

## The Role of Neurocognition and Social Context in Predicting Community Functioning Among Formerly Homeless Seriously Mentally Ill Persons

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**Objective:** To test the influence of neurocognitive functioning on community functioning among formerly homeless persons with serious mental illness and to determine whether that influence varies with social context, independent of individual characteristics. **Methods:** In metropolitan Boston, 112 persons in Department of Mental Health shelters were administered a neuropsychological test battery and other measures and then randomly assigned to empowerment-oriented group homes or independent apartments, as part of a longitudinal study of the effects of housing on multiple outcomes. Subjects' case managers completed Rosen's 5-dimensional Life Skills Inventory at 3, 6, 12, and 18 months and subjects reported on their social contacts at baseline, 6, 12, and 18 months. Subject characteristics are controlled in the analysis. **Results:** Three dimensions of neurocognitive functioning—executive function, verbal declarative memory, and vigilance—each predicted community functioning. Better executive function predicted improved self-care and less turbulent behavior among persons living alone, better memory predicted more positive social contacts for those living in a group home, and higher levels of vigilance predicted improved communication in both housing types. **Conclusion:** Neurocognition predicts community functioning among homeless persons with severe mental illness, but in a way that varies with the social context in which community functioning occurs.

*Key words:* neurocognition/executive function/  
community functioning/homeless/housing/  
social environment

### Introduction

A sustained body of research indicates that neuropsychological deficits accompany chronic psychotic illness<sup>1–3</sup> and that these deficits predict impaired community functioning.<sup>4–6</sup> While this general association is now well established, across multiple studies of schizophrenia, there is substantial variability in the effects of cognition on community functioning.<sup>7,8</sup> This has led to additional research to clarify whether specific cognitive deficits<sup>5</sup> are associated with particular dimensions of community functioning<sup>7</sup> among particular subgroups of patients,<sup>9</sup> as well as to determine the strength of these associations,<sup>8,10</sup> the extent to which they persist over time,<sup>11,12</sup> and their generalizability from laboratory-based<sup>7</sup> and paper-and-pencil tests<sup>13</sup> to observed functioning in actual community settings.<sup>6,8,10,12</sup> However, the social context in which community functioning occurs has yet to be taken into account. Since individual functioning is necessarily a product of available opportunities as well as of individual orientation and behavior, research in actual community settings must begin to consider the social context in which that functioning occurs.

We focus on the impact of social context on the relationship between neurocognitive functioning and subsequent community functioning among homeless persons diagnosed with severe and persistent mental illness. Three neurocognitive domains have been identified in prior research<sup>4,5</sup> as frequently related to social functioning and so we use measures of these particular functions as potential predictors of community functioning. We have demonstrated in previous analyses that our sample is very impaired on these and other measures<sup>14</sup> and that performance on these measures varies in response to the experience of living in different types of housing.<sup>15,16</sup> We operationalize community functioning with multidimensional observer ratings and self-reported social contacts collected 4 times over an 18-month period after the baseline cognitive assessment. Individuals studied were

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staying in homeless shelters at the time of the initial assessment and then randomly assigned to either group homes or “Independent Apartments” (IA), allowing a statistically unbiased test of the impact of social context on the relationship between neurocognition and community functioning.

Both cross-sectional research and longitudinal research suggest that attention, memory, and executive function deficits are implicated in community functioning.<sup>4,5,17</sup> In the review of cross-sectional research by Green et al.,<sup>5</sup> declarative verbal memory was identified as a strong correlate of different types of social ability measures, while the Wisconsin Card Sorting Test (WCST, a measure of executive function) was a consistent correlate of community functioning. Although there is less longitudinal research on the effects of cognitive deficits on community functioning, a recent review<sup>6</sup> identified 14 of 18 published studies and an additional 3 unpublished studies that found moderate to large effects of baseline cognitive functioning on some aspects of community functioning at least 6 months after baseline.

With respect to the relation between specific cognitive measures and particular dimensions of community functioning, however, findings have been inconsistent across studies.<sup>6-8,11,18</sup> Verbal memory has been identified most often in longitudinal research as a predictor of social functioning,<sup>7,11</sup> but neither executive functioning nor vigilance has had consistent effects across different diagnostic categories or follow-up periods.<sup>8,9,19</sup> Correlated influences of positive and/or negative symptoms,<sup>11,18</sup> social cognition and social support,<sup>10</sup> personality traits,<sup>20</sup> abuse of alcohol and other substances,<sup>16,21</sup> skill level<sup>22</sup> and variation in effects by diagnosis,<sup>9,22,23</sup> and length of follow-up<sup>18,19</sup> may help to explain the relationship between neurocognition and community functioning, but these influences have not yet yielded a consistent explanation for the variability of findings between studies.

