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An examination of instrumental activities of daily living assessment in older adults and mild cognitive impairment

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Basic activities of daily living (ADL) are self-maintenance abilities such as dressing or bathing. Instrumental ADL (IADL) are more complex everyday tasks, such as preparing a meal or managing finances (Lawton & Brody, 1969). IADL questionnaires play an important role in assessing the functional abilities of older adults and evaluating the impact of cognitive impairment on routine activities. This paper examined the cognitive processes that underlie IADL performance and concluded that the accurate and reliable execution of IADL likely draws upon the integrity of a wide range of cognitive processes. This review examined IADL in mild cognitive impairment (MCI) because of the controversial nature of distinguishing a significant decline in functional abilities in those with MCI versus dementia or MCI versus cognitively normal aging. The challenges of investigating IADL empirically were explored, as well as some of the reasons for the inconsistent findings in the literature. A review of questionnaire-based assessments of IADL indicated that: MCI can be distinguished statistically from healthy older adults and dementia, individuals with multiple domain MCI are more impaired on IADL than those with single domain MCI, mild IADL changes can be predictive of future cognitive decline, and the ability to manage finances may be among the earliest IADL changes in MCI and a strong predictor of conversion to dementia. This paper concluded with recommendations for more sensitive and reliable IADL questionnaires.

Keywords: Mild cognitive impairment; Instrumental activities of daily living; Cognitive correlates of everyday functioning; Prediction of future decline; Assessment and classification.

Activities of daily living (ADL) can be classified into basic activities of daily living (BADL) and instrumental activities of daily living (IADL; Lawton & Brody, 1969). BADL are composed of more basic, self-care behaviors such as ambulating, dressing, grooming, bathing, feeding, and toileting. By contrast, IADL facilitate independent living through behaviors such as transportation, telephone use, meal preparation, medication management, financial management, housekeeping, laundry, and shopping. IADL questionnaires play an important role in assessing functional abilities and evaluating the impact of cognitive impairment on routine activities in older adults.

IADL independence is one of the defining features that distinguishes normal aging from mild cognitive impairment (MCI) and dementia. As part of the diagnostic criteria for MCI, an individual must be independent for BADL but he or she can have “minimal” disturbance in their performance of IADL (e.g., Petersen, 2004; Winblad et al., 2004).

Characterizing impairment in IADL is controversial for several reasons. No objective standard exists as to the practical or theoretical definition...
of minimal functional impairment in MCI (e.g., Petersen, 2004; Winblad et al., 2004). For example, does functional disturbance entail frank impairment on a few IADL tasks such as shopping and meal preparation or is it better understood as some difficulty across many commonly assessed IADL tasks? While clinical judgment is called for by the expert panel that created these standards (e.g., Petersen, 2004; Winblad et al., 2004), the general clinician or researcher is left without much guidance about how to assess IADL impairment in MCI. Several options exist including performance-based tasks and questionnaires or interviews (with and without informant reports). However, different methods of assessing functional abilities provide different estimates of IADL independence (e.g., Burton, Strauss, Bunce, Hunter, & Hultsch, 2009); each approach has advantages and disadvantages.

Performance-based measures typically involve observing an individual enact an IADL, such as preparing his/her medications in either the community or the testing environment (see Moore, Palmer, Patterson, & Jeste, 2007, for a systematic review of performance measures). Performance-based assessments have been criticized for removing the individual’s chosen routines and environmental cues that typically facilitate IADL. Furthermore, performance-based assessments represent a single evaluation data point compared with the multiple observations afforded by a questionnaire that comments on an individual’s behavior in recent weeks or months. Although there are clear advantages to the validity of directly observing how an individual performs tasks such as balancing a checkbook, either in the laboratory or at home, the time and resources required make performance-based measures prohibitive for most clinical assessments or research trials.

More commonly, a questionnaire and/or an interview will be selected for the participant and informant (e.g., Strauss, Sherman, & Spreen, 2006). Several IADL questionnaires are commonly used with older adults in research and clinical environments, but no “gold standard” exists. The practice of using an informant’s perspective is important, because, beyond convergent validity, there is evidence for impaired insight and even anosognosia in MCI (e.g., Vogel et al., 2004). Driven perhaps by the rater’s familiarity with the individual’s performance in multiple environments over an extended period of time, the informants’ assessment of everyday functioning is sensitive to the distinction between healthy aging and dementia or MCI (e.g., Farias, Mungas, & Jagust, 2005). Balanced with the monetary and temporal efficiency of assessing a wide range of activities in a short time period, potential drawbacks to questionnaires include biases and inaccuracies in informants’ perceptions as well as the possibility that some older adults do not have an individual who can comment on their daily functioning.

Given that questionnaire-based assessments of IADL are the most prevalent method of gathering information (Strauss et al., 2006), this paper focuses on the empirical support for such measures. Although some consider performance-based measures to be superior to questionnaires, it is not necessarily the case that direct observation represents the highest standard (e.g., Strauss et al., 2006). In fact, a direct comparison has not often been made in the same study. A recent examination by Burton and colleagues (2009) indicates that a sensitive IADL questionnaire can predict patient groups equally as well as a performance-based measure.

There is heightened interest in establishing guidelines about the nature of functional impairments in MCI (e.g., Nygard, 2003). This type of work is important and can enable the application of empirical findings to accurate diagnosis of MCI and prediction of functional abilities from cognitive tests. However, previous research with IADL has been hampered by questionnaires that lack scientific rigor, and little attention has been given to the content of these measures. Experimental measures have been developed in response to the need for empirically validated IADL questionnaires, and this review describes such initiatives.

There is limited restriction in IADL in healthy older adults and near-complete restriction in IADL as dementia progresses (e.g., Galasko et al., 1997). The continuum of cognitive and functional decline between healthy aging, MCI, and dementia has prompted researchers to better understand the relationship between psychological process and functional abilities. Understanding the cognitive underpinnings of IADL may help clinicians and researchers to better discern the transition from functional independence to dependence and to predict which older adults are at greatest risk for future decline.

This goal of this article is to examine the cognitive processes that underlie IADL in community-dwelling older adults, including those with MCI (many of the investigations collapse across groups of older adults and MCI to maximize power). A better understanding of the psychological processes associated with IADL will allow researchers and clinicians to critically examine the breadth and meaning of IADL questionnaires, provide foci for the rehabilitation of IADL, and aid in the development of more sensitive and ecologically valid
measures. The review addresses some of the reasons for inconsistent findings in the assessment of functional abilities in community-dwelling older adults. Attention is given to the questionnaires themselves, to describe their contribution to the variability found in the investigations of IADL in community-dwelling older adults. These discussions are used to inform the second half of the review that focuses on examinations of IADL in MCI only, to demonstrate the nature and degree of functional impairment in MCI. Furthermore, the review also focuses on the importance of IADL in predicting decline in MCI populations. Taken together, the topics reviewed will inform recommendations for the development of new IADL measures.

Demographic/clinical variables and cognitive processes that underlie IADL

A number of demographic/clinical variables have been associated with IADL. Advanced age and lower education have been independently associated with poorer functional status (e.g., Artero, Touchon, & Ritchie, 2001), as have depressed mood (e.g., Cahn et al., 1996), poor motor functioning (e.g., Bennett et al., 2006), and chronic disease load and lifestyle factors (e.g., Wang, van Belle, Kukull, & Larson, 2002). Women may be more impaired on IADL, possibly due to higher rates of nonfatal, disabling conditions such as osteoarthritis that may account for gender differences in IADL over and above other factors such as lower income (Murtagh & Hubert, 2004). Controlling for these variables, there has been great interest in examining the cognitive variables associated with IADL performance. Not surprisingly, the most consistent finding is that better general cognitive functioning, defined as global cognitive status by brief screening tests such as the Mini Mental State Examination (MMSE: Folstein, Folstein, & McHugh, 1975), is associated with greater functional independence (e.g., Burton, Strauss, Hultsch, & Hunter, 2006; Eby, Hogan, & Parhad 1995; Jefferson, Paul, Ozonoff, & Cohen, 2006, Tuokko, Morris, & Ebert, 2005).

Beyond the consistent relationship between general cognitive functioning and IADL, there have been several systematic efforts to identify the role of unique cognitive processes in functional abilities. For instance, some recent MCI investigations have found memory (Farias et al., 2006), verbal learning (Jefferson et al., 2008), motor skills (Bennett et al., 2006), and psychomotor speed (Tuokko et al., 2005) to be associated with IADL. Across community-dwelling samples of healthy older adults and those with MCI, there is converging evidence about the role of memory in socialization (e.g., Cahn-Weiner et al., 2007; Plehn, Marcopulos, & McLain, 2004; Schmitter-Edgecombe, Woo, & Greeley, 2009), motor function more so than cognitive function in the “old-old” (81–94 years old; e.g., Bennett et al., 2006; Louis, Tang, Schupf, & Mayeux, 2005; Tam et al., 2008), and difficulties in financial management predicting future decline (e.g., Fillenbaum, 1985; Peres et al., 2008).

The bulk of the research, however, has focused on the role of executive functions in IADL completion (e.g., Bell-McGinty, Podell, Franzen, Baird, & Williams, 2002; Cahn-Weiner, Boyle, & Malloy, 2002; Jefferson et al., 2006), and findings suggest that executive functions play an important role in IADL production and prediction of future decline in healthy older adults and those with MCI (see Royall et al., 2007, for a comprehensive review). It is important to try to understand why different investigators have found such disparate relationships between cognitive function and IADL.

