

## Real-World Cognitive—and Metacognitive—Dysfunction in Schizophrenia: A New Approach for Measuring (and Remediating) More “Right Stuff”

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**While the role of impaired cognition in accounting for functional outcome in schizophrenia is generally established by now, the overlap is far from complete. Moreover, little is known about the potential mechanisms that bridge between cognition and functional outcome. The aim of this article is to aid in closing this gap by presenting a novel, more ecologically valid approach for neuropsychological assessment. The new approach is motivated by the view that metacognitive processes of self-monitoring and self-regulation are fundamental determinants of competent functioning in the real world. The new approach incorporates experimental psychological concepts and paradigms used to study metacognition into current standard neuropsychological assessment procedures. Preliminary empirical data that support and demonstrate the utility of the new approach for assessment, as well as remediation efforts, in schizophrenia are presented and discussed.**

*Key words:* Cognition/metacognition/real-world functioning/schizophrenia/ecological validity

To know that one knows what one knows, and to know that one doesn't know what one doesn't know, there lies true wisdom.

—Confucius (ca. 551–479 B.C.E.), Chinese sage

*Doctor:* Do you remember where that halfway house is?

*Patient:* It's on the other side of town, isn't it?

*Doctor:* Yes, but do you remember its exact address and what bus goes there?

*Patient:* I'm not sure. I think I could use a reminder.

*Doctor:* Here, let me draw you a little map.

Although fictional, this short transcript illustrates the vast flexibility that people generally have in addressing

cognitive problems in real-life situations. In contrast to most common neuropsychological tests, there is no official “list” of input items (eg, a list of words read to the participant) that must be resolved. Instead, the person is free to choose which aspects of the question to relate to and which to ignore, what degree of confidence to impart, what perspective to adopt, how much detail to volunteer, and so forth. Such decisions, needless to say, depend on a variety of personal and situational goals, such as in above example, in which the patient wants to obtain benefits, avoid hospitalization, succeed on a job, impress a case-manager, and so forth.

Furthermore, this brief transcript also demonstrates the rich processes of self-reflection that accompany these daily cognitive activities and appear to play a crucial role in monitoring and supervising them. In fact, the above transcript suggests that these monitoring and controlling processes are critical enablers of real-world competency that might be no less important than the cognitive abilities that they supervise.<sup>1</sup> In other words, knowledge about what one does or does not know can be as important for real-world functioning as what one actually knows. Thus, correctly imparting low levels of confidence to what one can't recall and asking for a reminder is an example of good real-life (executive) functioning in spite of rather poor memory abilities.

Our focus on participants' monitoring and voluntary control over their cognitive performance fits well with recent attempts to improve the ecological validity of neuropsychological assessment procedures in schizophrenia<sup>2</sup>; that is, to bridge the gap between laboratory measures of cognitive deficits or biases and real-world information-processing difficulties. The purpose of this article is to outline our analysis of this challenge and to introduce the concept of *metacognition* as a key contributing factor to functional outcome in schizophrenia, which is not tapped by current traditional measures of neurocognitive processing.

In what follows, we shall first briefly summarize the main hurdles to the ecological validity of current neurocognitive assessment procedures in schizophrenia, which have already been covered in the literature. In addition, we will present and discuss new limits of these tasks, which to our knowledge have not been addressed before.

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Next, in the main section of the article, we will examine the idea that metacognitive processes, which include competence-monitoring and report-control, constitute an important enabler of real-world functioning, and will present our new approach, which adapts paradigms developed in experimental psychology to study metacognition for use as neuropsychological assessment procedures. We will conclude this section by briefly reviewing recent preliminary (published) data that support and demonstrate the promising potential of the new approach for assessment, as well as remediation efforts, in schizophrenia. Finally, we will provide a brief discussion of the ways in which our use of “metacognition” is similar to or different from the ways this same term is conceptualized and measured in other “meta-level” models in the literature, such as source-monitoring, theory of mind (ToM), signal detection theory (SDT), and transfer of learning.

### **Cognitive Dysfunction in the Real World: An Ecological Perspective**

#### *What Is Known?*

While it has been understood for over 100 years, since Kraepelin and Bleuler’s early clinical observations, that cognitive impairment is present in schizophrenia, experimental demonstration and acceptance of the notion that neurocognitive impairment is a fundamental and valid feature of schizophrenia, and not just a transient, epiphenomenal effect of psychosis, is only a few decades old.<sup>3–5</sup> Yet, the past 2 decades have witnessed rapidly growing interest in the implications of neurocognitive abilities for the everyday social and occupational functioning of schizophrenia patients. There seem to be several reasons for this growth. First, according to many diagnostic systems, impairment in social functioning is necessary to establish a diagnosis of schizophrenia. Second, poor social functioning precedes the onset of schizophrenia, and premorbid social maladjustment is predictive of a more severe course of illness. Third, social functioning after the onset of the disorder continues to be a powerful predictor of long-term outcome, including relapses and rehospitalizations. Finally, social functioning tends to be improved only marginally by available pharmacological interventions.<sup>6</sup>

The rapidly accumulating literature on the relationship of cognitive function to social, occupational, and independent living outcomes in schizophrenia, as recently reviewed in 3 comprehensive papers, has indicated consistent and highly significant cross-sectional<sup>7,8</sup> and longitudinal<sup>9</sup> relationships between impaired performance on specific aspects of cognitive functioning and functional outcome in schizophrenia. In fact, this literature has suggested that cognitive impairments are the primary determinant of functional deficits, pointing to an intrinsic

relationship between these 2 domains of deficit in patients with schizophrenia.

There appear to be some questions about whether the relationship between cognition and functional outcome is domain specific. As comprehensively reviewed in the aforementioned papers, several different ability domains have been preliminarily shown to be differentially related to distinct functional outcomes. For instance, executive functioning deficits appear to be consistently related to deficits in independent living; attention deficits are associated with social functioning; learning and memory deficits appear to be consistently related to social, occupational, and independent living domains; whereas processing speed is related mainly to employment outcomes. Recent data have challenged this view of specificity, showing a more generalized relationship between multiple domains of cognitive functioning and essentially all higher-level functional skills, at least in older patients with schizophrenia.<sup>10</sup> Finally, several studies have shown that cognitive performance is an important predictor of improvement following rehabilitation programs<sup>11–14</sup> and that cognitive impairments exert a rate-limiting effect on the ability to learn skills in these programs,<sup>12</sup> as well as to maintain a competitive job.<sup>15</sup>

In sum, the role of neurocognitive deficits in predicting functional outcome in schizophrenia is generally well established by now. The acceptance of cognitive capacity as central to clinical and functional outcome in schizophrenia has led to a major initiative in the United States to develop a consensus, standard neurocognitive battery to assess cognitive enhancement in schizophrenia (Measurement and Treatment Research to Improve Cognition in Schizophrenia [MATRICS]).<sup>16,17</sup>

#### *What Is Not Known? Main Limitations of Present Research*

There is little doubt that neuropsychological studies of functional outcome over the past 2 decades have established the role of neurocognitive deficits as key determinants or predictors of real-world functioning in schizophrenia, especially in contrast to positive symptoms that apparently have little impact.<sup>18</sup> Yet there is also a growing consensus among schizophrenia researchers and clinicians that the current literature on this topic has several important limitations. In brief, some of the major concerns include the following:

1. The association between neurocognitive measures and functional outcome in these studies has been rather variable and often modest.<sup>19</sup> While it is obvious that the variability of the association is a function of the way that both cognition and function are measured, the effect size of the relationships between individual ability domains and aspects of functional outcome tends to be in the “medium” range

(ie, approximately 15–20% of shared variance). When composite scores for cognitive performance are used, the proportion of common variance is typically larger, often as great as 35–50%.<sup>20,21</sup> Yet, even these higher correlations suggest that a considerable amount of variance in functional outcome is unexplained by standard measures of cognitive impairments.