The social context for community functioning can constrain or enhance the expression of individual capacities and so is an essential focus for additional research. We conceive of social context most generally as the quantity and quality of social relationships available in work, residential, and community settings. Moos<sup>24</sup> refers to this as the “social climate” of employment and residential treatment settings, while Sampson<sup>25</sup> uses the term “collective efficacy” in communities. Contextual effects have not been tested directly in research on neurocognition and community functioning, but other research has identified direct effects of social context on treatment outcomes as well as interactions with individual levels of disability.<sup>24,26</sup>

## Methods

Although our study was designed to test the primary hypothesis that housing retention and other outcomes

would be more favorable among homeless persons with serious and persistent mental illness who were placed in empowerment-oriented group homes rather than IA, the resulting data are also well suited for testing the impact of social context on the relationship between neurocognitive functioning and community functioning. Our use of randomized assignment to either group or independent living controls for selection bias and provides a clear contrast in social context.<sup>27</sup> Our use of a test battery to assess neurocognitive functioning among homeless persons diagnosed with serious and persistent mental illness also allows insight into influences on community functioning in a particularly impaired population.<sup>14</sup> The structured, multidimensional clinician-based rating scale that we administered 4 times over an 18-month follow-up provides a robust measure of community functioning.<sup>28</sup>

The Massachusetts Department of Mental Health (DMH) collaborated in our study and so we recruited homeless persons from the 3 DMH-funded shelters in Boston at that time. There were 304 shelter residents at the time the study began and all were initially considered eligible for study participation. However, in order to minimize risk to persons who could be randomized to IA, a trained clinician assessed all potential subjects and, after consultation with the project principal investigator, rejected those judged at risk of harming themselves or others were they to live independently.<sup>29</sup> Participants in the study were also required to be able to speak English, to be seriously mentally ill, to be homeless, and to have given informed, voluntary consent. Of the 196 persons who met these criteria, 40 subsequently refused to participate and another 38 dropped out before moving into project housing (most commonly because they received housing from another source). Of the 118 who entered project housing, 112 completed an extensive neurocognitive assessment at baseline.<sup>14,29</sup> These procedures were approved by the Harvard Medical School Institutional Review Board for the Protection of Human Subjects.

Our housing alternatives provided a clear difference in social context. “Evolving Consumer Households” (ECH) were consumer-oriented group homes that provided 24-hour staffing for about 6–8 residents but also employed a consultant to meet weekly with residents and encourage them to make decisions collectively, take responsibility for the tasks of daily living, and thereby decrease their need for house staff. Our IA were conventional efficiency units and single room occupancy rooms for single residents in larger buildings that housed other DMH clients but provided no special services.<sup>27</sup> All subjects in both housing types received Intensive Case Management (ICM) services, ranging from brokering income benefits to counseling, throughout the project. The ICMs were all Master’s level clinicians who had an average caseload of 8, met with clients weekly or more often as needed, and were supervised by a senior project clinician.

**Table 1.** Measures and Descriptive Statistics

Measure	Description	Baseline Value $\mu$ ( $\sigma$ ) or %
Cognitive measures at baseline		
WCST perseverations <sup>14</sup>	Number of perseverative responses	46.7 (37.8)
Logical memory story recall <sup>14</sup>	Delayed recall (percentile)	22.4 (22.1)
Auditory CPT <sup>a14</sup>	Total correct of 30	19.8 (7.8)
Community functioning over time		
Ability to self-care	Cronbach's $\alpha$ = .89 (range of .82 to .88)	1.6 (0.46)
Nonturbulent behavior	Cronbach's $\alpha$ = .87 (range of .82 to .86)	1.4 (0.43)
Sociability	Cronbach's $\alpha$ = .86 (range of .77 to .81)	2.2 (0.65)
Communication	Cronbach's $\alpha$ = .84 (range of .54 to .59)	1.4 (0.35)
Responsibility	Cronbach's $\alpha$ = .81 (range of .75 to .77)	1.5 (0.52)
Number of positive social contacts	Mean of positive social contacts	3.8 (2.1)
Confounding variables at baseline		
Age	In years	37.5 (8.1)
Race	Dichotomized (minority)	49.1%
Gender	Dichotomy (female)	28.8%
Housing type	Dichotomy (ECH <sup>c</sup> )	55%
Schizophrenia or schizoaffective disorder	SCID diagnosis	67%
Lifetime substance abuse <sup>39</sup>	Symptoms reported in SCID interview: no use and some use vs abuse or dependence	61.3% lifetime abuse or dependence

<sup>a</sup>CPT, Continuous Performance Test.