The challenge of investigating the relationship between cognitive processes and IADL

Royall and colleagues’ (2007) meta-analysis of 68 studies that examined cognitive predictors of functional status testifies to the methodological and theoretical challenges of examining the relationship between cognitive predictors and measures of IADL. The meta-analysis did not analyze studies based on informant and self-report questionnaires, or performance and observational measures of IADL, despite the evidence that distinct methods yield different estimations of functional status (e.g., Burton et al., 2009). The variability between studies was enormous, with the total variance accounted for by cognitive predictors of IADL ranging from 0% to 80% (Royall et al., 2007). Overall, an average of 21% of the variability in functional abilities could be predicted by all cognitive measures combined (e.g., executive functions, memory, visuospatial skills), with a standard deviation of 20.2%. Of the 21% of variability accounted for by all cognitive measures, general cognitive functioning accounted for 12%, executive functions 6.5%, and memory 1.9%.

Some of the reasons for the inconsistent relationships found between cognitive processes and IADL may relate to: the method of reporting on IADL, the different relationships with executive processing found when using performance versus questionnaire-based assessments, the inherent heterogeneity of executive processes, and the
variability in the treatment of cognitive variables in prediction models. We review these possibilities below.

**Informant versus self-report questionnaires**

The method of reporting on IADL questionnaires influences the amount of variability that can be predicted by a cognitive domain, as well as the estimation of functional independence in MCI samples. For example, Tan, Hultsch, and Strauss (2009) found that executive functioning was more strongly associated with informant reports than self-reports in MCI. In addition, informant reports of IADL were able to accurately distinguish levels of functional independence in Farias and colleagues’ (2005) study, whereas self-report measures could not, consistent with the evidence of impaired insight into IADL performance in MCI (e.g., Tabert et al., 2002).

**Performance- and questionnaire-based assessment have different relationships with executive processes**

It is difficult to draw conclusions about the relative role of different cognitive processes in IADL execution because of the inherent differences between the performance-based measures and questionnaires. For instance, Bell-McGinty and colleagues (2002) reported that executive abilities could account for 54% of the variability in a performance-based measure of IADL in a sample of older adults. Similar studies that have investigated performance-based measures typically yield moderate to strong correlations, with executive measures able to account for approximately 12 to 55% of the variability in IADL (e.g., Bell-McGinty et al., 2002; Burton et al., 2006; Cahn-Weiner et al., 2002; Cahn-Weiner, Malloy, Boyle, Marran, & Salloway, 2000). In contrast, informant and self-reported measures typically yield small or no associations between executive processes and questionnaire-based evaluations of IADL in healthy older adults and those with MCI (e.g., Aretouli & Brandt, 2009; Jefferson et al., 2006; Pfehn et al., 2004).

Rarely have questionnaire and performance assessments been compared in the same study. Tan and colleagues (2009) compared a questionnaire and performance assessment of IADL and found that executive functions were more strongly correlated to performance-based measures than questionnaires. A simple explanation is that performance-based measures are a more sensitive tool. But, Cahn-Weiner and coworkers (2002) provide evidence that different executive processes may be recruited by performance and questionnaire-based measures. Whereas the Trail Making Test Part B (TMT-B; Reitan & Wolfson, 1985) was significantly correlated with both types of IADL measures, only verbal fluency was strongly associated with a questionnaire-based IADL, and not the performance-based measure (Cahn-Weiner et al., 2002), similar to a finding by Mariani and colleagues (2008). Verbal fluency draws upon initiation and response generation more so than TMT-B. For a performance-based IADL, the nature of the evaluation prompts an individual to commence a task and provides the structure for its completion. In contrast, a questionnaire-based assessment may be more similar to the environmental demands of spontaneously beginning an IADL task, generating the materials, and persisting until completion. Thus, the structure provided by a performance-based measure may reduce the real-world involvement of initiation and response generation required for IADL that is captured by questionnaire-based assessments (Cahn-Weiner et al., 2002). It may also be that performance-based measures are more strongly associated with executive function than questionnaire-based methods because they are higher in novelty, requiring a person to perform an IADL task or solve a problem in a new environment, stripped of the proceduralized cues that may have otherwise facilitated the successful IADL enactment.

**The heterogeneity of executive processes**

Beyond the variability created by investigations that do not differentiate between mode of assessment of IADL and the relationship between executive processes, there is also ambiguity caused by the diversity of executive processes. The heterogeneity of the processes that comprise executive functioning, including initiation, sequencing, monitoring, inhibition, set-shifting, planning, problem solving, and others (e.g., Lezak, Howieson, & Loring, 2004), represents a challenge in consolidating the findings from different investigations, as well as specifying the nature of the association between a specific cognitive process and IADL. A consistent finding worth noting is the relationship between speeded cognitive shifting/complex sequencing, as measured by the TMT-B, and IADL, in samples of community-dwelling older adults (e.g., Bell-McGinty et al., 2002; Cahn-Weiner et al., 2002) and those with MCI (e.g., Burton et al., 2006; Tan et al., 2009).
To better understand the relationship between executive processes and IADL, Jefferson and colleagues (2006) employed an executive battery composed of six tests. The authors found that a measure of inhibition (Delis–Kaplan Executive Function System, D-KEFS, Stroop; Delis, Kaplan, & Kramer, 2001) was most strongly associated with the Lawton–Brody (Lawton & Brody, 1969) in a sample of older adults with vascular risk factors. Transportation was associated with sequencing most strongly, and planning and inhibition. Although transportation includes driving and public transit, TMT-B happens to be one of the strongest neuropsychological predictors of driving (Mathias & Lucas, 2009), reflecting the need to quickly respond to environmental changes. Finally, managing finances was associated with inhibition only (Jefferson et al., 2006), perhaps underscoring the need to restrain irresponsible spending while not restricting reasonable transactions. Examinations such as these are effective as well for drawing attention to relationships between individual IADL items and cognitive processes, a topic that will be revisited later.

In possibly the most comprehensive examination of executive processes in IADL to date, Aretouli and Brandt (2009) administered an executive battery to individuals with MCI that included 18 tests. A principal component analysis was conducted, yielding three major components labeled as planning/problem solving, judgment, and working memory. Only the working memory block, which included measures of sequencing (TMT-B) and inhibition (D-KEFS Stroop), predicted a small amount of variance in IADL performance.

The treatment of executive function in prediction models

Aretouli and Brandt (2009) note that when general cognitive status (MMSE) was inserted into their regression model, the relationship between executive processes and an informant report of IADL abilities was no longer significant in their MCI sample. Reflecting back on some of the studies, Bell-McGinty and colleagues’ (2002) investigation is often cited for finding that executive processes account for more than 50% of the variability in IADL. In fact, the amount of unique variability accounted for by executive function was modest (15%) after factoring in the contribution of demographic variables to IADL (38%). In addition, general cognitive functioning mediates the relationship between specific cognitive variables, such as executive function, and IADL.

The MMSE is a sensitive but nonspecific measure of general cognitive functioning; it quickly surveys orientation, some executive processes, memory, language, and praxis—thus, it is highly correlated with lengthier measures of cognitive processing (e.g., Strauss et al., 2006). Examination of the matrices of correlations between executive functions and the MMSE, when available, indicates moderate to strong correlations. Although the correlation of two or more predictor variables in a regression model does not largely influence the predicted model as a whole, it does influence the relative contribution assigned to individual predictors (Tabachnick & Fidell, 2006)—an issue that has emerged in some of the investigations regarding the addition of a general cognitive functioning measure to a predictive model. The treatment of general cognitive functioning in regression models and bivariate correlations varies as a function of different investigations.

The role of executive processes in predicting IADL (e.g., Bell-McGinty et al., 2002) is a different question than the role of executive processes predicting variability in IADL over and above demonstrated variables of influences such as demographic/clinical factors and general cognitive functioning (e.g., Aretouli & Brandt, 2009). Some investigations are undertaken to examine the role of specific executive processes in IADL performance, and yield important information (e.g., Cahn-Weiner et al., 2002). One of the drawbacks of this method of investigation is that it does not allow for the comparison of the role of a particular cognitive process relative to another one.

Other investigations have taken on the challenge of examining multiple cognitive domains in predicting IADL and properly control for variables known to attenuate the relationship between specific cognitive processes and functional abilities (e.g., Aretouli & Brandt, 2009). As the number of cognitive domains added into the investigation increases, the amount of unique variability contributed for by executive processes or memory decreases in IADL as assessed by measures of performance (e.g., Burton et al., 2006) or questionnaires (e.g., Tan et al., 2009). For example, medium to large associations were reported between executive function (18–35% of variability) and memory measures (14–18%) and a performance-based IADL in a sample that included healthy older adults and those with MCI (Burton et al., 2006). Demographic/clinical variables (age, education, gender, and chronic illness) were entered into the hierarchical regression, accounting for 25.4% of the variability, followed by general cognitive functioning (MMSE) at 3%, processing speed,
executive function, memory, and verbal ability. Consequently, the amount of unique variability accounted for by the executive function component in their IADL measure was reduced to 7.9% (Burton et al., 2006). Similar findings were reported for questionnaire-based IADL, except the initial correlation with executive function was not as strong, and the unique variability becomes very small (e.g., Plehn et al., 2004; Tan et al., 2009).

