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Deconstructing the performance of everyday activities: a case in dementia

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ABSTRACT

Background: The assessment of everyday functioning in dementia is currently very global and in most cases fails to provide an in-depth overview of specific areas of deficits. Every activity comprises different sub-tasks which may be impaired to different degrees. Performance of some sub-tasks might be maintained and could thus be the foundation for remaining independent for longer. Thus, the objective of this study was to explore the benefits of breaking down everyday activities into sub-tasks.

Methods: A total of 183 family carers of people with mild dementia completed the revised Interview for Deteriorations in Daily Living Activities in Dementia 2 (R-IDDD2) rating their relative's everyday functioning. Each of the 20 activities comprised three sub-tasks. Data were analyzed using ANOVA with Bonferroni corrections, and sub-tasks were clustered in relation to different forms of cognition.

Results: The majority of activities showed at least one major area of impairment. Sub-tasks could be clustered based on different types of cognition. Several sub-tasks had a focus on memory (forgetting it is time to do the cleaning; forgetting previously known telephone numbers), whereby short-term, long-term, and prospective memory could be distinguished further. Other sub-tasks were clustered into attention (getting more distracted when driving) and executive function (sorting out bills).

Conclusions: The R-IDDD2 and its analysis of sub-task performance offers a novel platform to examine impairments comprehensively. This can help both in aiding timelier diagnosis by recognizing subtle deficits, but also in care management planning, whereby family and paid carers should only care for those sub-tasks that are most impaired and thus encourage remaining independent for longer.

Key words: dementia, activities of daily living

Introduction

Difficulties in initiating and performing complex instrumental activities of daily living (IADLs) and basic ADLs is a major symptom of dementia (Monaci and Morris, 2012; Giebel *et al.*, 2016a). To date, a great deal of research has focused on more global assessments of this symptom (i.e. Pocnet *et al.*, 2013; O'Connor *et al.*, 2016). However, with a push to improve the recognition of symptoms and timelier diagnosis rates of dementia, understanding better how individual activities deteriorate throughout dementia is vital. Therefore, understanding how individual sub-tasks of each IADL and ADL deteriorate can provide an even better framework to recognize subtle changes.

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To date, little research has broken down everyday activities into their sub-tasks. A sub-task represents one element of an individual activity, meaning that one activity constitutes several sub-tasks. For example, "sorting out bills" is one sub-task of the activity of *finance management*. Findings on the DAD scale (Gelinas *et al.*, 1999) allows the assessment of individual sub-tasks of certain few activities (Mioshi *et al.*, 2007), while research generally fails to evaluate these sub-tasks individually. Giovannetti and colleagues (2006; 2015) for example have explored in depth the different steps and action errors that people with dementia make when making a toast or preparing a hot drink; wrapping a gift; and packing a lunch box or picnic basket – three activities part of the Naturalistic Action Test (Schwartz *et al.*, 2003), while finance management is also one of the most explored IADLs in dementia. The Financial Capacity Instrument suggests that finance management comprises nine sub-activities,

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of which basic monetary skills and asset knowledge are found to be best maintained in mild dementia (Marson *et al.*, 2000; Griffith *et al.*, 2003; Chiong *et al.*, 2014). Not every activity can be broken down into nine sub-activities however. Indeed, with a large number of IADLs, ranging from 8 (Lawton and Brody, 1969) to 47 (Patterson *et al.*, 1992), assessing nine sub-tasks for every IADL would not be feasible. Thus, we designed a scale containing 20 everyday activities, each of which contain three sub-tasks. This scale is called the *revised Interview for Deteriorations in Daily Living Activities in Dementia 2* (R-IDDD2) (Giebel *et al.*, 2016b).