Housing was provided to participants with the expectation that it would be permanent—continuing after the 18-month funded project period—but some residents spent time back in shelters or on the streets during the project period, some were hospitalized at times, and some lost their housing due to substance abuse-related problems.<sup>30</sup> Overall, 76% were housed at project end, with an average tenure for all subjects of 310 consecutive days (standard deviation = 198) in their original housing. Thirty-five percent of the subjects assigned to independent living experienced at least one episode of homelessness sometime during the project, as did 20% of those who were assigned to ECHs.<sup>30</sup>

### Neuropsychological Functioning

Neuropsychological functioning was assessed with a 5-hour test battery.<sup>14,15</sup> For the purposes of this analysis and some of our previous work,<sup>15</sup> however, we focus on the 3 domains of neuropsychological functioning that prior research has indicated are often related to social functioning: executive functioning, verbal declarative memory, and attention<sup>4,5,17,31</sup> (see table 1). The specific variables we use as measures of these 3 domains have been used often in prior research and have been the focus of our previous analyses of neuropsychological functioning in this sample: total perseverations on the WCST to measure executive functions,<sup>33</sup> the delayed condition of the Logical Memory subtest (LMS) from the Wechsler Memory Scale-Revised<sup>34</sup> to measure verbal memory (LMS), and total number of correct responses out of 30 target-spoken letters on an “X” version of an auditory

Continuous Performance Test to measure sustained attention (vigilance).<sup>14</sup>

### Community Functioning

The construct of “community functioning” itself has at times been used interchangeably with “social functioning” and at times distinguished from it.<sup>35,36</sup> We conceptualize community functioning as a multidimensional construct that includes social functioning as one dimension. The broad construct of community functioning was assessed with the multidimensional Life Skills Profile (LSP) of Rosen *et al.*,<sup>28</sup> which project case managers completed at 3, 6, 12, and 18 months after subjects moved into project housing. The LSP uses 39 simple questions about observed functioning to generate index scores for 5 dimensions: ability to self-care (involving such activities as grooming, hygiene, budgeting, food preparation), turbulent behavior (eg, degree of offensiveness, violence, intrusiveness, anger control) (reverse scored), sociability (friendships, interpersonal interests, and activities), communication (conversational skills and appropriate gesturing), and responsibility (cooperativeness and responsibility regarding personal property and medication). Case managers visited subjects weekly throughout the project, but when completing the LSP they were instructed to focus on the subject’s “general state” “over the past month.” Case managers met with clients in their residences, in community settings, and on planned shopping trips and other outings, so their LSP ratings should have taken into account functioning outside of as well as inside the project residences. Each index except communication had inter-item reliability

coefficients (Cronbach's alpha) between .75 and .88; the alpha for communication varied between .54 and .59 over the 4 time points. Prior research has demonstrated high interrater reliability of the LSP between different professional caregivers,<sup>32</sup> although no special tests of interrater reliability were conducted during the training period in this study. In addition to Rosen's scale, perceived social support was assessed with the Arizona Social Support Inventory Schedule, administered to the subjects at baseline and at 6, 12, and 18 months.<sup>37</sup> Our inclusion of this measure of social functioning in addition to the LSP's sociability index permits consideration of the effect of using a self-report measure rather than an observer rating for this critical dimension of community functioning.

Data were missing for at least some of these indicators for 12 subjects; a comparison of the characteristics at baseline for these 12 subjects to the other 100 housed subjects revealed only one difference among variables used in this analysis that was significant at the .05 level: subjects lacking measures of community functioning were younger than the others ( $t = -2.7$ ,  $df = 18.3$ ,  $P < .05$ ). We do not regard this one difference as likely to affect our results, but we control for age in the analysis and we consider this issue of generalizability in our conclusions.