2. Since most of the previous studies were not designed to test specific a priori hypotheses about the relationship between neurocognitive abilities and functional outcome, they offer little insight into the potential mechanisms that might mediate or moderate the relationship between basic neurocognition and social functioning.<sup>7</sup>
3. Similarly, since most studies have focused on assessment of specific cognitive skills, they do not deal with the mechanisms that enable transfer of learning from one cognitive domain to another, and from cognition to action.<sup>22</sup>
4. The literature on neurocognitive deficits in schizophrenia consistently shows that there is a small subgroup of patients whose cognitive performance appears to be unimpaired on conventional neuropsychological tasks.<sup>23–28</sup> Evidently, poor social functioning in this neuropsychologically “normal” subgroup cannot be accounted for by the presence of deficits on standard neurocognitive measures.
5. Successful functioning in real-world situations undoubtedly depends on one’s own abilities. Yet, in many complicated circumstances in important domains such as health, employment, education, friendship, romance, and law, it also relies on the guidance and advice (either explicit or implicit in the form of role-modeling) of friends, family members, colleagues, clinicians, lawyers, teachers, and so forth. Current neuropsychological procedures do not take into account the important ability of correctly recognizing and utilizing effective cognitive skills in others.

These and other problems provide a substantial challenge to the ecological sufficiency of current neuropsychological assessment procedures. In fact, as already noted, they have led experts in the field to wonder whether we are measuring the “right stuff”<sup>7</sup> and to suggest that more attention should be paid to the issue of ecological validity.<sup>29,30</sup> These critiques reflect the fact that neuropsychological tests largely were not developed for these purposes.<sup>31,32</sup>

#### *Ecological Validity and the Hunt for the “Right Stuff”*

The question, then, is how to develop a new approach for neuropsychological assessment that will preserve many of the strengths of current procedures,<sup>cf31,32</sup> while also addressing the ecological validity problems described above. Ecological validity deals with the degree to which

performance on laboratory-based neuropsychological tests actually maps onto functioning in a variety of naturalistic—personal, social, vocational, or clinical—situations. Since performance on traditional tests does not fully account for real-world outcomes, it is possible that other contributing factors are involved. The hunt for contributing, “right stuff”<sup>7</sup> variables that will improve the ecological validity of current neuropsychological assessment procedures in schizophrenia has been progressing on 2 major paths. In the first, the search has been guided by the ecological relevance of *what* is being measured (ie, the *test content* or *test scenario*) in relation to real-world functioning. At the heart of this approach is the assumption that standard laboratory-based neuropsychological assessment procedures, while clearly useful for distinguishing impaired from normal performance, are less useful for studying complex capacities that appear to underlie real-world social functioning. The most prominent example of this approach can be found in the field of social cognition. This hybrid area involves the highly complex processes that allow one to perceive, interpret, and process social information.<sup>33</sup> Among these processes or functions are the ability to perceive emotion in others, the ability to infer what others are thinking (Theory of Mind), and the ability to understand and apply the rules that govern social interactions.<sup>19</sup> Other examples of this approach are recently designed tests that assess, in a standard manner, real-world scenarios such as cooking<sup>34,35</sup> and complex shopping (multiple errands).<sup>36,37</sup> A major strength of these tasks, at least superficially, lies in their being more “face-valid” than standard, socially neutral tests, which were developed primarily for other purposes: to help identify neurological disease or to measure the strengths and weaknesses of a person with a neurological disorder.<sup>31,32,38,39</sup>

Another nascent path for improving the ecological validity of current neuropsychological assessment procedures has been recently proposed by Green and his colleagues (2000).<sup>7</sup> Building on Lev Vygotsky’s early ideas and work on learning potential,<sup>40</sup> they propose a “fundamental shift” in assessment procedures from static evaluation of what patients already know to dynamic estimation of what they are capable of learning.<sup>7</sup> Learning potential, according to this view, can be an important mediator between basic neurocognition and skills acquisition since, unlike traditional tests, it does not assume that everyone has had an equal opportunity to acquire the skills necessary to perform well on these tests. While clearly promising from a conceptual point of view, actual attempts to develop and validate dynamic assessment methods of learning potential in schizophrenia are too scanty and preliminary to draw any conclusions regarding their actual (rather than potential) usefulness. While 1 study found that measures of learning potential contribute to the prediction of work skill acquisition, over and beyond the predictive power of a single

cognitive assessment,<sup>41</sup> another study failed to find an association between learning potential and social functioning or rehabilitation outcome.<sup>42</sup> In fact, the best predictors of social functioning in the latter study were “static” performance measures.

### Metacognition as a Critical Bridge Between Cognition and Functional Outcome

There is little question that the study of social cognition and learning potential reflects important steps in the evolution of more ecologically valid neurocognitive assessment procedures. Yet, as illustrated by the brief transcript at the beginning of this article, it also seems that both approaches are incomplete, as they fail to take into account an intrinsic aspect of cognitive performance in the real world, namely, personal control over one’s own performance. In line with Nelson and Narens’s<sup>43</sup> analysis of similar methodological limitations in experimental psychology, personal control over performance has generally been overlooked in schizophrenia research, perhaps because it is typically viewed as a mere methodological nuisance that interferes with the desired ideal of maximal experimental control.

Our perspective is founded on the assumption that rather than constituting a methodological nuisance, person-monitored and -controlled processes are actually a fundamental determinant of successful functioning in the real world.<sup>44,45</sup> That is, while real-world performance clearly depends on knowledge and abilities (ie, functional capacity or skills competence), it also depends on an accurate appraisal of this knowledge or these abilities, particularly when they are lacking. To illustrate this point, it might be useful to go back to the brief transcript in the beginning of this article. What this brief interaction reminds us is that successful real-life functioning can occur despite poor cognitive abilities (ie, not recalling the location of the halfway house), as long as the person imparts the correct confidence to the products of these abilities (monitoring) and requests help (control). In support of this view, in clinical applications it has long been known that a subgroup of mentally retarded persons can function adaptively in the real world.<sup>46</sup>

In our view, a major impediment to ecological validity in contemporary research is its failure to attend to the difference, which commonly exists in real-life situations, between performances under forced- versus free-response conditions. That is, contemporary research relies on tests that assess performance under either forced-response or free-response conditions, but not under both. Consequently, interpretation of overall performance scores on standard tests currently used in the literature—independent of whether they are forced or free report in nature—is necessarily ambiguous. This is so because it is unclear whether scores on these tests reflect good cognition (perhaps yielding a high score under forced-report

conditions) but poor metacognition (perhaps yielding a lower score under free-report conditions), poor cognition but good metacognition (perhaps yielding a low score under forced report but a higher score under free report), or medium levels of both. Motivated by the view that real-life functioning depends on both cognitive and metacognitive skills, and that a method to isolate the two of them is needed, we developed a novel approach based on methodologies used in experimental psychology to study metacognition, in particular the 2-phase paradigm developed by Koriat and Goldsmith.<sup>47</sup>

#### *What Is Metacognition?*

Metacognition is often described as “knowing about knowing.”<sup>48</sup> It is a term used to distinguish what one knows about one’s own cognitive abilities, states of knowledge, and actual performance from the cognitive abilities, states of knowledge, and performance per se. It also includes the use of such (meta-) knowledge to regulate one’s performance. Hence, 2 important aspects of metacognitive functioning are *monitoring* (the subjective evaluation of one’s own cognitive functioning) and *control* (the manner in which one’s behavior is directed by this evaluation).<sup>49</sup> Metacognitive abilities can vary independently of cognitive skills per se<sup>50,51</sup> and have important consequences over and above those skills. For example, although a person, like the one in the opening transcript, may forget the information needed for correct responding, he or she may nevertheless act only when he or she does recall correctly, and seek further reminder or advice otherwise. Conversely, a person may recall correctly in most situations yet be unable to discern those situations in which memory is lacking, acting in those situations as well, perhaps with serious consequences.