Breaking down everyday activities can also help in further establishing the relationship with cognition (Shankle *et al.*, 2013; Schmitter-Edgecombe and Parsey, 2014; Vermeersch *et al.*, 2015). Although research into different types of cognition and their impact on everyday functioning is in its infancy, not only memory, but also executive function and attention for example have been shown to be associated with successful performance of everyday tasks (Martyr and Clare, 2012; Yamin *et al.*, 2016). Memory however is such a vast term that comprises a number of different sub-types, including long-term, short-term, and prospective memory. Each type processes information differently, which is why the link between "memory" and everyday functioning needs to be explored more comprehensively. This can be achieved by breaking down tasks into sub-tasks, which can then provide some guidance as to whether an impairment lies with remembering to do something in the future (prospective memory), remembering something from the past (long-term memory), or being easily distracted (attention).

Such an activity breakdown can have important implications for everyday practice. While a person with dementia (PwD) might experience some difficulties with an activity, such as using the telephone, there might be some sub-tasks of the activity that are less affected. In care management planning, but also for immediate family caring for the PwD, it is important that the informal or formal carer does not care for the entire activity, but leaves the PwD to perform those sub-tasks that he or she is still able to do. Carers should only directly address those specific sub-tasks that are impaired the most, and training should be provided for these. Hence, breaking down IADLs into their individual components can help in guiding the care plan while still ensuring that independence is maintained by the PwD themselves, where possible.

The objective of this study was to explore whether people in mild dementia display subtle and more pronounced deficits within individual everyday activities. Improved knowledge of the intrinsic deficits of individual everyday activities in mild dementia can help to recognize and diagnose dementia timelier. This knowledge can have further implications for effective care management planning and intervention design. Without previous data on sub-task performance, no hypotheses were made.

Methods

Participants

Informal carers were eligible to take part in the study if they cared for someone in the mild stage of dementia. This was defined as having a Mini-Mental State Examination (Folstein *et al.*, 1975) score of 21 or above (Earnst *et al.*, 2001), a Montreal Cognitive Assessment (Nasreddine *et al.*, 2005) score of 15 or above (van Steenoven *et al.*, 2014), or an equivalent score on the Addenbrooke's Cognitive Examination III (Hsieh *et al.*, 2013).

Materials

The R-IDDD2 (Giebel *et al.*, 2016b) assesses the initiative and performance of everyday activities and is based on the original IDDD (Teunisse *et al.*, 1991) and the first stage of the revised version, the R-IDDD (Giebel *et al.*, 2016a). The scale comprises 17 activities on the initiative scale and 20 on the performance scale. Each activity can be rated on a Likert scale from "0" (never lacking motivation/never any difficulties) to "4" (always lacking motivation/always difficulties). On the performance scale, each activity comprises three sub-tasks. Participants are asked to rate the performance on all three sub-tasks if the overall activity is rated as impaired between "1" and "4".

The R-IDDD2 is shown to have high internal consistency for its initiative subscale for basic ADLs (including *washing oneself, dressing, and brushing hair/teeth)* ($\alpha = 0.894$) and IADLs ($\alpha = 0.934$), and for its performance subscale for basic ADLs ($\alpha = 0.858$) and IADLs ($\alpha = 0.959$) (Giebel *et al.*, 2016b).

Table 1 provides an overview of the 20 activities and their respective sub-tasks.

Procedure

Informal carers of people with mild dementia were approached by staff at nine NHS Trusts across England, as well as being recruited via the *JoinDementiaResearch* Network. Carers received the questionnaire during a routine visit with their relative with dementia, or via post, and could complete the questionnaire in their own time. The questionnaire lasted approximately 20 to

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Table 1. Impairments on the performance sub-tasks on the R-IDDD2