#### *Potential Confounders*

In order to identify the effects of neurocognition independent of other influences, we control for several variables that prior research has indicated may be correlated with both neuropsychological and community functioning. Our measurement procedures for these variables and summary statistics are included in table 1. Two-thirds of the sample members were identified as lifetime substance abusers, using Structured Clinical Interview for DSM-IV (SCID) criteria.<sup>38</sup> This lifetime measure correlated significantly with a composite self-report based on the Addiction Severity Index and observer ratings of substance abuse during the project ( $r = .54$ ,  $P < .001$ ). It is used instead of current abuse due to the lifetime measure's higher level of validity.<sup>39</sup> Two-thirds of the sample was rated with the SCID as having schizophrenia or schizoaffective disorder and these subjects are distinguished from those with bipolar or major affective disorder or other psychotic disorders. We know from previous analyses that several demographic characteristics were related to housing preferences or likelihood of housing loss among our subjects and so these characteristics are also controlled: race (52% were white and 40% were African American), gender (30% were women) and age ( $\mu = 37$ ).<sup>30,40</sup> The composition of our sample is similar on these and other characteristics to those reported for other urban samples of homeless persons with severe and persistent mental illness, except for the smaller fraction of African Americans (as expected due to the racial composition of Boston).<sup>41</sup>

Our multivariate analysis uses hierarchical linear modeling (HLM) to test the effects of neuropsychological functioning, housing type, and the covariates on community functioning at the 4 different follow-ups.<sup>42</sup> HLM allows inclusion of cases with missing data at any time point, thus basing estimates on the full set of available data. HLM also takes into account the correlated error terms for individuals living in the same households and for estimates for the same individual at different points in time, by adjusting relevant covariance structures. Given the equally spaced intervals between follow-ups in our design and our assumption that correlations within subjects will decline over time, we assumed a first-order autoregressive covariance structure; we used Satterthwaite's method for determining the appropriate degrees of freedom.<sup>43</sup>

We conduct our HLM analysis in 2 stages. First, we test for main effects of neurocognitive functioning on the community functioning measures. Then we test for the effect of social context on the relation between neurocognitive functioning and community functioning with interaction terms representing housing type and the 3 measures of neuropsychological functioning. We also test for interactions between housing type and each of the other individual characteristics entered as predictors. The final models presented in this article include only those interaction terms that were statistically significant after including all main effects. We also include in the text the bivariate correlation coefficients for the significant neurocognitive effects in our final models in order to indicate the size of these effects. We present in tabular form only neurocognitive effects for our final models;  $t$  statistics for other statistically significant effects are reported in the text. We also conduct supplementary HLM analyses to test the stability of our results by diagnostic type, alternative neuropsychological measures, change in case managers completing the LSP, and assumed covariance structure in the HLM; these findings are summarized at the end of the "Results" section.

#### **Results**

In the first HLM analysis, neuropsychological functioning measures had independent main effects on 3 of the 6 community functioning indicators (see table 2). Better baseline scores on the WCST perseverations score predicted improving self-care ratings ( $t = 2.16$ ,  $df = 97.6$ ,  $P = .033$ ). Higher baseline auditory attention scores predicted improving scores on the LSP communication index ( $t = -2.34$ ,  $df = 97.8$ ,  $P = .021$ ) and better delayed verbal memory scores predicted an increase in the number of positive social contacts ( $t = 3.27$ ,  $df = 103.5$ ,  $P = .001$ ).

In table 3, we present effects of baseline neurocognitive scores only for those aspects of community functioning for which our second HLM identified an interaction

**Table 2.** Coefficients for Cognitive Indicators in Hierarchical Linear Model of Community Functioning<sup>a</sup> (Main Effects Model Only)

	Community Functioning					
	LSP Ability to Self-Care	LSP Turbulent Behavior	LSP Communication	N Positive Social Contacts	LSP Sociability	LSP Responsibility
Neurocognition	Estimate <sup>b</sup>	Estimate	Estimate	Estimate	Estimate	Estimate
Perseverations	.003*	.002	.000	.002	.001	.001
Sustained attention	.004	.008	-.009*	-.013	.002	-.002
Delayed memory	.002	.002	.001	.040***	-.001	.001

<sup>a</sup>Higher scores indicate worse functioning on all but N Positive Social Contacts.

<sup>b</sup>Estimate is effect coefficient; significance is based on *t* test.