This trend, together with the role of general cognitive functioning in mediating the influence of demonstrated variables of importance such as executive and memory contributions, can be interpreted as indicating that IADL enactment is not a unidimensional cognitive construct and likely draws upon the integrity of multiple cognitive systems. For instance, consider the task of handling finances. Inhibition may play an important role (Jefferson et al., 2006), consistent with the demands of managing finances. Processing speed has also been implicated (e.g., Barberger-Gateau, Fabrigoule, Rouch, Letenneur, & Dartigues, 1999), consistent with the need to negotiate the cognitive demands and complexity of money exchanges. Memory may also be important (e.g., Tuokko et al., 2005), consistent with the demand to actively retrieve conceptual knowledge about finances and recall previous transactions.

Thus far, we have reviewed a number of clinical and demographic variables that influence IADL at times, as strongly as cognitive variables. A number of investigations have tried to pinpoint specific cognitive variables that may be associated with IADL (see Table 1), with mixed findings about the types of cognitive abilities and their relative strength. Some factors that may contribute to the variability between investigations include the method of assessing and reporting of IADL and the treatment of demographic/cognitive variables and general cognitive functioning in regression models. The bulk of the research suggests that of the cognitive variables, executive function likely contributes the most unique variance to IADL. The strength of its relationship to IADL depends on whether or not it is compared to other cognitive variables such as memory and whether or not clinical/demographic variables and general cognitive functioning are accounted for in prediction models. As the number of cognitive variables added into models increases, the amount of unique variance explained by executive function is more modest—consistent with one of the conclusions drawn by Royall and colleagues (2007). Another source of variability in the assessment of functional abilities in older adults can be attributed to the questionnaires themselves.

### Commonly used IADL questionnaires

There is evidence to suggest that the type of questionnaire used influences diagnostic criteria (e.g., Tabert et al., 2002). Only a small proportion of the larger scale MCI studies that are reviewed utilize the same IADL questionnaire. There is no agreement on the quality of IADL questionnaires, and there is room for improvement in the validity and reliability of these measures (e.g., Sikkes, de Lange-de Klerk, Pijnenburg, Scheltens, & Uitdehaag, 2009). Standards of quality for questionnaires in health-related fields—content; criterion and construct validity; internal consistency; reproducibility (agreement and reliability); responsiveness; interpretability; and minimal floor and ceiling effects—have been described in detail (e.g., Terwee et al., 2007), and applied to IADL measures in dementia (Sikkes et al., 2009). Sikkes and colleagues (2009) concluded that the psychometric properties

### TABLE 1

<table>
<thead>
<tr>
<th>IADL task</th>
<th>Associated variable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall IADL enactment</td>
<td>General cognitive functioning, clinical/demographic variables, executive function, memory, verbal learning, motor skills, psychomotor speed</td>
</tr>
<tr>
<td>Overall IADL enactment (in the “old-old”)</td>
<td>Pure motor function (more so than cognitive function)</td>
</tr>
<tr>
<td>Overall IADL enactment (questionnaire-based more than performance)</td>
<td>Phonemic fluency (initiation, response generation)</td>
</tr>
<tr>
<td>Socialization</td>
<td>Memory, source memory</td>
</tr>
<tr>
<td>Finances</td>
<td>Inhibition, processing speed, memory</td>
</tr>
<tr>
<td>Difficulty managing finances</td>
<td>Future decline (e.g., conversion to dementia)</td>
</tr>
<tr>
<td>Transportation (driving)</td>
<td>TMT-B</td>
</tr>
<tr>
<td>Medication use &amp; household activities</td>
<td>Prospective and temporal order memory</td>
</tr>
<tr>
<td>Future IADL decline</td>
<td>Decline in executive function independently, and with memory</td>
</tr>
</tbody>
</table>

Note. IADL = instrumental activities of daily living; MCI = mild cognitive impairment; TMT-B = Trail Making Test-B.
of the commonly used IADL questionnaires either were unavailable or did not meet the standards of quality.

IADL are more complicated daily tasks than basic self-care activities and were originally differentiated from work and leisure activities (Lawton, 1988). This distinction is no longer as clear in some IADL measures that survey elements of recreation, such as watching television or completing a puzzle. The Appendix reviews the characteristics of the primary IADL measures found in the review of the MCI literature. The eight Lawton–Brody (Lawton & Brody, 1969) tasks are ordered first in the IADL items column in the Appendix to demonstrate their representation in other measures. The strict interpretation of Lawton (1988) was not applied, and leisure or recreation activities were included as IADL. The non-IADL items represent a collection of activities that were either too general or vague and did not represent a quantifiable activity, or, were cognitive processes, personality features, or behaviors. None of the items was changed from the original measures, but arranging them in this manner reveals some of the conceptual issues with the measures and the similarities and differences in the scope and breadth of items being assessed.

An important challenge inherent to consolidating findings from various investigations and being able to provide more information about the nature of the tasks with which MCI individuals show difficulties is the variability in the IADL items probed. The Appendix indicates that although there are commonalities in the items selected (most of the eight Lawton–Brody items are represented), there are numerous disparate items as well (e.g., reading). Some of these items are cognitive processes as opposed to IADL. For instance, some of the measures include items such as finding words to express oneself (word finding abilities), continuing after interruption (executive function abilities), or multitasking (complex attentional abilities). Other tasks are inherently difficult to quantify because they involve interpreting the intention of an individual, such as reaching for the wrong object, or are vague, such as getting organized.

There is variability in phrasing of questions as well that can influence responses between questionnaires. While one measure may inquire more simply about independence in financial management, the other will probe the same task more comprehensively by querying about bill payment, accounting, and bank transaction. Thus, the same question about financial independence can produce disparate responses.

Beyond the content of the items in IADL measures, the format of items to be rated varies from dichotomous selections (e.g., either performs or does not perform activity) to 10-point scales (e.g., Likert-type ratings). Thus, scales vary in the range of rating points between independence and dependence in a task. As is described in the MCI review, it is necessary to have a sensitive IADL tool to appropriately classify healthy aging, MCI, and dementia.

Another difficulty in consolidating findings across studies is the reference point in time that is used as a comparison to current functioning. Some measures, for example, ask an informant to comment on IADL relative to a month ago or 10 years ago. Although no guidelines exist as to an appropriate timeline, one could speculate that an older adult may show some changes from a decade ago, but these may be normative and expected. Some IADL measures do not draw any temporal distinction, and thus it is unclear whether there is a decline in performance or whether a person has always performed the activity that way. For instance, in the Lawton–Brody scale, an individual may have never done full grocery shopping or travelled alone because of social or religious norms. Yet, an individual may nonetheless appear restricted in these domains.

Another source of complexity in these questionnaires is the difference between capacity and actual performance, as many measures inquire about whether a person has performed a task in a particular timeframe or is capable of performing a given task. Commenting on actual performance is more straightforward because a person has either performed a task or they have not. Capacity to enact an IADL task is arguably less scientific, because the task may not have been performed and requires an estimation or assumption about the ability to perform that task. This issue first came to surface in the Lawton–Brody (1969) IADL scale, still the most widely used measure.

The partial IADL restriction, or requiring some help with a task, was a necessary addition, especially given the evidence that IADL loss is often gradual. The change to capacity for performing an IADL was proposed by Lawton because he felt that it allows more discretion by the rater if the individual is not performing the task regularly because of gender role, custom, or preference (Lawton, 1988). An estimate of capacity is less accurate (e.g., Burton et al., 2009) and, at the very least, less empirical. Nevertheless, questionnaires vary in their selection of capacity or actual performance. Many researchers use the original eight items from 1969, with the 3-point rating scale from 1982, under the citation of a modified version of Lawton–Brody (1969). Some groups use the “actual performance” question stem, while others use “capacity,” but it is
often difficult to know unless a detailed method section indicates an investigator’s choice. To address Lawton’s concern of some tasks not being applicable to certain individuals, many investigators have adopted a “not applicable” option and have created a prorated score out of the proportion of items that individuals do perform (e.g., Jefferson et al., 2008; Jefferson et al., 2006). This is a useful strategy for comparisons within and between studies because it allows for means and standard deviations to be collected to facilitate cutoff scores.

Perhaps the greatest challenge to drawing clear distinctions from the IADL research is that many questionnaires were created for the assessment of different levels of dementia in community or institutionalized samples. As such, they have divergent normative data sets relative to MCI or older adults, when efforts to validate measures using representative samples were even undertaken. Furthermore, unless a professional is using a given scale for the precise purpose for which it was created, an inaccurate estimation of functional abilities is produced. For instance, an MCI or healthy older adult may appear normal on his/her IADL execution relative to individuals with dementia. Even within the measures specifically intended for dementia, there are an uneven number of BADL and IADL items (Appendix), which can lead to discrepant estimations of functional abilities between measures.

Thus, a number of factors related to the commonly used questionnaires influence the inconsistent prediction of functional status and the variability between cognitive variables and IADL.