	OVERALL ACTIVITY		SUB-TASK 1		SUB-TASK 2		SUB-TASK 3	
1.	Washing oneself	46%	Needs reminder	17%	Not being thorough enough	15%	Fails to wash hands appropriately	14%
2.	Making tea/coffee	55%	Forgetting having recently made a hot drink	24%	Forgetting where things are stored	21%	Confusing order of making hot drink	14%
3.	Dressing	58%	Leaving the same clothes on for too long	27%	Requiring help to put on clothes	18%	Putting clothes on in the wrong order	10%
4.	Brushing hair/teeth, shaving	41%	Forgetting to do OR doing less frequently	18%	Missing out areas when shaving/brushing	15%	Not doing task properly (e.g. not using tooth paste)	15%
5.	Shopping	73%	Forgetting where items are in shop	36%	Getting lost in the aisles	29%	Forgetting what is already in the trolley	27%
6.	Using the telephone	79%	Forgetting numbers previously known	49%	General difficulties using the telephone	44%	Confusion whilst calling someone	25%
7.	Using the computer	80%	Difficulty using the internet	37%	Difficulty using email	34%	Difficulty discriminating between multiple items on the screen	32%
8.	Preparing a cold meal	63%	Only prepares very simple meals	35%	Difficulty finding items to prepare meal with	21%	Wrong order of meal preparation	18%
9.	Preparing a hot meal	75%	Difficulty finding cooking equipment	27%	Wrong order of meal preparation	25%	Incorrectly using cooking equipment	23%
10.	Cleaning house/ doing repair work	72%	Not washing up or cleaning as well as before	37%	Forgetting it is time to do tasks, such as laundry or cleaning the bathroom	34%	Setting the table incorrectly	16%
11.	Handling finances	84%	Sorting out bills	56%	Using the cash point	55%	Difficulty counting change	36%
12.	Medication management	79%	Forgetting to take medication	45%	Confusion concerning which medication to take	44%	Forgetting to order new medication	43%
13.	Driving	68%	More distracted when driving	25%	Getting lost when driving	24%	Forgetting to do key tasks	22%
14.	Taking public transport	64%	Having to pay attention for correct bus stop	31%	Difficulties ordering a taxi	31%	Getting confused with bus times	30%
15.	Maintaining active social life/engaging in hobbies	82%	Forgetting what happened at last social event	48%	Won't settle into hobby	47%	Forgetting key aspects of hobby	36%
16.	Following familiar routes	69%	Mixed up street/location names	34%	Is unhappy when going out	28%	Getting lost	27%
17.	Following current affairs	83%	Forgetting information soon after watching/listening to/reading the news	55%	Difficulty following complex news stories	53%	Failing to understand the significance of news items	44%
18.	Recognizing familiar faces	57%	Difficulty recognizing famous people	26%	Difficulty recognizing friends/members of social club	15%	Difficulty recognizing family members	8%
19.	Monitoring own day	83%	Receiving help to plan the day	48%	Lack of awareness of passage of time	41%	Difficulty monitoring time of the day	39%
20.	Monitoring current activity	84%	Becoming easily distracted	49%	Forgetting what s/he was doing once s/he has left the room	48%	Not completing tasks appropriately	44%

Percentage impaired in each activity is displayed in the overall activity column.
Percentage of people with dementia scoring 3 or 4 on impairment level in individual sub-tasks is displayed for each sub-task.
Sub-tasks are organized from most to least impaired. Grey shaded areas are significantly most impaired sub-tasks.

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30 minutes to complete, and all carers received a free-return envelope to post the completed questionnaire back to the research team. Ethical approval was obtained prior to study begin from the NRES Committee North West – Preston (14/NW/0241). Data were collected between April 2014 and October 2015.

Data analysis

Data were analyzed using SPSS 22 for Windows. Frequency analysis was used to calculate the proportion of PwD impaired in each activity and the proportion with severe impairments (scoring "often" or "always") on each sub-task. Paired samples *t*-tests were performed to explore variations in sub-tasks for each of the 20 performance activities.

Each of the 60 sub-tasks was clustered together based on their implied underlying cognitive underpinnings, including attention, executive function, as well as prospective, recent, and remote memory. The operational definitions of these types of cognition were anchored in neuropsychology and defined in the context of everyday behavior: Attention was considered in its wider sense, by not specifying a particular type such as divided or selective attention, but by referring to the level of focus and constant awareness required in performing a task. Executive function was similarly considered in a broader sense by relating to everyday problems and problem solving skills. Prospective memory referred to remembering to perform a task in the future. Recent memory referred to the memory of a task only just having been performed, or possibly while the task is still being performed. Remote memory refers to events in the past, or to activities that have been performed in the past and now performing these cannot be remembered any longer.