The main advantage of Koriat and Goldsmith’s<sup>47</sup> metacognitive paradigm is that it allows for experimental isolation of the unique contribution of monitoring and control to a patient’s overall performance and enables an assessment of the extent to which performance improves when the patient is allowed to choose when to offer a response and when to withhold it. Furthermore, by examining free-response performance, this paradigm also enables manipulation and assessment of possible motivational factors affecting performance. Finally, as will be shown, the paradigm enables assessment of the ability to monitor not only personal performance but that of others as well. As already mentioned, successful social adjustment often times depends not only on the ability to correctly solve a problem but also on the ability to correctly identify good performance in others in order to follow or get advice from them.

#### *Accuracy-Based (Output-Bound) Versus Quantity-Based (Input-Bound) Performance*

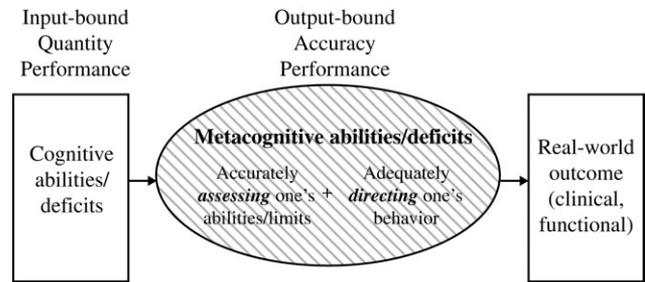
To grasp the potential contributing role of metacognition and free-response control over cognitive performance to

functioning in the real world, it is important to clarify a distinction between 2 fundamentally different ways of assessing cognitive functioning—*input-bound quantity-based* versus *output-bound accuracy-based* assessment.<sup>44,52–54</sup> Input-bound quantity-based assessment begins with the number of questions or problems that were presented to the participant (ie, the “input”) and indicates the probability that each input item will be answered or solved correctly. The most common measure of this type is *percent correct*—the percentage of the total number of items that were answered or solved correctly. Output-bound accuracy-based assessment, in contrast, begins with the number of answers or solutions that were provided by the participant (ie, the “output”) and indicates the (conditional) probability that each output item will in fact be correct. The most common measure of this type is *conditional percent correct*—the percentage of provided answers or solutions that are correct.

Under forced-response conditions (ie, when the participant must provide a substantive response to all questions or problems—no omissions are allowed), the number of output responses equals the number of input questions/problems, and hence the 2 measures are operationally equivalent. Under free-response conditions (ie, when the participant is allowed to refrain from answering—to respond “don’t know”), however, the number of substantive responses will generally be lower than the number of input questions/problems. Under these conditions, the 2 types of measures differ both operationally and theoretically: In contrast to the input-bound quantity measure, which taps the person’s ability to answer/solve the questions/problems that are posed to him or her, the output-bound accuracy measure uniquely taps the dependability of the answers and solutions that the person is actually committed to, that is, the extent to which each freely volunteered response can be depended on to be correct. Thus, the output-bound accuracy measure (but not the input-bound quantity measure) reflects the person’s ability to distinguish between questions/problems that he or she can answer/solve correctly and those that he or she cannot—volunteering answers or solutions in the former case but not in the latter case.

We believe that output-bound accuracy performance is a crucial aspect of real life functioning,<sup>42</sup> which is no less important to functional outcome than is input-bound quantity performance: Whereas the latter reflects the actual ability to understand something about the external world (eg, the various pros and cons of a suggested treatment), the former refers to one’s ability to know when one is understanding correctly and when one is not, and to control one’s behavior accordingly—responding only when one is able to respond correctly, and abstaining (seeking help or further information) otherwise (Figure 1).

Even though it may be that these 2 levels of performance are served by the same cognitive system, the



**Fig. 1.** Metacognitive Abilities Underlying Free-Response Output-Bound Accuracy Performance as Neglected Mediators Between Cognitive Performance and Real-World Performance.

distinction between them is an important one from a theoretical point of view. Whereas the first refers to *primary* representations of the external world (eg, What was said to me? What are the pros and cons of  $x$ ?), the second refers to *secondary* representations of one’s own state of knowledge about the world (eg, How good is my memory of what was said to me? How well do I understand the pros and cons of  $x$ ?). Although the lines between these 2 types of representation are sometimes fuzzy, it is customary to refer to the processes relating to secondary representations as metacognitive.<sup>55</sup> Moreover, this distinction is particularly important because the secondary metacognitive process and its target primary metacognitive process need not be interdependent. For example, although a person may often forget or be unable to understand the information needed for correct responding (low input-bound quantity performance), he or she may nevertheless act only when he or she does understand correctly, and seek further advice otherwise (high output-bound accuracy performance). Conversely, a person may understand correctly in most situations (high input-bound quantity performance) yet be unable to discern those situations in which understanding is lacking, and act in those situations as well, lowering output-bound accuracy performance, perhaps with serious consequences. While we shall return to this issue in more detail, it is important to note from the start that the decision to venture or not to venture a response does not necessarily reflect any single response tendency (eg, impulsiveness or risk taking). Rather, according to Koriat and Goldsmith’s model, the decision to venture or not to venture a response is multiply determined by 3 different factors: (1) subjective monitoring of the correctness of the candidate answer (confidence); (2) the extent to which one’s behavior is dependent on one’s confidence (see control sensitivity, below); and (3) the conservativeness or liberality of the response criterion one sets in accordance with the operative payoff schedule (ie, the prices for type 1 versus type 2 errors). Each of these can be both theoretically and empirically isolated.

For purpose of illustration, imagine 2 patients who are having trouble remembering exactly which 5 pills they are

supposed to take. Patient A remembers 3 of the pills correctly, but being unaware that she does not remember the other 2 correctly (poor monitoring ability), she takes 2 wrong pills as well (with potentially dangerous results). Patient B, on the other hand, also remembers 3 of the pills correctly, but being aware that she does not remember which are the other 2 pills (good monitoring ability), she refrains from taking the 2 additional pills until she is able to ask for advice. Note, then, that both patients have equal input-bound quantity performance (3 out of 5 pills remembered correctly = 60%), but Patient B's output-bound accuracy performance is perfect (3 out of the 3 pills taken are correct = 100%), whereas Patient A's output-bound accuracy performance is much lower (3 out of the 5 pills taken are correct = 60%). Put another way, when Patient B does not know/remember something, she does not act on her knowledge (but rather seeks help), whereas Patient A continues to act on her incorrect knowledge in any case—because she is unaware that she lacks the required knowledge (poor monitoring), because she is indifferent to this lack (good monitoring but poor control sensitivity), or because she is a risk taker (good monitoring but liberal response criterion).