THE NATURE OF THE FUNCTIONAL IMPAIRMENT IN MCI

Louise Nygard’s (2003) widely cited literature review of IADL in MCI challenged the notion of intact activities of daily living in the inchoate construct of a transitional stage between healthy aging and dementia. A literature review using the term MCI would not have provided meaningful information, so Nygard had to consolidate information from studies of cognitive impairment no dementia, age-associated memory impairment, predementia, and related conditions. Despite the ambiguity of the terms and the differences in populations being investigated, individuals with some form of cognitive impairment were consistently showing subtle differences in the performance of complex everyday activities relative to healthy older adults and those with dementia (e.g., Barberger-Gateau et al., 1999; Doble, Fisk, & Rockwood, 1998; Ebly et al., 1995). Nygard’s review was important for identifying that IADL changes occur in the stage encompassed by MCI, and that more sensitive tools were needed to identify the subtle changes with longitudinal studies. The original definition of intact IADL in MCI (Petersen et al., 1999) was later changed to relatively intact IADL (Petersen, 2004; Winblad et al., 2004).

There is a considerable methodological challenge in the examination of IADL in MCI. Not only do investigators have to assess functional abilities to determine whether an individual meets criteria for MCI, dementia, or healthy aging, but they also need to include an experimental measure of IADL (see Aretouli & Brandt, 2009; Burton et al., 2009; Jefferson et al., 2008; Perneczky, Pohl, Sorg, Hartmann, Tosic, 2006; for examples of larger scale investigations that account for classification and experimental issues well). Nevertheless, since the expert panel’s call for research on the nature of the functional impairment in MCI in 2003 (Peterson, 2004; Winblad et al., 2004), a number of investigations have been conducted. These studies unequivocally indicate that individuals with MCI perform IADL significantly worse than matched controls (e.g., Aretouli & Brandt, 2009; Burton et al., 2009; Perneczky, Pohl, Sorg, Hartmann, Komossa, et al., 2006).

This section reviews findings from MCI investigations of IADL, with a particular focus on the measurement tools utilized, effect size or number of IADL tasks compromised, and the particular tasks that showed group differences. MCI is a heterogeneous group, often characterized into single domains of cognitive impairment that are amnestic (AS) and nonamnestic (NAS), as well as multiple amnestic (AM) or nonamnestic (NAM) cognitive domains lower than general cognitive abilities. This review also explores the relationship between cognitive processes and IADL tasks. Finally, longitudinal evidence is reviewed that provides an indication of the predictive value of IADL changes.

The methodology employed in the following review entailed a PsychInfo and PubMed search conducted on December 1, 2009, using combinations of the terms “mild cognitive impairment” along with the keywords or MeSH topics “instrumental activities of daily living,” “activities of daily living,” “functional abilities,” “everyday functioning,” “daily functioning,” “instrumental function,” and “independent living.” The initial search yielded 222 abstracts that were reviewed. Only abstracts from peer-reviewed journals available in English were considered. In order to isolate studies that specifically focused on IADL as opposed to MCI investigations that happened to include an IADL questionnaire, inclusion criteria consisted of studies that had IADL or some measure of...
functional abilities as dependent variables. In addition, the review focused on investigations that used questionnaire-based assessments of IADL, thus excluding performance-based investigations (see Moore et al., 2007, for a review). An additional number of abstracts (8) were located by tracking down references within articles or books that were identified in the search. After employing the prior criteria, 29 articles were selected for the current review.

Many of the investigations classified MCI individuals based on the Clinical Dementia Rating Scale (CDR; Hughes, Berg, Danziger, Coben, & Martin, 1982; Morris, 1993). The CDR is used for evaluation and staging of dementia and employs informant and participant evaluation within six domains (memory, orientation, judgment and problem solving, community affairs, home and hobbies, and personal care). Some investigators use the CDR only to diagnose MCI according to Petersen (2004) criteria, despite the fact that this stage represents early-stage or very mild dementia (Morris et al., 2001). As part of the Ginkgo Evaluation of Memory, 3,063 community-dwelling older adults completed the CDR and neuropsychological testing to compare how well each measure could classify MCI (Saxton et al., 2009). Taken together with the critique of assessing MCI using a dementia staging instrument, it may not be advisable to use the CDR only as an evaluative measure of cognitive and instrumental functioning in MCI studies (Saxton et al., 2009), even though it allows investigators to use a tool that reserves their neuropsychological measures as an important challenge in better understanding functional abilities. Tam and colleagues (2008) investigated a community sample of 765 individuals living in Hong Kong. The CDR was used to categorize individuals into groups of normal controls and those with cognitive impairment, further divided into groups of healthy older adults (n = 389), MCI (n = 291) and very mild dementia (n = 85). IADL was assessed with the Disability Assessment for the Dementia Scale (DAD; Gelinas, Gauthier, McIntyre, & Gauthier, 1999), revealing subtle but decreasing independence from the controls (M = 81.35, SD = 22.35), through to the MCI group (M = 92.80, SD = 10.52) and dementia group (M = 95.63, SD = 10.79). Consistent with other investigations with the “old-old” (e.g., Bennett et al., 2006), the MCI group showed an association between pure motor abilities and IADL. These findings underscore the need for MCI investigators to include these areas when attempting to predict the cognitive underpinnings of functional abilities, as other investigators have found MCI groups to be more impaired on physically demanding IADL (e.g., Tuokko et al., 2005). Tam and colleagues (2008) point out that motor slowness or decreased motivation in IADL may not be benign changes commonly found in older adulthood, but are worthy of clinical evaluation.

As described in previous sections, changes in cognitive functioning can predict a certain amount of the changes in IADL. Similarly, there may be certain tasks associated with particular cognitive processes, or that play a role in predicting future decline. To a certain degree, different cognitive processes, within and between neuropsychological domains, are differentially involved in particular IADL tasks, as was demonstrated in the recent work of Schmitter-Edgecombe and colleagues (2009).

Schmitter-Edgecombe and colleagues (2009) reported that most traditional memory tasks that assess content memory, such as recalling a list of words, series of objects, or a story, were limited in their association with an informant’s report of IADL. However, source memory was a significant unique predictor of social functioning. The ability to link the content and reporter of information (source memory) in the social environment is likely important for social interactions (e.g., knowing the story and the story teller). Using traditional memory tests, Tan and colleagues (2009) found that of their informant-reported IADL items, only social engagement was associated with memory and executive processes, again highlighting an important role for memory in relating to others. In addition, Schmitter-Edgecombe and colleagues (2009) found that prospective memory and temporal order memory were unique predictors of medication use and household activities—remembering to carry out household activities or take medication at a particular time and in a specific sequence underscores the completion of these tasks. The amnestic and nonamnestic MCI groups performed similarly on the nontraditional memory measures, which were more strongly associated with IADL than the traditional measures. That the amnestic and nonamnestic groups were equally impaired on the source, temporal, and prospective memory measures was interpreted by the authors as evidence that memory measures more closely associated with frontal/executive function may be more predictive of IADL.

Overall, there is evidence for both executive and memory correlates of IADL. After controlling for demographic variables and general cognitive functioning, executive function is only somewhat predictive of IADL (e.g., Aretouli & Brandt, 2009;
Mariani et al., 2008; Tan et al., 2009). A number of different cognitive domains were sampled by Jefferson and colleagues (2008), but only a measure of verbal learning was significantly associated with IADL in her MCI investigation. For Farias and coworkers (2009), the memory aspect of IADL was helpful in differentiating MCI from controls. Perneczky and colleagues (Perneczky, Pohl, Sorg, Hartmann, Tosic, et al., 2006) concluded that their MCI group showed limitation on IADL that involve memory or complex reasoning, although this interpretation was not based on correlations with cognitive measures of these abilities, but rather inference about which neuropsychological processes are likely compromised.

At the level of IADL task, individuals with MCI are significantly more impaired than controls on many of the IADLs investigated (e.g., Kim et al., 2009; Schmitter-Edgecombe et al., 2009) or most of the tasks (e.g., Aretouli & Brandt, 2009; Perneczky, Pohl, Sorg, Hartmann, Tosic, et al., 2006). The four tasks (finances, telephone, medications, transportation) found to be predictive of dementia (Barberget-Gateau et al., 1999) are often compromised in the MCI groups (e.g., Aretouli & Brandt, 2009; Perneczky, Pohl, Sorg, Hartmann, Tosic, et al., 2006).

Other consistent trends are more difficult to identify, and many of the investigations do not examine IADL at the task level. Although not an item included on all measures, the task of keeping appointments shows significant differences between MCI and controls (e.g., Farias et al., 2006; Kim et al., 2009; Perneczky, Pohl, Sorg, Hartmann, Tosic, et al., 2006). For instance, in Aretouli and Brandt’s (2009) study, the most frequently reported difficulty was with keeping appointments (about 50% vs. 18%), followed distantly by driving/transportation (about 23% vs. 5%) and financial management (about 22% vs. 2%). Although financial management is not necessarily the most frequently reported IADL task impairment (e.g., Mariani et al., 2008), it is significantly lower in MCI than controls (moderate to large effect sizes; Farias et al., 2008; Kim et al., 2009; Perneczky, Pohl, Sorg, Hartmann, Tosic, et al., 2006), with strong converging evidence of its susceptibility to decline from the financial capacity literature (e.g., Marson et al., 2009).

**Different MCI subtypes and IADL**

Another important question not yet addressed surrounds functional abilities in different MCI subtypes. Careful attention to the performance of the subgroups of individuals with MCI reveals that viewing the group as a whole often masks important differences in functional abilities and may alter the relationship with cognitive predictors of IADL performance.