Frequency analysis was used to explore the proportion of total sub-tasks impaired, as well as the proportion of impaired sub-tasks in the five clusters of cognition.

Results

In total, 183 carers completed and returned the R-IDDD2. The majority of carers were female (75%), on average 66 (+/−11) years old, and spouses (69%) or adult children (26%). Most carers were the only carer for their relative with dementia (82%) and lived with their relative (74%). People with dementia were mostly male (57%), on average 77 (+/−9) years old, and had Alzheimer's disease (62%). The remaining PwD had diagnoses of vascular disease (12%), mixed dementia (17%), or other dementia subtypes including Lewy bodies and fronto-temporal dementia (10%).

Table 1 shows the proportion of PwD who were impaired on the overall performance of the 20 daily activities. Over 80% of PwD were impaired handling finances, maintaining an active social life/engaging in hobbies, following current affairs, monitoring own day, and monitoring a current activity. Table 1 also shows the proportion of PwD who were reported to often or always experience difficulties in a particular sub-task. Paired samples *t*-tests were performed to analyze the sub-task ratings for performance on each activity. Table 2 only shows the results of those *t*-tests which found significant variations. In total, 16 activities had at least one major area of impairment that varied significantly from the performance of other sub-tasks. Four activities (*using the computer, preparing a hot meal, medication management, taking public transport*), showed no significant variations across sub-tasks.

Clustering the 60 sub-tasks into their most prominent suggested links with cognition resulted in 17 sub-tasks for remote memory, 15 for executive function, 6 for prospective memory and attention, respectively, and 5 for attention (see Table 3). Eleven sub-tasks could not be categorized.

Of the 16 activities with significant variations across their sub-tasks, the majority of the most impaired sub-tasks had a theme of forgetting and memory in common, either for recent or remote events or for events in the future. Leaving clothes on for too long (Dressing), forgetting to brush hair or teeth or to shave, forgetting where items are located in the shop (Shopping), forgetting previously known telephone numbers, forgetting that it is time to do the cleaning, getting lost (Driving), forgetting what happened at the last meet up of a social activity, and forgetting what the PwD was currently doing (Monitoring an activity) all suggest memory deficits.

For some activities, impaired sub-tasks had a theme of attention, such as getting more distracted (Driving) and being easily distracted (Monitoring an activity).

Some sub-activity impairments could also be clustered together under the theme of executive functioning, with some of the most impaired sub-tasks being sorting out bills (Finance management), only preparing simple meals (Preparing a cold meal), and requiring help to plan the day (Monitoring the day).

The more spared sub-tasks, including correctly setting the table (Cleaning), forgetting how to do key tasks (Hobbies), difficulties recognizing family members (Recognizing familiar faces), difficulty counting change (Finance management), and

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Table 2. Paired samples *t*-tests on sub-task variations