\**P* ≤ .05; \*\*\**P* < .001.

with housing type. There were 3 such interactions: A better baseline WCST perseverations score predicted improving self-care ratings ( $t = 2.34, df = 96.8, P = .021$ ) and improving behavioral turbulence ratings ( $t = 2.07, df = 93.9, P = .041$ ) for respondents living alone compared with those living in an ECH, while the number of positive social contacts reported rose for subjects with higher baseline delayed verbal memory scores living in an ECH ( $t = 4.57, df = 104.7, P < .001$ ), but not for those living alone. In addition, the main effect of sustained attention on behavioral turbulence was statistically significant in the HLM after the inclusion of the perseverations by housing type interaction ( $t = 2.28, df = 94.3, P = .025$ ).

Bivariate Pearson correlation coefficients provide another indicator of the strength of effects of neurocognitive measures on community functioning variables, albeit

**Table 3.** Coefficients for Cognitive Indicators<sup>a</sup> in Hierarchical Linear Model of Community Functioning<sup>b</sup>

	Community Functioning		
	LSP Ability to Self-Care	LSP Turbulent Behavior	N Positive Social Contacts
Neurocognition by Housing Type	Estimate <sup>c</sup>	Estimate	Estimate
Perseverations			.002
IL	.005*	.003*	
ECH	.001	.001	
Sustained attention	.012	.011*	-.005
Delayed memory	.001	.001	
IL			.010
ECH			.078***

<sup>a</sup>Interactions with housing type presented instead of main effects when significant.

<sup>b</sup>Higher scores indicate worse functioning on all but N Positive Social Contacts.

<sup>c</sup>Estimate is effect coefficient; significance is based on *t* test.

\**P* ≤ .05; \*\*\**P* < .001.

an indicator that does not take into account the other variables or groupings in the HLM. As indicated by Pearson's *r*, both effects of total perseverations were weak: total perseverations with self-care in IL houses ( $r = .3$ ), total perseverations with turbulence in IL houses ( $r = .2$ ), a sustained attention with communication ( $r = .2$ ). The relation between verbal delayed memory and number of positive social contacts was moderate in strength ( $r = .45$ ).

In our final models (3 involving neurocognitive interactions with housing type and 3 involving main effects only), several covariates had statistically significant effects. Overall, self-care ratings were most positive at the 3-month assessment ( $t = 2.55, df = 112.2, P = .012$ ). More turbulent behavior was predicted by a lifetime history of substance abuse for those living in an ECH ( $t = 3.61, df = 92.0, P < .001$ ) and by minority ethnicity ( $t = 2.57, df = 92.8, P = .012$ ), and it was least elevated at the 3-month assessment ( $t = -2.54, df = 130.1, P = .012$ ).

Communication skills were rated as most impaired at the first 3-month follow-up ( $t = 2.145, df = 119.9, P = .034$ ), but there were no other predictors of communication scores. Positive social contacts became more frequent among those assigned to an IL ( $t = 2.37, df = 98.6, P = .020$ ) and also among those who were lifetime substance abusers ( $t = 2.22, df = 95.5, P = .029$ ). LSP responsibility scores were better for those living in an ECH ( $t = -3.00, df = 95.2, P = .003$ ) and for white residents ( $t = 2.40, df = 93.1, P = .019$ ). The LSP social functioning index was more positive among those who were lifetime substance abusers ( $t = -2.03, df = 96.4, P = .045$ ).

Our supplementary HLM analyses using alternative measures and models did not produce markedly different results. A composite index of all major neurocognitive measures in our data had no relationship to community functioning, but only because its components had no more than weak associations with each other. When we substituted 2 alternative measures of executive functioning—the Porteus Maze Test quotient and the visual/verbal test (total misses)—for the Wisconsin Card Sort

perseverations score, we found that, like total perseverations, both of these other measures predicted behavioral turbulence in ILs. However, these 2 other measures did not predict self-care.

Our sample was diagnostically heterogeneous, but we had only limited ability to test for the stability of the neurocognitive effects we identified across diagnoses. Two-thirds of our subjects were diagnosed with schizophrenia or schizoaffective disorder, and the results of separate HLM analyses among these subjects were largely consistent with the findings for the total sample: Auditory attention predicted communication scores and verbal memory predicted positive social relations in ECHs. The effects of the number of perseverative errors on self-care and turbulence in ILs were similar in magnitude to those in the entire sample but no longer statistically significant, most likely due to reduced statistical power. The remainder of the sample was approximately evenly divided between those diagnosed with major affective disorder, bipolar disorder, and other psychotic disorders and so there were insufficient cases with which to assess the stability of neurocognitive effects in these subgroups.