Individuals with multidomain MCI are more restricted in IADL than individuals with single-domain MCI (e.g., Aretouli & Brandt, 2009; Burton et al., 2009; Farias et al., 2008), and the effect sizes are typically large. For instance, Tam and colleagues (Tam, Lam, Chiu, & Lui, 2007) investigated IADL in a sample of 310 older adults in China, 147 of whom had MCI (37% AS, 63% AM). They found greater impairment with AM ($M = 84.91, SD = 15.45$) than with AS ($M = 95.40, SD = 7.79, d = 0.86$) using the DAD (Gelinas et al., 1999). There is some converging evidence that multidomain (mostly amnestic) groups are significantly more impaired on the planning and organization element of IADL than AS (Farias et al., 2008; Tam et al., 2007). One study found a unique impairment in managing finances for AM (Kim et al., 2009). More often, multidomain MCI groups show a greater decline than single-domain or controls on many of the tasks investigated, or, the total IADL score (e.g., Burton et al., 2009; Farias et al., 2008; Perneczky, Pohl, Sorg, Hartmann, Komossa, et al., 2006), but still significantly less impairment than dementia (e.g., Farias et al., 2006; Tam et al., 2007).

Another approach in the literature is to establish psychometric properties using the older IADL questionnaires to identify individuals with MCI.

**Establishing normative data with older IADL questionnaires**

An especially strong demonstration of the validity of using a questionnaire-based approach to examine the nature of the functional impairment in MCI comes from the work of Perneczky and colleagues (Perneczky, Pohl, Sorg, Hartmann, Tosic, et al., 2006) in Germany. Although the MCI group was not defined as multidomain MCI, the average number of cognitive domains in which they were impaired was 3.46 ($SD = 1.77$). Perneczky and colleagues (Perneczky, Pohl, Sorg, Hartmann, Tosic, et al., 2006) reported that the MCI group ($n = 48$) was significantly different from a control group ($n = 42$) on 14 of the 18 informant-rated items of the Alzheimer’s Disease Cooperative Study (ADCS) ADL scale for MCI (Galasko et al., 1997; 18 IADL items, rated on a 3-point scale). The ADCS–ADL–MCI mean total score was 40.95 ($SD = 9.81$) for the MCI group and 55.43 ($SD = 2.13$) for the controls, $d = 2.04$ (Perneczky, Pohl, Sorg, Hartmann, Tosic, et al., 2006).
Using similar measures, Perneczky and colleagues (Perneczky, Pohl, Sorg, Hartmann, Komossa, et al., 2006) examined the predictive validity of the ADCS–ADL–MCI in distinguishing MCI and controls with an area under the curve analysis (perfect = 1, excellent > .9, good > .8 accuracy; Tabachnick & Fiddel, 2006). Results indicated that the ADCS–ADL–MCI distinguished between MCI and controls with an optimal cutoff at 52, with a sensitivity of .89 and a specificity of .97. This study not only demonstrates the impairment in IADL in a heterogeneous sample of MCI, but provides representative normative data that could be used in future MCI investigations and clinical settings, including cutoff scores and other useful psychometric properties.

Similar to Perneczky and colleagues’ (Perneczky, Pohl, Sorg, Hartmann, Komossa, et al., 2006) work with the ADCS–ADL, there is psychometric information that can be used to help distinguish IADL performance that is more consistent with individuals categorized as MCI or dementia. Sanchez-Benavides and colleagues (2009) argued in favor of the Bayer Activities of Daily Living Scale (B-ADL; Hindmarch, Lehfeld, de Jongh, & Erzigkeit, 1998) with its 10-point response range and selection of complex IADL, allowing it to detect differences between MCI (n = 78), and mild AD (n = 199) in a Spanish population. Although the study could be critiqued for not including healthy controls, and using a global cognitive measure to categorize MCI and AD, a cutoff point of 3.3 on the B-ADL was able to differentiate MCI from mild dementia with a sensitivity of .81 and a specificity of .72.

**Experimental measures**

Beyond using existing questionnaires to develop normative data on IADL in MCI, another approach is to validate new measures. This section will review measures identified in the literature as experimental on the basis of investigators seeking to demonstrate the validity of an IADL-type questionnaire to be used with MCI. The following questionnaires are responses to the need for an IADL tool with more rigorous psychometric properties to capture the subtle differences in functional abilities between individuals with MCI and normal aging, and MCI and dementia.

To address this limitation, Farias and colleagues (2006) developed the Everyday Cognition (ECog) to detect the mild changes pertinent to capturing the differences in IADL between mild dementia, MCI, and healthy aging. Their underlying rationale was that although IADL rely on multiple cognitive domains, different everyday tasks draw on unique neuropsychological processes. To validate the ECog, a sample of 576 individuals was used, with 174 healthy older adults, 126 MCI (46% AS, 18% NAS, 37% AM/NAM) individuals, and 276 dementia patients as assessed by the CDR, MMSE, and the Blessed Dementia Rating Scale (BDRS; Blessed, Roth, & Tomlinson, 1968). Using confirmatory factor analysis, Farias and colleagues (2008) identified a seven-factor model with one global factor and six domain-specific factors: Everyday Memory (e.g., repeating stories), Language (e.g., understanding spoken directions), Visuospatial Abilities (e.g., finding way around store), Planning (e.g., developing a schedule), Organization (e.g., balancing a checkbook), and Divided Attention (e.g., cooking and talking at the same time).

Farias and colleagues (2008) examined the sensitivity and specificity of their measure, with promising findings. At a specificity value of .80 (a conventional level in psychological research), the ECog had a sensitivity of .93 in discriminating normal controls from dementia, .75 in discriminating MCI from dementia, and .67 in discriminating normal controls from MCI. Incremental discriminative power was added by including Everyday Memory to better distinguish normal controls from MCI and Everyday Language to better predict MCI from dementia. Although still in the early stages, this tool may be promising to capture the unique pattern of IADL performance in healthy older adults, MCI, and those with early stage dementia.

A sensitive measure of everyday functioning is clearly needed to capture the differences between MCI patients and controls. Jefferson and colleagues (2008) found that their MCI group (n = 38; 47% AS, 5% NAS, 34% AM, 13% NAM) and normal controls (n = 39) did not differ significantly on the informant-rated Lawton–Brody. The informant-based Functional Capacities of Activities of Daily Living (FC-ADL) scale focuses on the subtle errors in performing everyday activities and has the advantage of not relying on rating an individual’s dependence or independence (Glosser et al., 2002). Instead, the FC-ADL consists of 50 statements (rated on a 5-point Likert scale) reflecting errors associated with everyday activities such as food preparation (e.g., “forgets and leaves things on the stove”). Findings indicated that the MCI group (M = 58.3, SD = 8.6) was significantly lower than controls (M = 52.0, SD = 3.2) on this measure, d = 0.84. Jefferson and colleagues (2008) explain that because the functional changes in MCI are subtle, a novel and more qualitative measure of functioning is needed to detect them.
Similarly, Burton and colleagues (2009) did not find a significant difference between their MCI groups \((n = 92)\); 7% AS, 42% NAS, 21% AM, 30% NAM) and normal controls \((n = 158)\) on the informant Lawton–Brody. However, using the Modified Scales of Independent Behavior–Revised (mSIB–R) they were able to detect a difference. The mSIB–R contains at least five questions in 13 different areas of functional abilities that include subscales in motor abilities, social interaction and communication, personal living, and community living (Burton et al., 2009). Burton and colleagues (2009) adapted the scale to capture the full range of everyday activities that other measures were overlooking. More sensitivity is provided by use of a 4-point rating scale (e.g., Demers, Oremus, Perrault, Champoux, & Wolfson, 2000), allowing for the mild variations in IADL to be captured. The mSIB–R was more sensitive to the changes in functional abilities in MCI when directly compared to the Lawton–Brody.

Taken together, these experimental measures were better able to differentiate MCI individuals from controls and those with dementia than the older IADL measures. Overall, the cross-sectional investigations reviewed mostly point towards weak relationships between IADL and executive function or memory. Individuals with multidomain MCI are significantly more impaired on IADL than single-domain MCI or controls, but still show significantly less decline than dementia. The various investigations differ in their relative composition of the MCI subtypes, and it is unclear whether the proportion of single and multidomain MCI in a sample also influences the relationship between a particular cognitive substrate and IADL. For instance, Jefferson and colleagues (2008) interpreted the relationship between list learning and functional ability as a reflection of the fact that more than 80% of their MCI group was amnestic rather than the prominence of memory abilities in IADL. Farias and colleagues (2008) also found that the memory aspect of IADL best differentiated MCI individuals from controls in a sample that had a similar proportion of amnestic individuals. In contrast, Mariani and colleagues (2008) did not find a relationship with memory and IADL in an AS-only sample. More research is needed to determine whether the relative proportion of MCI subtypes in a sample mediates the relationship between a cognitive variable and IADL.

### Longitudinal investigations

By their very nature, cross-sectional examinations of IADL provide limited information about the relationship between change in cognitive processes and IADL. The following studies point to the importance of capturing IADL rigorously, as insidious changes in IADL play an important role in understanding risk for dementia (e.g., Purser, Fillenbaum, Pieper, & Wallace, 2005).