ACTIVITY	*t*-TEST RESULTS
1	$t_{A,C}(160) = -2.722$, $p < 0.01$; $t_{B,C}(160) = 2.872$, $p < 0.01$
2	$t_{A,B}(158) = -2.722$, $p < 0.001$; $t_{A,C}(156) = -3.815$, $p < 0.001$
3	$t_{A,B}(155) = 7.090$, $p < 0.001$; $t_{A,C}(155) = -3.170$, $p < 0.01$; $t_{B,C}(155) = 4.054$, $p < 0.001$
4	$t_{A,B}(157) = -2.392$, $p < 0.05$; $t_{B,C}(158) = 3.279$, $p < 0.01$
5	$t_{A,C}(136) = -3.354$, $p < 0.01$; $t_{B,C}(136) = -3.482$, $p < 0.01$
6	$t_{A,B}(158) = -9.014$, $p < 0.001$; $t_{A,C}(156) = -6.576$, $p < 0.001$; $t_{B,C}(156) = -2.722$, $p < 0.01$
7	/
8	$t_{A,B}(156) = 3.958$, $p < 0.001$; $t_{A,C}(154) = 5.457$, $p < 0.001$
9	$t_{A,C}(137) = 2.812$, $p < 0.01$
10	$t_{A,B}(151) = 6.396$, $p < 0.001$; $t_{B,C}(146) = -6.913$, $p < 0.001$
11	$t_{A,B}(150) = -7.476$, $p < 0.001$; $t_{A,C}(150) = -6.216$, $p < 0.001$
12	$t_{A,B}(150) = -2.072$, $p < 0.05$; $t_{B,C}(149) = 2.411$, $p < 0.05$
13	$t_{A,C}(97) = 2.515$, $p < 0.05$; $t_{B,C}(98) = 2.182$, $p < 0.05$
14	/
15	$t_{A,B}(149) = 5.165$, $p < 0.001$; $t_{A,C}(154) = 2.617$, $p < 0.05$
16	$t_{A,B}(154) = -3.200$, $p < 0.01$; $t_{B,C}(157) = 3.197$, $p < 0.01$
17	$t_{A,C}(165) = 4.699$, $p < 0.001$; $t_{B,C}(164) = 5.263$, $p < 0.001$
18	$t_{A,B}(168) = -6.543$, $p < 0.001$; $t_{A,C}(168) = -8.085$, $p < 0.001$; $t_{B,C}(168) = -3.972$, $p < 0.001$
19	$t_{A,B}(160) = 4.406$, $p < 0.001$; $t_{A,C}(161) = 3.817$, $p < 0.001$
20	$t_{A,C}(165) = 2.581$, $p < 0.05$; $t_{B,C}(165) = 2.796$, $p < 0.01$

The number of each activity is displayed in Table 1.
A, B, and C refer to the first, second, and third sub-task of each activity, as also displayed in Table 1.

awareness of time (Monitoring own day), covered several cognitive domains.

Comparing the proportion of severely impaired sub-tasks between the five cognitive clusters, it emerged that the greatest proportion of impairment was found for executive functioning (36 +/− 21%). If different memories were taken together, memory would be the cognitive function suggested to underlie the largest number of impairments in sub-tasks. Distinguishing between different memory types, remote memory made up the largest proportion of impairments (19 +/− 15%), followed by recent (11 +/− 9%) and prospective memory (9 +/− 12%). A similar proportion to recent and prospective memory was impaired on attention (9 +/− 8%). The majority of PwD showed a spread of impairment across these clusters, with 29 cases showing a clear cluster of impairment with either deficits in only one or two cognitive clusters.

Discussion

Deficits in everyday functioning in mild dementia cannot only be detected through the assessment of individual activities, but the analysis of sub-tasks, by breaking down each activity into its components, can potentially add much needed detail regarding the nature of the deficit. This exploratory study has clearly shown how people with mild dementia struggle more with performing certain sub-tasks of specific activities, such as "forgetting where items are in the shop" when *going shopping*. This information can be critical for non-pharmacological interventions that should be designed to target those specific sub-tasks showing impairment, rather than simply the task as a whole.

In light of significant variations in sub-task performance for the majority of activities, a breakdown of activities can provide important additional detail. While the R-IDDD2 is not the only scale breaking down activities into their initiative and performance, as work by Bier and colleagues (2013) shows activities can be broken down further, into formulating a goal, planning, execution, and verifying goal attainment, the R-IDDD2 addresses novel activities such as computer use and driving, and allows the assessment of their individual sub-tasks. Instead of providing general training to maintain or regain the ability to perform a specific activity, such as maintaining an active social life, targeted therapy can be offered by addressing the most impaired sub-task, in this case, "forgetting what happened at the last social event." Only four activities showed no differences between sub-task performances, so that in those cases a breakdown might not be as informative. The R-IDDD2 contains three sub-tasks for each activity. While some activities may contain more than three sub-tasks, such as *finance management* as evidenced in the Financial Capacity Instrument (Marson *et al.*, 2000), the R-IDDD2 already asks

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Table 3. Sub-tasks clustered by prominent cognitive underpinnings