Once again, our basic assumption is that in the context of real-life performance, accuracy-oriented metacognitive skills are at least as important for successful functioning as the cognitive ability to solve concrete problems. Thus, the goal of our work is to incorporate cognitive and metacognitive measures of (output-bound) free-response accuracy performance into current neuropsychological research on “everyday functioning” in schizophrenia.

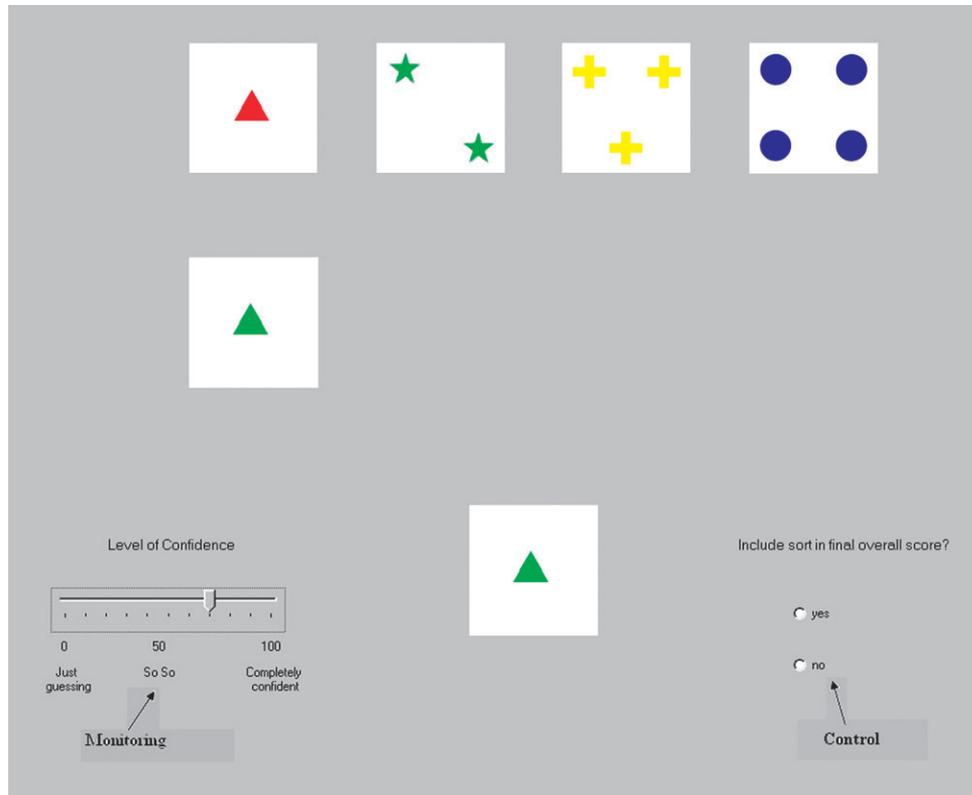
### Preliminary Empirical Support

Do free-response, metacognitive measures of self-monitoring and self-directed actions in fact improve the association between basic neurocognition and real-world function? To assess this question, we used our new metacognitive assessment approach to study the neuropsychological basis of 2 instances of cognitive function in the real world; namely, insight into illness<sup>56</sup> and competence to consent to treatment.<sup>57</sup> Although these phenomena may not be regarded by some as prototypical examples of real-world function, such as cooking, shopping, or paying bills, we chose them as outcome measures in this validation study for 2 important reasons. First, they both meet what we perceive as the 2 major criteria for cognitive function in the real world, which are (1) being dependent on complex cognitive processes and (2) being aimed at maintaining or promoting participation in the social world. Formation of such insight into one's illness is based on one's ability to gather, understand, and synthesize relevant pieces of information from both internal (by way of self-reflection) and external sources, such as cultural norms, medical knowledge, peers' feedback, and so on. Similarly, it meets the second

criterion since it represents an interactive meaning-negotiation effort, whose aim is to maintain relationships and positions in the social and occupational world.<sup>58</sup> Similarly, competence to consent to treatment can be seen as a real-world function since it relies on complex cognitive abilities and is aimed at enabling one to become an active participant in guiding one's own treatment and rehabilitation plans. The second reason we chose these 2 particular real-world behaviors was strategic. In order to determine if our new metacognitive approach was related to real-world outcome, we needed to start with an outcome that clearly has a strong intrinsic component of self-awareness (ie, that is more proximal to metacognition) and then assess how the approach generalizes to more distal outcomes in which expression of choice (ie, self-control) is an inherent element.

Thus, our aim in this pilot validation study was to evaluate the relationships of insight into illness (assessed with the Scale for Unawareness of Mental Disorder [SUMD]<sup>59</sup>) and competence to consent to treatment (assessed with the MacArthur Competent Assessment Tool for Treatment [MacCAT-T]<sup>60</sup>) with deficits at the cognitive versus metacognitive level. Our main hypotheses were (1) that insight and competence would be less strongly related to conventional knowledge measures (“*performance quantity*”) than to measures of how accurately the knowledge can be employed (“*performance accuracy*”), and (2) that prediction of insight and competence would be improved by addition of the free-response, metacognitive measures to the conventional, forced-response cognitive measures. To assess these hypotheses, a paradigm developed to study monitoring and control processes in memory performance<sup>53</sup> was adapted for use with the Wisconsin Card Sorting Test (WCST),<sup>61</sup> a commonly used test of executive function. The WCST was selected because the literature, including work from our own group,<sup>62,63</sup> suggests that the complex reasoning and memory processes that this test taps are among the more salient and persistent cognitive deficits in schizophrenia.<sup>64</sup> In addition, against the background of generally weak and inconsistent findings, performance on the test, particularly perseverative errors, showed the most replicated association with poor insight in schizophrenia.<sup>65</sup> Finally, we wanted to show that our metacognitive control process is different than executive control process because it relates to whether the output of a primary executive function process should be committed to.

Administration of the WCST in our study followed the standard administration instructions with one significant exception. Prior to receiving the feedback regarding each sort, we also asked our participants (1) to rate their level of confidence in the correctness of that sort on a “0” (just guessing) to “100” (completely confident) scale and (2) to decide whether they want that sort to be “counted” toward their overall performance score on the test (for a representative screen from the revised test see Figure 2).



**Fig. 2.** A Representative Screen From the Computerized Metacognitive Version of the Wisconsin Card Sorting Test (WCST).

Each “ventured” sort received a bonus of 10 cents if correct but an equal penalty if wrong; “withheld” sorts were neither penalized nor rewarded. Thus, in addition to the standard “forced response” input-bound quantity measure (ie, the proportion of all sorts that were correct), which reflects the patient’s ability to perform the sorting task (acquiring the rule and shifting it when appropriate), our procedure also yielded measures of “free response” performance that depend on the patient’s metacognitive knowledge. The key metacognitive variables that were derived were (1) free-response output-bound *accuracy score*, defined as the proportion of ventured responses that were correct; (2) free-response *improvement*, defined as the difference between the free-response output-bound accuracy score and the forced-choice input-bound (quantity) score; (3) *global monitoring* defined as the difference between the total number of correct sorts and the total number of sorts asked to be counted, (ie, the veridicality of one’s overall sense of one’s level of knowledge; although this measure provides a gross index of monitoring, it is also dependent on the conservativeness or liberality of the “control criterion” that is used for venturing responses); (4) *monitoring resolution* (ie, the extent to which the confidence judgments distinguished between correct and incorrect sorts), indexed by the Kruskal-Goodman gamma correlation calculated across all sorts between the level of confidence and the correctness of the sort; (5) *control*

*sensitivity* (ie, the degree to which the control process was dependent on the monitoring process), indexed by the gamma correlation calculated across all sorts between the level of confidence and the decision to venture the sort; and (6) *monetary gains*, the amount of monetary rewards gained, calculated as the difference within all ventured sorts between those that were correct and those that were incorrect (for a summary of the new metacognitive measures, expressed as equations, see Table 1). Given the additional tasks, only the first 64 of the full set of 128 cards were administered.