Given the progressive nature of MCI, and the current concept of the gradual continuum between healthy aging, MCI, and dementia, longitudinal studies provide better evidence of how change in cognitive or functional abilities may influence one another and predict decline. Changes in executive functions alone (Cahn-Weiner et al., 2007; Rozzini et al., 2007), or together with memory (Farias et al., 2009), have been associated with future decline in IADL.

Farias and colleagues (2009) argue that creating subgroups of older adults reduces power and limits information that can be garnered about the process surrounding functional change for individuals that transition from normal to compromised cognition. As such, Farias and colleagues (2009) did not separate their 100-person sample into groups of healthy controls \((n = 45)\), MCI \((n = 29)\), and dementia \((n = 26)\), and neither did Cahn-Weiner and coworkers (2007). Both investigators administered a memory and executive function battery, as well as the informant-rated BDRS, to capture IADL. Cahn-Weiner and colleagues (2007) found that only executive functions could predict future IADL changes. In contrast, Farias and colleagues’ (2009) random effects modeling indicated that memory and executive abilities conferred unique and additive effects for IADL. Thus, a decline in either memory or executive abilities was associated with functional decline, and an even greater decline if both executive functions and memory were impaired, consistent with the cross-sectional evidence of greater IADL restriction in multidomain MCI. The correlation between the change in memory and IADL questionnaire was \(-.69\), while for executive functioning it was \(-.72\). Farias and colleagues (2009) argued that the unique variance accounted for by memory (48%) and executive functioning (52%) in IADL may not be an artifact of the study collapsing across groups of healthy and cognitively impaired adults in the prediction of functional abilities over time. Rather, the robust relationship between neuropsychological measures and IADL questionnaires reflects the importance of examining changes longitudinally (e.g., Cahn-Weiner et al., 2007), compared to the more modest associations found cross-sectionally. Nevertheless, future investigations with sufficient power to comment on the influence of unique cognitive correlates of the trajectory of IADL in MCI only are still needed.
The measure matters and the importance of informants

Tabert and colleagues (2002) compared the discrepancy between informant and self-reported assessments of IADL as a predictor of conversion from MCI (n = 107) to dementia. At baseline, subtle but significant differences in favor of the healthy controls were found for both groups with the Lawton–Brody and the Functional Activities Questionnaire (FAQ; Pfeffer, Kurosaki, Harrah, Chance, & Filos, 1982), consistent with the findings of a smaller, cross-sectional examination by Albert and colleagues (1999). However, it was the FAQ scale and not the Lawton–Brody that was able to predict the incidence of future dementia (Tabert et al., 2002). After two years, the discrepancy between self and informant ratings held the highest positive predictive value (Tabert et al., 2002). If the difference between self and informant ratings on the FAQ was greater than or equal to 1, the sensitivity was 62% (8/13), and specificity was 83% (35/42), for a positive predictive value of 73%.

The importance of IADL in predicting decline

Although there is significant positive predictive value between neuropsychological tests and conversion to dementia, as is demonstrated in the next section of the review, there is evidence for the prominence of IADL changes in predicting future decline. It is important to acknowledge that the predictive value of IADL change in MCI conversion to dementia may be explained by the fact that IADL is an important distinguishing factor between MCI and dementia, and there is potential for circularity of argument. Nevertheless, careful consideration of IADL status compares individuals with no restriction in IADL to those with mild decline in IADL and reveals that MCI individuals with subtle restriction in IADL are at greater risk for dementia.

For instance, as part of the Iowa Established Populations for Epidemiologic Studies of the Elderly, Purser and colleagues (2005) examined 10-year trajectories of 2,371 healthy older adults and 810 MCI individuals. IADL restriction was measured as self-reported difficulty or dependence with any of three instrumental activities (shopping, preparing meals, or doing housework). After covarying for demographic and clinical variables, individuals with MCI progressed to dementia at a similar rate as individuals that were cognitively intact. However, MCI individuals with difficulties in IADL were much more likely to develop dementia than individuals with MCI that were independent for IADL, even if their memory worsened over the 10-year period.

A similar finding is reported by Peres and colleagues (2008), who followed a group of nearly 1,000 older adults in France. Functional abilities were assessed with a self-report modified version of the Lawton–Brody (only telephone, transport, medicine, and finance). Even for individuals with normal neuropsychology test performance, self-reported restriction on IADL was able to predict conversion to dementia after two years (Peres et al., 2006) and four years (Di Carlo et al., 2007). In regard to this finding, Peres and colleagues (2006) suggested that perhaps IADL are sensitive to cognitive processes not explored in their neuropsychology battery. Di Carlo and colleagues (2007) argue that there is a complicated relationship between IADL and everyday functioning that is not well understood. Nevertheless, even using the standard of dependence in one or more IADL items from the FAQ significantly increased the positive predictive value of conversion to dementia in MCI and controls (Di Carlo et al., 2007).

Taken together, these findings indicate that IADL difficulties in older adults represent a significant risk factor for future dementia. Furthermore, for MCI individuals (already at a greater risk for dementia), greater restriction in IADL is associated with increased risk for dementia, often with a gradual but progressive loss of functional independence (Wadley et al., 2007). The relationship between cognitive variables (executive functions alone, or together with memory) and IADL may be stronger in longitudinal than in cross-sectional investigations. Of the various IADL tasks investigated, it appears that financial management may have special importance for predicting cognitive decline.

The importance of finance

Ten years prior to the diagnosis of dementia (controlling for general cognitive functioning, age, education, and sex), restriction in two or more of the self-reported IADL items significantly predicted risk of dementia in Peres and colleagues’ (2008) sample of MCI and healthy controls. The incipient cognitive deterioration that has been reported 10 years prior to diagnosis of dementia, such as in the Nun Study (Snowdon et al., 1996) or the Framingham cohort (Elias et al., 2000), may also be reflected in functional deterioration (Peres et al., 2008). Ten years before the onset of dementia, restriction in managing finances was the strongest predictor of future decline (Peres et al., 2008), consistent with other investigations that have
found impairment in managing finances in MCI (e.g., Kim et al., 2009). In Toukko and colleagues’ (2005) longitudinal examination of individuals with MCI, poor performance on measures of memory, in particular, significantly predicted future impairment in handling finances. Toukko and colleagues (2005) argued that the memory aspect of handling finances may be particularly cognitively complex, requiring active retrieval of knowledge (Barberer-Gateau et al., 1999). Taken together, the findings indicate that financial ability (a known predictor of conversion to dementia) may be amongst the earliest IADL changes in MCI.

Conclusions and recommendations

This review identified a number of factors that may have impeded efforts to consolidate the literature regarding cognitive variables and IADL estimation. Studies that systematically investigate IADL need to be grouped by performance and questionnaire-based assessments because they produce different estimates of functional abilities. A better understanding of the reasons for the different relationship between cognitive variables and performance and questionnaire-based reports of IADL functioning could be an important focus for future study (e.g., specific executive functions may be solicited by the demands of different methods of IADL assessment). Other factors, such as the method of reporting on IADL questionnaires and the treatment of cognitive variables in prediction models were identified as sources of obfuscation. General cognitive functioning appears to mediate the relationship between specific cognitive variables, such as memory and executive function, and IADL. In turn, demographic/clinical variables, such as education and illness burden, share variability with cognitive processes in their prediction of IADL, which also underscores the need for clinicians to be properly accounting for factors such as physical abilities and health in their case conceptualizations. As the number of cognitive domains considered in a prediction model increases, the amount of unique variance contributed by a cognitive variable such as executive function declines. The example of the diversity of cognitive processes that have been associated with financial management underscores the multidimensional nature of IADL. Taken together, the literature suggests that the smooth execution of the diverse range of IADL likely draws upon the integrity of a wide range of cognitive processes, including an important role for executive functions.

Thus, a more meaningful prediction of IADL would seek to explain the unique variance of a cognitive process in the prediction of IADL relative to other cognitive abilities, factoring in the relationship with general cognitive functioning and demographic/clinical variables. Many more examinations have been conducted that examine the role of executive functions only in IADL, sometimes not acknowledging other variables of influences, possibly inflating the number of investigations and the relative importance of executive function in IADL.

Nevertheless, several explanations have been posited for the stronger relationship between IADL and executive functions, relative to another cognitive domain such as memory. Executive functions help organize behavior, generate or inhibit responses, and regulate other cognitive abilities such as memory (e.g., using a retrieval strategy). Even if praxis, memory, attention, language, and perceptual abilities were intact, an individual might not be able to complete IADL because of executive dysfunction. The use of executive processes may also enable an individual to derive and implement compensatory strategies for other cognitive abilities that have become weaker, such as spatial perception. Another line of reasoning is more specific to a situation such as AS/AM caused by a disease process like AD (e.g., Aretouli & Brandt, 2009; Cahn-Weiner et al., 2007). The involvement of the hippocampal formation early in the disease process underlies the memory decline (Braak & Braak, 1991), while later changes to other cortical areas, including frontal regions, could be consistent with disruptions in executive functioning (Welsh, Butters, Hughes, Mohs, & Heyman, 1992). In this instance of an incipient AD pathology, memory decline that is concurrent with, or followed by, executive impairments may be indicative of a more advanced disease process in the brain. This hypothesis is supported by the evidence that individuals with AM progress more rapidly to AD than AS and nonamnestic subtypes of MCI (e.g., Tabert et al., 2006).