REMOTE MEMORY	EXECUTIVE FUNCTION	RECENT MEMORY	PROSPECTIVE MEMORY	ATTENTION	NON-CATEGORIZED
Forgetting where things are stored (Making tea/coffee)	Putting clothes on in the wrong order (Dressing)	Forgetting having recently made a drink (Making tea/coffee)	Needs reminder (Washing)	More distracted when driving (Driving)	Not being thorough enough (Washing)
Confusing order of making hot drink (Making tea/coffee)	General difficulties using the telephone (Telephone)	Getting lost in the aisles (Shopping)	Leaving the same clothes on for too long (Dressing)	Having to pay attention for correct bus stop (Transport)	Fails to wash hands appropriately (Washing)
Not doing task properly (Brushing hair/teeth)	Difficulty using the internet (Computer)	Forgetting what is already in the trolley (Shopping)	Forgetting to do OR doing less frequently (Brushing hair/teeth)	Lack of awareness of passage of time (Monitoring own day)	Requiring help to put on clothes (Dressing)
Forgetting where items are in shop (Shopping)	Difficulty using email (Computer)	Getting lost (Following familiar routes)	Forgetting it is time to do tasks (Cleaning/repair work)	Difficulty monitoring time of day (Monitoring own day)	Missing out areas (Brushing hair/teeth)
Forgetting numbers previously known (Telephone)	Difficulty discriminating between multiple items on the screen (Computer)	Forgetting information soon after (Following current affairs)	Forgetting to take medication (Medication)	Becoming easily distracted (Monitoring current activity)	Confusion whilst calling someone (Telephone)
Difficulty finding items to prepare meal with (Cold meal)	Setting the table incorrectly (Cleaning/ repair work)	Forgetting what s/he was doing (Monitoring current activity)	Forgetting to order new medication (Medication)		Only prepares very simple meals (Cold meal)
Wrong order of meal preparation (Cold meal)	Sorting out bills (Finances)				Incorrectly using cooking equipment (Hot meal)
Difficulty finding cooking equipment (Hot meal)	Using the cash point (Finances)				Not washing up or cleaning as well as before (Cleaning/ repair work)

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Table 3. Continued

REMOTE MEMORY	EXECUTIVE FUNCTION	RECENT MEMORY	PROSPECTIVE MEMORY	ATTENTION	NON-CATEGORIZED
Wrong order of meal preparation (Hot meal)	Difficulty counting change (Finances)				Won't settle into hobby (Social life)
Getting lost when driving (Driving)	Confusion concerning which medication to take (Medication)				Is unhappy when going out (Following familiar routes)
Forgetting to do key tasks (Driving)	Difficulties ordering a taxi (Transport)				Not completing tasks appropriately (Monitoring current activity)
Forgetting what happened at last social event (Social life)	Getting confused with bus times (Transport)				
Forgetting key aspects of hobby (Social life)	Difficulty following complex news stories (Following current affairs)				
Mixed up street / location names (Following familiar routes)	Failing to understand the significance of news items (Following current affairs)				
Difficulty recognizing famous people (Recognizing familiar faces)	Receiving help to plan the day (Monitoring own day)				
Difficulty recognizing friends (Recognizing familiar faces)					
Difficulty recognizing family members (Recognizing familiar faces)					

participants to rate the performance of 60 activities, in addition to 17 initiative ratings. Hence, based on qualitative data obtained from carers regarding individual deficits for each activity (Giebel *et al.*, 2016a), three sub-tasks were considered sufficient to not overburden participants but to equally obtain an appropriate breadth of information.

Understanding precisely where the deficits lie in performing a certain task can also help in effective care management planning. Based on the present findings, few PwD put on clothes in the wrong order or required help to put on clothes, whereas more people needed assistance so as to not wear the same clothes for too long. Obviously, this needs to be assessed on an individual basis so that care and treatment are personalized. However, the evidence does suggest that carers should only target the issue surrounding leaving the same clothes on for too long, as PwD were significantly more able to perform other sub-tasks. This would delay the PwD becoming increasingly more reliant on family and paid carers, and thus encourage the PwD to remain independent and use those skills that are little compromised. One possible limitation of these findings is that reports were provided by carer proxies, which can vary from directly observed performance (Zanetti *et al.*, 1999). However, the majority of studies into everyday functioning in dementia uses proxy assessments (Mioshi *et al.*, 2007; Sikkes *et al.*, 2011; Nagaratnam *et al.*, 2013), and can indeed be a better estimation of the everyday functioning abilities of the PwD, due to likely anosognosia in the patient.