Our results were illuminating. First, both insight and decision-making competence had higher associations with the new metacognitive measures than with the conventional WCST measures (see  $R^2$ s in Table 2). Second, the prediction of insight and competence was improved by adding the new metacognitive measures to the conventional WCST measures. Specifically, the addition of the new metacognitive measures improved the predictive power of the cognitive variables (see uniqueness indices in Table 2). Finally, several poor-insight/low-competency patients displayed a unique substantial qualitative impairment at the metacognitive level. Their decisions regarding which sorts they wanted to volunteer were occasionally independent of their self-monitoring processes (ie, sorts with relatively low rates of confidence were chosen to be included, while high-confidence sorts were left out).

**Table 1.** Formulas for Calculating the New Metacognitive Measures

Measure	Formula
Quantity score =	$N_{\text{correct}} / N_{\text{total}}$
Accuracy score =	$V_{\text{correct}} / V_{\text{total}}$
Free-choice improvement =	Accuracy score – Quantity score
Global monitoring =	$N_{\text{correct}} - V_{\text{total}}$
Monitoring resolution =	$\gamma R_{\text{confidence}} R_{\text{correct}}$
Control sensitivity =	$\gamma R_{\text{confidence}} R_{\text{venture}}$
Monetary gains =	$V_{\text{correct}} - V_{\text{incorrect}}$

*Note:*  $N_{\text{total}}$  = total number of items that were presented;  $N_{\text{correct}}$  = total number of correct responses;  $V_{\text{total}}$  = total number of volunteered responses;  $V_{\text{correct}}$  = total number of correct responses out of those volunteered;  $V_{\text{incorrect}}$  = total number of incorrect responses out of those volunteered;  $R_{\text{confidence}}$  = confidence in the correctness of a given response;  $R_{\text{correct}}$  = actual correctness of a given response;  $R_{\text{venture}}$  = actual decision to venture a given response;  $\gamma$  = within participant Kruskal-Goodman gamma correlation.

These preliminary results suggest that poor insight and decision-making competence are more strongly related to deficits at the metacognitive level than to certain cognitive deficits per se. In addition, they indicate that prediction of poor insight and competence can be improved by adding the new metacognitive measures to the conventional WCST measures (number of categories achieved, percentage of correct sorts, percentage of perseverative responses, percentage of perseverative errors, and number of trials to first category). Finally, the findings suggest that the predictive power of the new metacognitive measures does not come at the expense of the conventional cognitive measures; on the contrary, the latter

are actually enhanced in the joint model. Taken together, these findings suggest that free-response, output-bound accuracy performance, which depends on metacognitive skills of monitoring and control, provides an important link between basic-level cognitive skills and the clinical phenomenon of poor insight and competence to consent to treatment. In fact, they also suggest that such performance may be at least equally, if not even more, relevant for these phenomena than forced-response, input-bound quantity performance, which is the typical performance measure in traditional assessments of cognitive functioning.

These preliminary findings have several important limitations. First, as already mentioned, both insight into illness and competence to consent are not classical examples of real-world functional outcome. Further evaluation of the extent to which these findings generalize to more prototypical instances of social functioning is obviously needed. Second, one might argue that the correlation between insight and metacognition is not informative since both are measures of the same construct (ie, awareness). While having some validity, this concern is actually obviated by several factors. First, as previously mentioned, both metacognition and insight into illness are constructs that are much broader than just self-awareness. Second, while insight into illness is assessed using self-report ratings of one’s own mental condition, in our paradigm metacognitive self-monitoring and self-control are measured behaviorally on a trial-by-trial basis. And third, and most important, ecological validity does not necessarily require that the predictor and outcome be conceptually distinguishable. In fact, the exact opposite is the case. Ecological validity is the degree to which laboratory-based measures of a given construct are related to real-world examples of that *same*, rather

**Table 2.** R<sup>2</sup> and Uniqueness Indices Obtained in Sequential Multiple Regression Analyses Predicting Insight and Competence to Consent to Treatment

	Insight		Competence to Consent	
	R <sup>2</sup>	Uniqueness Index <sup>a</sup>	R <sup>2</sup>	Uniqueness Index <sup>a</sup>
Model 1: Conventional WCST predictors alone (% correct responses, number of categories, perseverative responses, perseverative errors, trials to first category)	0.06	0.13	0.22	0.24
Model 2: Metacognitive predictors alone (accuracy score, improvement due to free choice, global monitoring, monitoring resolution, control sensitivity, monetary gains)	0.62*	0.62**	0.50 <sup>§</sup>	0.39
Model 3: All predictors from both domains	0.75*		0.63 <sup>§</sup>	

*Note:* Based on Koren et al. (2004)<sup>56</sup> and Koren et al. (2005).<sup>57</sup>

<sup>a</sup>Uniqueness index indicates the percentage of variance accounted for by that set of predictors beyond the variance accounted by the other set.

<sup>§</sup> $p < .10$ ; \* $p < .05$ ; \*\* $p < .005$ .

than different, construct. Thus, assuming that insight truly reflects real-world function, the fact that metacognition and insight are significantly related supports, rather than refutes, the ecological validity of the new metacognitive approach. This is very much the same as with other cognitive domains, such as memory or social cognition, in which a relationship between performance on a standard test and real-world behavior that involves that same cognitive function supports the ecological validity of that test.

#### *How Do the New Tasks Affect Performance on the Test?*

A main point of the current findings is that the advantage of adding metacognitive measures to the conventional WCST measures was detected in a single integrated process, rather than by comparison of correlations from 2 separate sets of tests. A key question in this regard, however, is to what extent the additional metacognitive tasks affect WCST performance. It is possible that they “interfere” with the expected WCST performance. While this question is yet to be explored systematically, there are some hints in our data suggesting that the effect of the new tasks on performance, if one occurs at all, is not substantial. First, group means of conventional test scores in our studies are rather consistent with those of similar samples reported in the literature.<sup>66–70</sup> Second, data on 8 of 9 patients who took both versions of the test within 2 weeks do not reveal any major or consistent differences in any direction. While certainly too small for reaching a decisive conclusion, it is nonetheless noteworthy that the variability of the scores in the only case that was different from this general rule did not appear to be related to the version used. That is, the difference between the 2 administrations of the metacognitive version was greater than that of each one of them with the standard version.

Clearly, the main limitation of these preliminary data lies in the small sample size on which they are based. Thus, replication and further validation of the new method, applied to other neuropsychological domains in larger and more heterogeneous samples, is necessary. However, if further validated, the new paradigm may provide a novel, accuracy-oriented approach to neuropsychological models of other clinically meaningful phenomena in which free-response and self-directed action are inherent elements, such as treatment compliance, rehabilitation outcome, violent behavior, and the like. Ultimately, the new metacognitive approach can provide an empirical foundation for future studies relating such measures to brain function and structure in these patients.