Our necessary use of multiple case managers to provide LSP assessments also requires some attention to the issue of interrater reliability. In order to determine whether our findings could have been a product of variation in the case managers who completed the LSP ratings, we added to our models an interaction term that distinguished cognitive scores for subjects who had the same or different LSP raters at the 18-month follow-up as at baseline. Inclusion of these terms did not alter the statistical significance of the neurocognitive effects we had previously identified. These effects also did not change appreciably after we controlled for the length of time that subjects spent in their initially assigned housing, even though this time varied somewhat between housing types.<sup>30</sup>

In order to evaluate the robustness of our findings with respect to the assumptions we made in order to structure our HLM tests, we reestimated effects using 2 alternative covariance structures that imposed fewer restrictions in the HLM analysis. Replication of the HLM with either a heterogeneous first-order autoregressive covariance structure or an unstructured covariance structure did not alter the neurocognitive effects identified with the first-order autoregressive structure reflected in table 3.

## Discussion

Baseline neurocognitive functioning was an important predictor of community functioning over an 18-month period after these subjects moved into project housing, but these effects were mostly contingent on housing type. Poorer executive functioning predicted worse self-care and more turbulent behavior for subjects who were living alone, but not for those living in a staffed, group home. Better delayed verbal memory predicted

more positive social contacts, but only for those living in a group home. Only higher scores on sustained attention predicted subsequent functioning irrespective of housing type—better communication skills, but also greater turbulence.

Although neither sociability nor responsibility was related to cognitive functioning, the general import of the effects on self-care, turbulence, communication, and number of positive social contacts adds to the body of evidence that cognitive functioning affects community functioning. Since ours is not simply a replication study, but rather is the first published research to demonstrate the importance of cognitive functioning for community outcomes among homeless persons with severe mental illness, albeit during the period after they were housed, our findings add considerable evidence of the external validity of these effects. Our use of Rosen's multidimensional Life Skills Profile to measure community functioning observed by case managers with frequent subject contact 4 times over an 18-month period also suggests that the relationships we have identified reflect changes in observable behavior, not just in the self-reported abilities or on laboratory-based tests that have been used in many studies of cognition and community functioning.<sup>28</sup> We note that the only other prior related research using the LSP, Norman et al's<sup>8</sup> study of patients in a Canadian community treatment and reintegration program, did not find any association between either executive functioning or verbal memory and subsequent community functioning (they did not measure attention). However, because they did not take account of social context we do not feel that their null findings contradict our primary conclusion.

Our findings suggest that living in a supportive group home can compensate for the detrimental effects on community functioning of poor executive functioning and can also enhance the beneficial effects of verbal memory. Further research is needed to test this interaction with social context among different samples and to determine whether the compensatory effects of group homes can be linked specifically to living with staff, to living with peers, or to our special "empowerment-centered" model of group home management. Certainly, the generalizability of our findings to traditional staff-controlled group homes with strict enforcement of rules and schedules cannot be assumed. Nonetheless, we believe that our findings provide another indication of the value of social support<sup>44,45,46</sup> and are consistent with the positive assessment of small group homes that was identified in the Team for the Assessment of Psychiatric Services project.<sup>47</sup>

Investigation of the process by which cognitive functioning influences community functioning is the key to understanding the effect of social context. Since community functioning inherently involves interaction with other people, to differing degrees, the actions and reactions of those people inevitably shape individual behavior. Group or staff support in the group home context

may compensate for the effects of deficits in executive functioning and so the failure to take account of social context could explain the relatively weak and inconsistent effect of executive functioning in prior research on community functioning.<sup>7</sup> Specification of the aspects of social context that make a difference for the effects of cognitive functioning as well as the process through which these differential effects occur should thus be scrutinized in future research. Special attention must be given to social cognition and social competence as facilitating or inhibiting social context effects.<sup>48,49</sup>

Unlike executive functioning or delayed verbal memory, sustained attention influenced one dimension of community functioning—communication—irrespective of social context. Although this influence may simply reflect the need for sustained attention in the process of communication, it is consistent with the conclusion of Proteau *et al.*<sup>50</sup> that sustained attention plays a “crucial role” in the community functioning of outpatients with schizophrenia. This promising lead is particularly in need of replication, however, given the relatively low reliability level of the LSP communication measure in our sample.

