (Pomarol-Clotet et al., 2008), although the authors acknowledge the effects could be artifacts of patients’ slower responses.

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Given such inconsistent findings and methodological problems, we assessed language understanding by explicitly probing interpretations of novel noun-noun expressions. People frequently combine familiar concepts into *novel phrases* (“boomerang flu”) specifying referents in discourse contexts and extending the expression of language. Crucially, there are specific rules or strategies by which novel combinations are interpreted. We capitalized on these robust effects and explored to what extent patients interpret novel phrases in a lawful manner. Specifically, we examined whether patients would combine concepts to produce *relation* interpretations (robin snake: “snake that eats robins”), *property* interpretations (goose duck: “duck with long neck”) or *hybrid* interpretations (goose duck: “cross between a duck and a goose”). Additionally, we evaluated the *similarity effect* that when combined concepts are highly similar (“skunk squirrel”) property or hybrid interpretations are frequently produced, but when dissimilar relation interpretations are more likely (Parault, Schwanenflugel, & Haverback, 2005; Wisniewski, 1996; Wisniewski & Love, 1998).

Patients (n=24; all medicated) were from the NIMH and met schizophrenia criteria (Structured Clinical Interview for DSM-IV). Healthy controls (n=21) were recruited through the NIH volunteer office. The study was approved by the NIMH internal review board and informed consent was obtained.

Novel combinations of highly similar constituents (“mosquito fly”) and dissimilar constituents (“knife truck”) (from Wisniewski, 1996 - Experiment 2) were presented orally one at a time and participants provided a description of the most likely meaning (see Table 1). Interpretations were scored blindly as relation, property or hybrid interpretations. Misinterpreted, vague or idiosyncratic responses were scored as “other” (mosquito fly: “mosquito that is flying”).

Despite patients’ overall lower intelligence (WAIS-R), verbal output (fluency) and memory (WMS-R) (all p ’s<.05), patients’ and controls’ performance was strikingly comparable: Both groups primarily produced property and hybrid interpretations to highly similar combinations (cow horse: “horse that has spots”) and primarily relation interpretations to dissimilar combinations (knife truck: “truck that delivers knives”). For similar combinations, patients produced 71% property interpretations versus 74% for controls, and for dissimilar combinations, patients produced 81% relation interpretations versus 85% for controls (in both cases, $t < 1$). Patients produced more “other” relations (i.e., misinterpreted, vague or idiosyncratic responses), 15% versus 7.9% for controls ($p > .1$). However, the majority of “other” interpretations were produced by six patients and one control who gave 30% or more such interpretations¹. When data from these participants were discarded, percentages of “other” responses were equal for both groups (6.4%).

By explicitly probing interpretations of novel noun-noun expressions we find patients both interpret concepts similarly to healthy people and use similar cognitive processes to access these concepts. Thus, the production of unconventional speech cannot be attributable to how patients represent and combine concepts, since this is strikingly similar to that of controls. It has been argued that accessing interpretations of novel combinations - especially relational interpretations - may be differentially affected by symptoms, specifically thought disorder (Titone et al., 2007). Our patients displayed a wide range of symptoms (PANSS) but there was no meaningful relationship between their symptoms and types of interpretations (all p ’s>.05). In conclusion, we do not find support for differences in the representation and combination of concepts in schizophrenia, and thus the idea that production of unconventional speech is attributable to this seems improbable.

¹Importantly these patients shared similar symptom and intelligence scores to the overall group.

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Table 1

Similar and dissimilar combinations used

Similar	Dissimilar
bus truck	book plastic
cow horse	bus chair
cup bowl	cow cabbage
goose duck	drill pamphlet
igloo tent	knife truck
mosquito fly	ladder box
saxophone trumpet	motorcycle screwdriver
skunk squirrel	robin snake
tiger pony	stone rake
whiskey beer	vase clay