#### **Other Advantages of the New Metacognitive Approach**

As already mentioned, the main advantage of the new metacognitive approach is that it assesses the relative

importance of cognitive versus metacognitive measures in a single integrated process, rather than by comparison of correlations from 2 separate sets of tests. In addition, it has a few extra benefits that are worth mentioning.

1. *It is widely applicable.* It is important to note that although Koriat and Goldsmith’s metacognitive model was applied in this study to abstraction, its basic logic can be applied to any type of cognitive task, in which discrete responses (that may be correct or incorrect) are arrived at. Thus, this model can be applied to performance of participants on many other tests that tap other domains of functioning, such as memory, visual perception, olfaction, attention, Theory of Mind, and affect recognition
2. *It is highly engaging/motivating.* The WCST has a reputation for inducing frustration and irritation, particularly due to the explicit negative feedback elicited by incorrect responses. However, thus far with our new metacognitive, free-choice approach none of the patients (out of more than 150 tested) requested to discontinue the task prior to completion. While we did not systematically evaluate the reasons for this high completion rate, our subjective impression is that this pattern is due more to the free-choice nature of the procedure, than to the fact that there is monetary reinforcement. Although there is limited research on the positive effect of monetary reinforcement on WCST performance,<sup>71</sup> the majority of studies did not find a significant benefit in performance from monetary reward.<sup>72–74</sup> Further research on this issue is needed because none of these studies reported completion rates as an outcome.
3. *It provides a behavioral measure of awareness.* Most measures of self-awareness currently used in the literature are based on verbal self-report questionnaires or interviews in which participants rate their level of competence in a given area. The main advantage of these declarative measures is that they are highly face-valid. However, due to this very same reason (ie, being transparent), they are also more susceptible to distortion and intentional response bias (eg, fake-bad or fake-good). In contrast, in our new metacognitive approach, awareness is assessed using behavioral or procedural measures that are gathered on a trial-by-trial basis. Consequently, they are less susceptible to motivational bias since the participant does not really know what kind of response would support an impression of capacity for self-awareness versus the lack of self-awareness.
4. *It allows separation of metacognitive abilities from cognitive performance.* The new metacognitive approach allows assessment of metacognitive monitoring and control not only of one’s own responses but those of anonymous participants as well. That is, rather than being asked to take the test themselves, patients

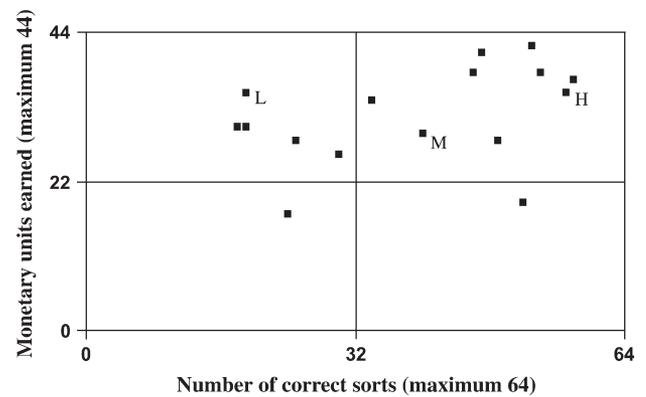
can be asked to watch the answers given by another anonymous participant, to rate the probability that each of these answers is correct, and to also advise that person on whether to volunteer or withhold each response. Note that in order to evaluate the performance of another person, one does not necessarily need to be able to know the correct answers oneself. Even though knowing the correct answers can surely help, there are all sorts of performance-related (feedback, speed, amount of production), as well as contextual, cues that can enable one to make these judgments. This “anonymous” option has several potential benefits. First, by applying it to a preset sequence of responses, it can provide a standard, common baseline to assess and compare patients’ metacognitive abilities in a way that is experimentally independent of their own (online) level of performance. Second, by applying it to one’s own set of responses from a day or two earlier (without the patient knowing whose performance it is), along with asking the patient to offer better alternative answers, a method to isolate effects of performance anxiety can be developed. This is so because this situation manipulates the level of threat to one’s self-image while keeping the overall cognitive load constant.

### Implications for Remediation Programs

There is little question that selection of the most appropriate deficits as prime targets for remediation is the “key to success.”<sup>75</sup> Our preliminary data appear to have important implications for this matter. First, they highlight the potential promise of focusing on deficits at the metacognitive level, in addition to those evidenced at the cognitive level of performance. This point is particularly important since it is relevant not only for cognitively impaired patients but also for patients from the normal or even superior ends of the cognitive performance spectrum. Second, the data also suggest that the focus or level of intervention might be different for different patients.

To further illustrate these points, we sampled 15 patients from our ongoing research. Figure 3 presents the scatterplot of these patients’ level of cognitive performance as estimated by the total number of correct sorts on the WCST (64-card version) presented by the amount of money they earned while monitoring the performance of another “anonymous other.” As already mentioned, this procedure allows a common ground (ie, the amount of potential earnings is equal for all participants) to compare patients’ metacognitive abilities in a way that is independent of their cognitive abilities.

Close scrutiny of this plot reveals that, given equal opportunity, the amount of money one can make is not necessarily tied to the ability to perform the task (ie, one’s cognitive level of performance). In fact, it appears that



**Fig. 3.** Scatterplot of Monetary Gains by Level of Wisconsin Card Sorting Test (WCST) Performance in a Subgroup of 15 Schizophrenia Patients.

it is more heavily influenced by the ability to accurately monitor and regulate either one’s own performance or that of another person. Note, for instance, that the amount of money earned by the patient (L) who was most cognitively impaired is almost the same as that gained by the patient (H) with the highest level of cognitive functioning, and even better than that of a patient (M) in the medium-range level of impairment.

Assuming that monetary gains are a good estimate of one’s functional effectiveness in real-life situations, these data have some important implications for cognitive remediation. First, they provide us with a very clear means of showing each patient whether his or her performance effectiveness (amount of money they make) is below or above his or her cognitive abilities and why. Second, they offer a target for remediation with cognitively intact but poorly functioning patients, like patients M or H. And third, they convey hope for even the most impaired patients, who, like L, suffer from persistent cognitive deficits. This last point makes metacognition particularly important for pharmacological studies of new cognitive enhancers since an improvement is possible even in the absence of any improvement in base-level cognitive skills.

Finally, free-response accuracy performance has another characteristic that makes it particularly important for cognitive remediation. Note that from a learning point of view, in quantity-oriented training, reinforcement (either material or psychological) is achievable only with correct responses. In contrast, in accuracy-oriented training, reinforcement can be obtained with both correct *and* incorrect responses. That is, correctly assessing incorrect response as such is potentially quite gratifying in and of itself. Thus, from a motivation point of view, accuracy-oriented remediation of metacognitive abilities has the potential to have greater engaging capability than standard cognitive remediation. While remediation programs that are specifically designed to target metacognition do not exist yet, an extensive description of the possible ways by which metacognitive deficits can

be remediated can be found in a recent book by Wykes and Reeder on cognitive remediation for schizophrenia.<sup>22</sup>

### Important Conceptual Questions Regarding Metacognition

#### *What Metacognition Is Not? Its Relationships with Other Constructs*

The concept of metacognition has been employed in several neuropsychological perspectives that have been applied to schizophrenia to describe a variety of “meta-level” deficits. While all of these models use “metacognition” as one of their conceptual cornerstones, the exact meaning attached to it within each theoretical framework is different. To avoid confusion, a brief comparison of our use of “metacognition” with that of these other models is indicated. In the following paragraphs, we will cover the following concepts: executive functions, source monitoring, theory of mind, signal detection theory, and transfer of learning.