Cognitive functioning predicted number of positive social ties but not variation in the LSP measure of sociability, thus highlighting the importance of distinguishing the different properties of measures of functioning. Differential susceptibility to error may account for the differences between the social functioning measures. Case manager judgments with respect to social relations may have been particularly prone to error, because accurate rating of social functioning requires that others be present at the same time as the case manager. This particular measurement problem does not occur with self-reported social contacts, so the effect of delayed verbal memory on number of self-reported positive social contacts for those residing in a group home may be the better indicator of the role of verbal memory: memory aided social contacts when there were others with whom to socialize. This difference in neurocognitive effects between measures should also serve as a caution for those who rely on third party functional assessments: the knowledge and perspective of the observer must be evaluated carefully.

The effects of substance abuse have important implications for mental health services as well as for understanding the processes involved in community functioning. We know from other research that substance abusers were much more likely to lose their housing during the 18-month follow-up period<sup>30</sup> and that they were less likely to gain in cognitive functioning after housing placement.<sup>16</sup> Our finding in this analysis that the community functioning of substance abusers was worse along several dimensions if they were living in group homes suggests that special addiction treatment programs could help to retain individuals in housing who are otherwise seen as causing trouble for others and behaving irresponsibly.

The fact that substance abusers living in group homes themselves reported that they had more positive social relations, compared with substance abusers living alone, is an interesting counterpoint to this broader conclusion. Ethnographic data collected in the group homes recorded frequent conflicts with substance abusers, in part due to their contacts with drug dealers and others from outside the homes (R.K. Schutt, unpublished data). It may be that social relations with other substance abusers are being reported as positive by the substance abusers themselves.

Several limitations in our research design must be taken into account. First, the type of subjects we studied was shaped by the nature of the treatment we offered and by the screening process we employed. All study participants had been living in shelters funded by the DMH, they had to agree to randomization to either group or independent living, and they were screened carefully for potential harmfulness to self or others.<sup>29</sup> As a result, our sample did not include the most at-risk homeless mentally ill persons (those who refuse shelter or who are violent toward self or others) or the highest functioning clients of mental health agencies (those in community placements). The higher rate of missing data in our analysis involving younger persons with less social contact indicates that our conclusions may not generalize to the most impaired homeless persons. We also do not know whether the overall cognitive effects we observed would have occurred for individuals who had not been homeless, since nonhomeless samples could have had very different patterns of community functioning and symptom levels. Due to limited numbers of cases, we also cannot determine whether the effects we identified for the entire sample, and for those diagnosed with schizophrenia or schizoaffective disorder, would be replicated for those with bipolar illness or major affective disorder.

As in previous analyses, we focused on widely used neurocognitive measures that operationalize the 3 different cognitive abilities that have consistently been related to social functioning.<sup>4,5</sup> At the time our study began in 1990, however, little was known about the relevance of alternative neurocognitive measures for research about social functioning, and so we used a comprehensive battery of neurocognitive tests. As a result, we were able to reanalyze our data using alternative approaches to neurocognitive assessment. As summarized in the “Results” section, these additional analyses largely affirmed our primary findings, although they did suggest that ability to self-care is not as reliably predicted by executive functioning as is behavioral turbulence.

In conclusion, our findings add to research indicating that cognitive functioning affects community functioning among seriously and persistently mentally ill individuals<sup>51,52</sup> and that neuropsychological test performance generalizes “upward” to actual behavior.<sup>5,17</sup> Our focus on a homeless sample and our multidimensional assessment of community functioning extends the evidence for

these effects to a population and with measures of community functioning that have not previously been used to address our research question. The interaction effects that we identified suggest that lack of attention to social context in research designs may explain some of the variability in prior research and its limited generalizability to real world applications. The variation we found in relationships between specific cognitive indicators and dimensions of community functioning also suggests that measurement procedures must be highlighted when explaining disparate findings between studies.

More generally, our findings support the growing body of evidence that indicates the specificity of behavioral effects of particular cognitive abilities and the need to consider both subject characteristics and social context when predicting these effects. We encourage further investigation to specify the conditions for specific cognitive effects on particular dimensions of community functioning and the causal mechanisms by which these effects occur. We also encourage programmatic experimentation to identify ways in which knowledge of these effects can best be translated into cognitive remediation programs that are effective in particular social contexts.

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