Investigators are working towards specifying particular processes within cognitive domains, such as the relationship between memory and socialization, with interesting findings. An important question surrounds the role of pure motor abilities relative to cognitive abilities in the performance of IADL, as a number of studies suggest that pure motor abilities may play an important role in IADL, especially in the “old-old.” Among the executive measures, the TMT-B was consistently found to play a role in predicting IADL overall, and driving in particular.

Drawing conclusions from the MCI literature is challenging because research groups are using a wide variety of questionnaires, with different properties. Most of the extant IADL measures lack
sufficient psychometric rigor, and the contents of these measures are disparate. In some MCI investigations, researchers are still relying on older IADL questionnaires that were intended for dementia samples. A factor analysis study on the 9-item Lawton–Brody scale revealed a single underlying construct with high internal consistency, allowing for item scores to be summed into a meaningful total score (Spector & Fleishman, 1998), but also indicating limited variability. Furthermore, although the core 8 IADL items form the basis of most IADL measures used today, this instrument is more likely to detect differences between MCI and healthy adults in very large samples (>200; such as in Peres et al., 2008) and less so in normal sample sizes (40–80; Burton et al., 2009; Jefferson et al., 2008; Tabert et al., 2002; Tan et al., 2009). Of the IADL measures, the FAQ was more sensitive than the Lawton–Brody (e.g., Tabert et al., 2002), as were some of the newer experimental measures (e.g., Burton et al., 2009).

Fortunately, researchers are establishing normative data for MCI with the older IADL questionnaires, or developing new experimental IADL questionnaires with better psychometric properties. Unfortunately, limited information can be drawn about the particular trends in the everyday tasks that are compromised in MCI. It would appear that some tasks, such as financial management, are more likely to predict future decline. Systematically investigating the full spectrum of neuropsychological correlates of IADL may yield information about the cognitive processes required to perform IADL in everyday settings. Furthermore, IADL may be capturing an element of cognition not encapsulated by neuropsychological testing and revealing information about the cognitive neuropsychology of MCI outside the laboratory setting. This is an ambitious endeavor, as the qualitative nature of the restriction in IADL is such that MCI individuals do not show frank impairments in one or two tasks, but rather show subtle decline across a number of IADL.

Importantly, the literature suggests that multidomain MCI (particularly AM) is associated with greater functional restriction. In the literature examined, the relative distribution of different MCI subtypes varies by investigation, and an MCI group with a higher proportion of multidomain would be more likely to produce a larger difference with controls. The composition of the MCI sample investigated may influence the nature of the relationship between cognitive processes and IADL, such as in the case of memory with amnestic subtypes.

Longitudinal data indicate that IADL restriction in MCI better predicts future dementia than cognitive testing. Amongst the cognitive variables, declines in executive functions alone, or concurrently with memory decline, were predictive of future decline in IADL. The nature of the decline in IADL is a gradual and progressive deterioration across a number of tasks, many years before the onset of dementia. One of the IADL tasks found to be the earliest predictor of future decline was financial management. This information can be used to help with clinical interventions, as well as encourage the careful consideration of financial management, given its potential for early restriction in MCI. The relationship between cognitive variables and IADL may be stronger when examined longitudinally; however, more research is needed with larger groups of MCI individuals to learn more about longitudinal changes for MCI only and to explore whether the stronger relationships between cognitive variables and IADL is due to the greater variability found in the larger investigations that collapse across community-dwelling groups of controls, MCI, and mild dementia.

Based on the evidence reviewed, the rehabilitation of executive abilities may be more beneficial than current memory rehabilitation strategies to maintain functional autonomy. However, the unique relationship between any cognitive domain, or the sum of all cognitive domains investigated, typically does not exceed one fifth of the explained variance in IADL. A better prediction of IADL functioning could be made by considering neuropsychology performance together with demographic and clinical information. IADL may also be capturing an element of cognition that is not captured by neuropsychology tests, emphasizing the need to better understand the cognitive processes that facilitate IADL enactment in the community. Beyond trying to rehabilitate cognition, it may be more effective to directly rehabilitate IADL in order to maintain functional independence for those with MCI. Further, longitudinal investigations have found protective effects of demographic/clinical factors such as education and good physical health in mitigating the influence of cognitive decline on functional abilities in MCI (Artero et al., 2001). Thus, therapeutic approaches that target these demographic/clinical variables (e.g., cardiovascular health, physical mobility, mood, cognitive stimulation) may be another important way to maintain IADL into older adulthood.

Returning to the issue of IADL classification in MCI, a glance at the Appendix indicates the absence of cutoff scores. Creating cutoff scores for functional restriction in MCI would require agreement as to what theoretically constitutes restriction. This is the critique being echoed over and
over again in the literature (e.g., Nygard, 2003). Researchers and clinicians alike are looking for guidance as to what constitutes minimal functional impairment in IADL in order to better apply the diagnostic criteria of the International Working Group (Petersen, 2004; Winblad et al., 2004). Although Sikkes and colleagues (2009) did not directly comment on this debate, they describe the need for “minimal important change,” which may be a better way of conceptualizing the definition of the relatively intact functional abilities in MCI. Important questions remain. Is it the number of declining tasks that is most important, or, is it the magnitude of decline on some tasks in particular? If agreement could be achieved, it would be possible to apply a neuropsychological rubric of determining degree of impairment from standard scores of healthy, MCI, and dementia populations to improve classification.

This paper reviewed a number of investigations whose cumulative weight demonstrates that MCI individuals perform significantly worse on IADL measures. The difference in IADL performance between healthy older adults, MCI, and dementia is statistically significant, with moderate to large effect sizes. Many of the large-scale studies reported mean performance (with standard deviations) on IADL measures that could be used as the basis of stratified normative data for patient populations and healthy individuals. Pernezcky and colleagues (Pernezcky, Pohl, Sorg, Hartmann, Komossa, et al., 2006), for example, were able to psychometrically derive sensitivity and specificity analyses with the ADCS–ADL measure to yield a meaningful cutoff score that was impressive by test theory standards. Promising work is emerging from the experimental performance so that the knowledge gained between their functional autonomy. This initiative may need to commence with better classification of IADL performance so that the knowledge gained between and within investigations can be used to create better psychometric measures and advance research into the nature of IADL.

Sikkes and colleagues (2009) commented on the absence of a “gold standard,” and there are certainly psychometric challenges that need to be overcome. Nevertheless, investigators could work towards creating a gold standard with the approach of using a meta-analysis on preexisting data. Some of the critiques described in this review could help guide this process. Information could be pooled from informant data from studies with questionnaire measures of IADL. One measure could serve as a diagnostic tool and the other as an experimental IADL variable. A factor analysis could be conducted on IADL items to ensure that a unique and diverse range of functional abilities is surveyed. Cognitive tests could also be used in a factor analyses to ensure that IADL items cluster upon a diverse range of abilities. This measure would acknowledge that a suitable IADL item should also be an objective, quantifiable activity, as opposed to a cognitive process, and should be relevant to the population of interest. For instance, there are particular items that are more sensitive to early decline in MCI, such as financial management. The sensitivity of the questionnaire could be increased by adding more gradations of change on a 7-point scale for instance, to capture the subtle impairments in MCI that differentiate IADL performance from healthy aging and very early dementia. The measure should also query what an individual is actually performing, as opposed to capable of performing, to establish a more empirically rigorous way of questioning functioning. If a person is not performing a task, there should be a “not applicable” option to help create a prorated score.

There is a natural age-related decline in certain elements of cognitive functioning in the seventh and eighth decades of life that accompanies or coincides with a decline in certain IADL (e.g., Willis, Jay, Diehl, & Marsiske, 1992). Willis and colleagues concluded from their longitudinal investigation of 102 community-dwelling adults that changes in functional ability are not age related exclusively, but rather involve a certain element of cognitive decline as well. The challenge for researchers is to expose the cognitive processes that underlie multi-step, complex activities in the real world to understand better how to predict performance and to provide rehabilitation for individuals to promote their functional autonomy. This initiative may need to commence with better classification of IADL performance so that the knowledge gained between and within investigations can be used to create better psychometric measures and advance research into the nature of IADL.

REFERENCES


amnestic mild cognitive impairment to dementia of Alzheimer type is independent to memory deterioration. *International Journal of Geriatric Psychiatry*, 22, 1217–1222.


### APPENDIX
Summary of primary IADL questionnaires used in MCI investigations

<table>
<thead>
<tr>
<th>Title of scale</th>
<th>Purpose</th>
<th>Normative sample</th>
<th>IADL items assessed</th>
<th>BADL items assessed</th>
<th>Non-IADL items assessed</th>
<th>Format of items</th>
<th>Method of assessment/“actually doing” or “capable of doing”</th>
<th>Number of items</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lawton–Brody Self-Maintaining and Instrumental Activities of Daily Living Scale IADL (Lawton &amp; Brody, 1969).</td>
<td>To assess the functional ability of older people.</td>
<td>265 older adults drawn largely from retirement homes, county institutions, psychiatric screening ward admissions, and family service agency clients. Validated on a separate sample of 180 applicants to the Philadelphia Geriatric Centre.</td>
<td>Shopping, food preparation, housekeeping, laundry, mode of transportation, medication, ability to handle finances, telephone.</td>
<td>Bathing, toileting, dressing, eating, grooming, ambulating.</td>
<td>Items rated on a 2-point gradation of “unable” and “independent.” Summary scores are calculated based on 8 IADL and 6 BADL (if administered) to reflect global functional status in older people.</td>
<td>Informant/actually doing.</td>
<td>8 (14 when BADL administered).</td>
<td></td>
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<tr>
<td>Lawton IADL Multilevel Assessment Instrument (Lawton, Moss, Fulcomer, &amp; Kleban, 1982).</td>
<td>To assess the functional ability of older people.</td>
<td></td>
<td>Shopping, food preparation, housekeeping, laundry, mode of transportation, medication, ability to handle finances, telephone, handyman work.</td>
<td>Bathing, toileting, dressing, eating, grooming, ambulating.</td>
<td>Items rated on a 3-point gradation: “unable,” “with help,” and “independent.” Summary scores are calculated based on 9 IADL and 6 BADL (if administered) to reflect global functional status in older people.</td>
<td>Informant/capable of doing.</td>
<td>9 (15 when BADL administered).</td>
<td></td>
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</table>
AN EXAMINATION OF IADL

**Modified Lawton–Brody (1969) scale**

(Lawton, 1988).