**Executive Functions.** Executive functions are commonly defined as a set of higher-order processes that modulate lower-level schemas according to one’s intentions<sup>76</sup> and consciously direct one’s behavior towards a selected goal.<sup>77</sup> By emphasizing the regulation of information processing necessary to produce voluntary action, executive function is closely related to metacognition, especially to its control aspect. In fact, it is commonly considered by many as either the control aspect of metacognition<sup>78</sup> or simply as a synonym for metacognition.<sup>79</sup>

Because research on metacognition and executive function has been progressing more or less in parallel, with little cross-talk, it is difficult to come up with black-and-white definitions. Based on the current scarce data, we, like others,<sup>80</sup> regard the metacognitive processes of correctness-monitoring and report-controlling as related to executive-functioning processes. However, despite the obvious conceptual similarities, our treatment of metacognitive control differs in important ways from common conceptualizations and measures of executive functions. First, while our correctness-monitoring may be a subset of executive functions (cf error monitoring and verification processes in Shallice and Burgess’s supervisory system framework<sup>1,81</sup>; uncertainty monitoring in dolphins and monkeys<sup>82</sup>), it appears to be more general in scope. This is so because it can be applied to any cognitive output that is a basis for behavior and that can be evaluated as correct or incorrect. And second, our control process is specifically concerned with regulating the accuracy of one’s cognitive performance in free-response tasks. Thus, although metacognitive control over responding may be a specific type of executive functioning, it is different than common measures of executive function (eg, Verbal Fluency Test, Trail Making, WCST)<sup>83</sup> since it is secondary in nature. That is, it relates

to whether the output of a primary process (eg, is the rule I have been using thus far is still in effect, or does it need to be inhibited?) should be committed to.<sup>56</sup>

For purpose of illustration, imagine 2 patients who have devised the same inefficient action plan to solve a given problem (ie, both have the same level of poor executive function). Patient A, being confident that the plan is a good one (poor monitoring), goes on to use it. Patient B, on the other hand, being more doubtful (good monitoring) that the plan she reached is actually a good one, refrains from acting on it and seeks advice.

**Source-Monitoring.** Self-monitoring, as a key “metacognitive” skill, is also a conceptual constituent of source-monitoring theories of schizophrenia. In this context, however, self-monitoring refers to a fundamental cognitive ability that enables one to correctly attribute authorship or agency to one’s own actions, thoughts, or emotions.<sup>84</sup> That is, it allows one to discriminate between self-generated actions or thoughts and those generated by external sources of stimuli. Deficits in this “meta-level” skill have been proposed by theorists as potential accounts for key psychotic symptoms of schizophrenia, such as delusions of control and hallucinations.<sup>85–87</sup> While such theories are both promising and informative, it is important to note that their use of the term “self-monitoring” is somewhat different from our use of the same term (ie, one’s subjective assessment of the correctness of one’s own knowledge). In this case, our use of the term “monitoring” appears to be more general: Whereas source-monitoring surely plays an important role in assessing the correctness of one’s knowledge, there are undoubtedly many other types of processes that contribute.<sup>eg.88–90</sup> A potential solution for this terminological confusion might be to regard self-monitoring in the more specific, self-agency context as source-monitoring, and in the more general, metacognitive context as correctness-monitoring.

**Theory of Mind.** Theory of mind (ToM) refers to a complex social cognitive ability that allows one to infer and represent mental states (eg, beliefs, intentions, thoughts) of other people. Impairments in ToM have been proposed and studied as a possible account of schizophrenia symptomatology, both positive and negative.<sup>91</sup> In fact, some researchers have even gone as far as claiming that schizophrenia can be understood as a “disorder of meta-representation” of mental states in self and others, in which a failed ToM plays a central role.<sup>92</sup> Due to its focus on metarepresentational states, over the years ToM has become strongly associated with metacognition, perhaps even a synonym for it.<sup>93</sup> As in the case of executive functioning, however, it is important to note the ways in which the common notion of ToM differs from the type of metacognition considered here. Once again, whereas metacognitive certainty monitoring is specifically

concerned with monitoring the correctness of potential responses, ToM is generally applied to the monitoring of a wide variety of mental and emotional states, particularly the states of others. Indeed, although the notion of correctness-monitoring can be extended to monitoring the cognitive performance of others, the focus is on the *correctness* of the other's response (or underlying mental representation) rather than on the *content* of their mental state while they perform the task. Note that the ability to correctly infer another person's state of mind (eg, to make a correct discrimination on a standard ToM task) may be quite different than the ability to discriminate between ToM inferences (one's own or others') that are correct and those that are incorrect. Finally, like the common measures of executive functioning, most measures of ToM involve forced-response tasks. Thus, the metacognitive control aspect of the strategic regulation of (free-response) output-bound accuracy is not tapped by such measures.

*Signal Detection Theory.* Our treatment of metacognitive monitoring and control, and the distinction between input-bound quantity and output-bound accuracy measures, also has a great deal in common with psychological applications of signal-detection theory (SDT),<sup>94</sup> which are used to demonstrate lowered perceptual sensitivity in schizophrenia.<sup>95</sup> SDT also represents an accuracy-oriented, decision-making approach to cognitive functioning, and it raises some of the same issues brought out here. For example, it too involves a distinction between monitoring ( $d'$ ) and control ( $\beta$ ) and emphasizes the idea that performance accuracy, in terms of a reduced false-alarm rate, can be achieved at the expense of performance quantity, in terms of a reduced "hit" rate. Yet, despite the apparent similarities, there are several fundamental differences that should be emphasized.

First, the control decision addressed by the traditional (Type-I) SDT framework is not whether to respond, but rather whether to respond "A" (eg, "old/studied") or "B" (eg, "new/foil") under forced-responding conditions. That is, a response must be made to each and every item. In fact, although the logic of SDT can be extended to free-response tasks,<sup>44,96</sup> the traditional (Type-I) SDT performance-assessment methods cannot be applied to such tasks, precisely because they give participants the freedom to decide whether to volunteer or withhold responses<sup>97</sup> (but see<sup>98</sup> for a partial application of Type-II measures to free-response tasks). Second, and more fundamentally, SDT does not distinguish between "cognitive ability" (eg, memory strength) and "monitoring ability" (eg, the ability to discriminate studied from foil items): Both are equally valid interpretations of  $d'$ .<sup>97</sup> (Interestingly, when Type-II SDT methods are used to measure the ability to discriminate between one's own correct and incorrect answers,  $d'$  reflects monitoring ability alone,<sup>97</sup> in which case SDT does not

provide a separate measure of cognitive ability.<sup>98</sup>) By contrast, in our metacognitive approach to understanding the determinants of free-response performance, these 2 aspects (as well as control) may be evaluated independently: One may show good cognitive performance, yet poor monitoring ability, or vice versa. Moreover, although SDT isolates "control" in terms of the parameter  $\beta$  (strictness or liberality of the response criterion), the notion of "control sensitivity" has no place within the SDT framework: It is axiomatic in SDT that the response decision is based entirely on the underlying dimension that is being monitored (eg, confidence or perceptual-memorial strength). In contrast, our framework allows for variance both in the setting of the control (response) criterion and in the extent to which the control decision is based on the monitoring output (ie, confidence). It also allows these 2 aspects of control to be independently measured.<sup>eg,53,80,99</sup>

*Transfer of Learning.* Another area in which the concept of metacognition plays a central role is transfer of learning. Transfer of learning, which has its roots in the literature on learning theory,<sup>100</sup> is defined as the ability to use existing knowledge, experience, motivations, and skills in new contexts.<sup>101</sup> That is, it occurs when learning in one context enhances (positive transfer) or undermines (negative transfer) a related performance in another context. Transfer includes *near* or *low road* transfer (to closely related contexts or tasks) and *far* or *high road* transfer (to rather different contexts or tasks).<sup>102</sup> As Wykes and Reeder recently argued,<sup>22</sup> transfer is particularly crucial to cognitive remediation and social skills therapies in schizophrenia since their main goal is to impact on functioning in real-world contexts that are often quite different than those of learning. Effective transfer, especially of the high road type, depends crucially on effortful reflection on one's thinking processes and abstraction of common themes and meta-level action schemas (that can then guide performance in novel situations).<sup>102</sup> Due to their self-reflective and meta-level nature, these abstraction processes are referred to in this context as metacognitive processes, and their products as metacognitive knowledge.

This view of metacognition, which has been the focus of extensive research in education, and ours share a similar notion regarding the processes aspect of metacognition, namely, that it consists of reflection on and regulation of one's own thinking. On the other hand, the 2 views are completely different with respect to the type of knowledge that is produced by these metacognitive processes. Whereas in the context of transfer of learning they are viewed as generating a stable meta-knowledge about general cognitive strategies and principles, in our model they are viewed as producing a moment-to-moment knowledge about the quality of one's cognitive outputs. Consequently, while assessment of metacognitive knowledge in the context of transfer is based on verbal

self-report questionnaires or interviews (in which learners rate their metacognitive knowledge or recall what they thought during a learning experience),<sup>103,104</sup> in our new method it is assessed online using behavioral measures (confidence ratings and venture decisions).

*Synopsis.* To summarize, there are 2 main differences between metacognition as denoted in this article and all of the related concepts reviewed above. First, our notion of metacognition refers to a global, overarching meta-level of performance, which monitors and controls (if allowed to do so) the correctness of performance in all types of cognitive tasks; including those just considered (ie, tasks tapping executive functions, source-monitoring, theory of mind, and so forth). Second, and no less important from a methodological point of view, the performance effects of the metacognitive monitoring and control functions addressed here cannot be examined with “forced-response” tests that focus solely on input-bound quantity-based performance. Rather, their evaluation depends on the incorporation of “free-response” tasks and output-bound accuracy-based performance measures—both cognitive and metacognitive—into current testing procedures.

### *Is Metacognition Reducible to Lower-Level Cognitive Abilities?*

Another issue that we wish to address briefly is the relationship between metacognitive processes and cognitive processes in general: Are the monitoring and control processes used to evaluate the degree (correctness) of one’s knowledge, abilities, and performance, and to direct one’s behavior accordingly, essentially the same or different from other cognitive processes, in particular, the specific cognitive processes that are being monitored and controlled? At present, there is no consensus on this issue. On the one hand, it has been proposed that essentially the same processes are responsible for both cognitive and metacognitive performance. For instance, Dunning *et al.*<sup>88(pp84–85)</sup> suggest, “In many intellectual and social domains, the skills needed to produce correct responses are virtually identical to those needed to evaluate the accuracy of one’s responses.” Thus, people lacking such skills are “doubly cursed”—they have difficulty both in producing correct responses and in deciding whether the responses they (or others) have produced are right or wrong. In support of this idea, performance on an exam is often positively correlated with the ability to monitor the correctness of one’s answers,<sup>eg,105,106</sup> and good performers are less able than poor performers to evaluate the performance of others.<sup>107</sup>

On the other hand, many influential theories view metacognitive processes as being tied to, yet functionally separate from, the cognitive processes that they monitor.<sup>51,108–110</sup> In this view, metacognitive judgments are

based on a variety of inferential cues, some of which relate to the object-level cognitive process (eg, ease, speed, amount and fluency of information retrieval<sup>49,89</sup>), whereas others do not (eg, the perceived familiarity of the question itself<sup>109,110</sup>). These metacognitive judgments (and their accuracy) can therefore be dissociated from actual cognitive performance. For example, advance priming of potential answers to general-knowledge questions increases subjective confidence in those answers regardless of whether they are right or wrong,<sup>111</sup> and advance priming of the question increases feeling-of-knowing judgments, again without having any effect on actual performance.<sup>109,110</sup> Also, in examining the factors affecting text comprehension, Weaver<sup>112</sup> found that adding topic sentences to text passages enhanced individuals’ ability to judge whether they had comprehended the text but did not improve the overall level of comprehension. Such dissociations imply that there is at most a partial overlap between the meta-level and object-level processes.<sup>55,113</sup>

These examples have all concerned metacognitive monitoring. With regard to metacognitive control, the case for functional separation between cognitive and metacognitive processes is even more clear. For example, such varied factors as monetary incentives,<sup>47,52</sup> instructions,<sup>114</sup> and hypnosis<sup>115</sup> have all been shown to affect the strictness or liberality of the criterion one uses to decide whether to volunteer or withhold potential responses in free-response testing, without having any effect on forced-response performance. Moreover, one of the most intriguing issues in the developmental metacognition literature is the fact that children sometimes have metacognitive capabilities that they do not spontaneously apply.<sup>50</sup> This may be the case with schizophrenics as well: First, patients with schizophrenia appear to have lower control sensitivity than normal controls.<sup>56,116</sup> Second, for the schizophrenic patients tested in the Koren *et al.* study,<sup>57</sup> control sensitivity was more highly correlated with the clinical measures of insight than any of the other metacognitive measures (for example,  $r = -.67$  and  $r = -.52$  for awareness of medication effect and overall insight, respectively), whereas the cognitive performance measures (conventional WCST scores) did not correlate at all!

In sum, although the issue is surely more complex than our brief treatment here allows, we believe that the treatment of metacognitive processes as at least partially distinct from cognitive processes is justified, both theoretically and empirically.

### **Conclusion**

The main theme of this article is that metacognitive processes of self-monitoring and self-control are fundamental components of human cognition that normally accompany many of our daily activities. As we have tried

to show, the fact that these processes have long been neglected as valid objects of scientific inquiry has reduced the ecological validity of neuropsychological research in schizophrenia. Metacognition emerges where cognition begins to apply to its own processes and products. As such, it inextricably relates to issues of reflectivity, subjectivity, and free will. Traditionally, due to their philosophical and empirically resistant nature, these issues have been considered as mere methodological nuisance factors that prevent strict experimental control. The perspective we have tried to put forward in this article, however, is different. It is founded on the assumption that these processes are not only key determinants of competent functioning in the real world but also that they can be assessed with reliable and valid experimental methods that do not compromise methodological standards.

Clearly, there are important aspects of real-life functioning, such as voluntary control over task order or allocation of study time, which are not covered by the type of metacognition emphasized here. Furthermore, there are also undoubtedly many situational and personality factors that affect the appreciation and regulation of cognitive performance in the real world. However, if further validated, our new metacognitive approach may still make a modest contribution toward bridging the gap between basic neurocognition and real-world functioning. In addition, it may provide a sound theoretical and empirical base from which to develop and assess the effectiveness of therapeutic interventions specifically focused on remediation of deficits at this level. Finally, it may provide an empirical foundation for future studies focusing on the brain systems or neural mechanisms involved in deficits of self-monitoring and self-directed action, as well as on new medications that potentially target them.

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