To assess the functional ability of older people.

**Items rated on a 3-point gradation:**

“unable,” “with help,” and “independent.”

Summary scores are calculated based on 8 IADL and 6 BADL (if administered) to reflect global functional status in older people.

**Informant/actually doing or capable of doing, depends on investigator.**

**8 (14 when BADL administered).**

**Bayer Activities of Daily Living Scale (B-ADL; Hindmarch, Lehfeld, de Jongh, & Erzigkeit, 1998).**

To measure changes in activities of daily living in community-dwelling individuals with mild levels of cognitive impairment and the early stages of dementia.

No sample is reported. See Erzigkeit et al. (2001) for a validation study.

**Items rated on a 10-point Likert scale with the two extremes of “never” and “always.” A category of “nonapplicable” is provided for questions that do not apply. Total score computed by summing the individual item scores for IADL and other items to yield a global functioning score.

**Informant/actually doing.**

25.

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<table>
<thead>
<tr>
<th>Title of scale</th>
<th>Purpose</th>
<th>Normative sample</th>
<th>IADL items assessed</th>
<th>BADL items assessed</th>
<th>Non-IADL items assessed</th>
<th>Format of items</th>
<th>Method of assessment/&quot;actually doing or &quot;capable of doing&quot;</th>
<th>Number of items</th>
</tr>
</thead>
<tbody>
<tr>
<td>Activities of Daily Living–International Scale (ADL-IS; Reisberg et al., 2001).</td>
<td>To rate ADL cross-culturally in pharmacological trials and diagnosis of early-stage AD.</td>
<td>239 subjects with and without cognitive impairment (MMSE M = 24.5, SD = 5.5). 239 subjects with and without cognitive impairment (MMSE M = 24.5, SD = 5.5).</td>
<td>Food preparation (preparing simple meals, approximating the correct amount of food to prepare, estimating correct amount of seasoning, measuring cooking ingredients, cooking different meals for the week), housekeeping (performing simple activities around the house, putting items in proper place), laundry, mode of transportation, medication (needs frequent instructions and close supervision, able to follow a simple medication regimen without written instruction), telephone (remembers frequently dialed numbers, while looking up a phone number does the patient need to refer back to the number), using new complex appliance, multitasking (doing two things at once), participating in meaningful conversation, TV/radio management (finding a desired TV or radio channel, describing what is viewed on TV or in a movie), reading (concentrating on reading material, describing what is read, need to read the same material more than once to remember it), completing forms, going for a walk, using a map (reading an unfamiliar map, touring an unfamiliar place alone, following a map to a new place).</td>
<td>None.</td>
<td>Difficulty finding the right words, begin an activity and then forget the steps necessary to complete it, have difficulty continuing with an activity after a short interruption, have to repeatedly ask for information when learning something new, forget anniversaries or birthdays, remember important dates and events, forget names of people who have just been introduced, ability to be organized, giving detailed information, searching for personal belongings, become overwhelmed with new information, need landmarks and signs to find their way.</td>
<td>Items rated on a 5-point scale with scores ranging from &quot;completely unable&quot; to &quot;fully able.&quot; If item &quot;never performed&quot; or &quot;unknown&quot; it does not contribute to the total score. 13 different domains (concentration, recreation, self-care, household, general activities, medication, socializing, telephone, reading, organization, food preparation, travel, and driving) are sampled to create a global functioning score.</td>
<td>Informant/actually doing.</td>
<td>40.</td>
</tr>
<tr>
<td>Activities of Daily Living Inventory (ADCS–ADL; Galasko et al., 1997).</td>
<td>To evaluate ADL abilities over time and detect changes in patients with AD.</td>
<td>64 healthy older adults and 242 individuals with AD (stratified by MMSE score).</td>
<td>Shopping, food preparation, housekeeping (clearing the dishes, doing chores), mode of transportation, telephone, hobbies and games, TV management (watching TV), conversation (maintain conversation, able to talk about current events), keeping appointments, walking, depositing of garbage, reading, writing, getting a beverage, finding personal belongings.</td>
<td>Bathing toileting, dressing (selecting clothes and physically dressing), eating, grooming.</td>
<td>Being left alone.</td>
<td>Item rated on 4-point gradations: “normal or as well as usual, with some or a little difficulty, with a lot of difficulty, &amp; unable to do or did not do the ADL.” Only items that are performed are rated in the total score. There are 18 IADL and 5 BADL to yield a global functioning score.</td>
<td>Informant &amp; self/actually doing.</td>
<td></td>
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</tr>
<tr>
<td>Alzheimer Disease Cooperative Study Activities of Daily Living Inventory (ADCS–ADL; Galasko et al., 1997).</td>
<td>To evaluate ADL abilities over time and detect changes in patients with AD.</td>
<td>64 healthy older adults and 242 individuals with AD (stratified by MMSE score).</td>
<td>Shopping, food preparation, housekeeping (clearing the dishes, doing chores), mode of transportation, telephone, hobbies and games, TV management (watching TV), conversation (maintain conversation, able to talk about current events), keeping appointments, walking, depositing of garbage, reading, writing, getting a beverage, finding personal belongings.</td>
<td>Bathing toileting, dressing (selecting clothes and physically dressing), eating, grooming.</td>
<td>Being left alone.</td>
<td>Item rated on 4-point gradations: “normal or as well as usual, with some or a little difficulty, with a lot of difficulty, &amp; unable to do or did not do the ADL.” Only items that are performed are rated in the total score. There are 18 IADL and 5 BADL to yield a global functioning score.</td>
<td>Informant &amp; self/actually doing.</td>
<td></td>
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<table>
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<tr>
<th>Title of scale</th>
<th>Purpose</th>
<th>Normative sample</th>
<th>IADL items assessed</th>
<th>BDL items assessed</th>
<th>Non-IADL items assessed</th>
<th>Format of items</th>
<th>Method of assessment/&quot;actually doing&quot; or &quot;capable of doing&quot;</th>
<th>Number of items</th>
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</thead>
<tbody>
<tr>
<td>Disability Assessment for the Dementia Scale</td>
<td>To evaluate functional disability in community-dwelling persons with Alzheimer's disease.</td>
<td>59 informants for individuals with AD.</td>
<td>Food preparation, housekeeping, mode of transportation (travel outside home), medication, ability to handle finances, telephone, leisure.</td>
<td>Hygiene, toileting, dressing, eating.</td>
<td></td>
<td>Items rated on 2-point gradations: &quot;without assistance&quot; or &quot;with assistance.&quot;</td>
<td>Informant/actually doing.</td>
<td>40</td>
</tr>
<tr>
<td>Blessed Dementia Rating Scale (BDRS; Blessed, Roth, &amp; Tomlinson, 1968).</td>
<td>To describe in quantitative terms the degree of intellectual and personality deterioration shown by a dementia patient.</td>
<td>264 patients from a psychiatric, geriatric, or general admissions hospital.</td>
<td>Housekeeping, ability to handle finances, mode of transportation (travel in familiar areas, within the home).</td>
<td>Dressing, eating, bowel control.</td>
<td></td>
<td>Items rated on 3-point gradations with higher scores indicating more disability.</td>
<td>Informant/capable of doing.</td>
<td>22</td>
</tr>
<tr>
<td>Functional Activities Questionnaire (FAQ; Pfeffer et al., 1982).</td>
<td>To assess and compare the social functioning of retired individuals with and without dementia.</td>
<td>195 older adults with and without dementia.</td>
<td>Shopping, food preparation (making coffee/tea, preparing a balanced meal), mode of transportation (out of the neighborhood), medication, ability to handle finances (writing checks, paying bills, keeping financial records, assembling tax or business records), playing games of skill, keeping track of current events, paying attention and understanding while reading or watching a TV show, remembering appointments or family occasions.</td>
<td>None.</td>
<td></td>
<td>Items rated on a 4-point scale ranging from: &quot;dependent, requires some assistance, performs task normally, and never did and would have difficulty now.&quot; The total score on the 10 items could range from 0 to 30.</td>
<td>Informant &amp; self/actually doing.</td>
<td>10</td>
</tr>
</tbody>
</table>

*Note.* IADL = instrumental activities of daily living; MCI = mild cognitive impairment; BADL = basic activities of daily living; MMSE = Mini-Mental State Examination; AD = Alzheimer’s disease.