Among those impaired sub-tasks, certain patterns emerged that could be linked to cognitive domains. While some sub-tasks appeared to be associated with specific forms of cognition that does not mean that one sub-task is exclusively linked to only one form of cognition, but that a particular area of cognition was more prominent. Indeed, all forms of cognition are interlinked, as Marson (2016) also outlines in an overview of conceptual models of finance management. Memory was one of the primary clusters that transpired, while sub-tasks could be divided into different memory types. Long-term (forgetting previously known telephone numbers) and short-term (forgetting what s/he was currently doing) memory could in several activities be linked to the most impaired sub-task. While literature suggests that all three forms of memory are impaired to different degrees in the early stages of dementia (Giebel *et al.*, 2015), evidence linking different types of memory with everyday functioning is very sparse and lacks intricate details. Studies by Schmitter–Edgecombe and colleagues (Schmitter-Edgecombe *et al.*, 2009; Schmitter-Edgecombe and Parsey, 2014; McAlister and Schmitter-Edgecombe, 2016) for example showed how delayed memory, temporal order memory, and prospective memory are related to everyday functioning. However, the majority of research only explores global IADL functioning, although Schmitter-Edgecombe *et al.* (2009) showed how prospective memory was specifically associated with performing medication management and household activities, and memory for temporal order with medication management and preparing a meal. The deconstruction of activities in the present study adds further knowledge to these individual relationships, as one of the main areas of impairment for cleaning in this study was that PwD forgot it was time to do tasks. This aligns with the prospective memory link evidenced in the study by Schmitter-Edgecombe *et al.* (2009). Furthermore, when preparing cold meals, PwD primarily struggled with preparing only very simple meals. Although the wrong order of meal preparation was impaired the least, this is likely because PwD were more inclined to only prepare very simple meals, which would have fewer steps than preparing a complex meal. This finding again corroborates the association found between (temporal order) memory and food preparation in the above study. Thus, breaking down activities into its components has obvious benefits for the assessment of cognition and everyday functioning, and its management.

Sub-tasks could also be clustered based on other forms of cognition, including executive functioning and attention. There has been some research into the contributions of the former to perform specific everyday activities. Razani and colleagues (2007) showed how executive functioning contributes to successfully performing finance management, shopping, and transport. In patients with brain damage, deficits with executive functioning have been shown to be able to be rehabilitated, which had a positive effect on meal preparation abilities (Levine *et al.*, 2000). Considering that executive functioning can be rehabilitated in people with Alzheimer's disease also (Cipriani *et al.*, 2006), the present study adds to previous findings recognizing the importance of targetedly focusing on this type of cognition.

Similarly, attention appears to be of importance in the performance of several sub-tasks. However, previous research has been very limited in exploring the contribution of attention (Yamin *et al.*, 2016). Out of the five explored forms of cognition in the present study, attention showed fewer links with the traditional IADLs, but more with newly added IADLs on the R-IDDD2, including monitoring own day and monitoring a current activity. The link between driving and attention argued in the

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present study is supported by previous research in older adults (Munro *et al.,* 2010). Considering that everyday activities are linked to a mix of cognitive areas and that different forms of cognition are interlinked with one another, targeting non-memory areas such as attention and executive functioning might result in improvements in a range of activities and possibly even on memory areas. More importantly, having deconstructed IADLs into their sub-tasks has shown how several activities appear to be linked to the same form of cognition. This may imply that providing cognitive training for attention in general may have a positive impact on all activities involving attention, but also other types of cognition which are linked to attention. With little literature on targeted cognitive rehabilitation training in dementia (Bahar-Fuchs *et al.,* 2013), directly targeting specific sub-tasks by relying on their links to cognition is an important step in the intervention arena made possible by deconstructing everyday activities.

While cognition plays a vital role in the successful performance of everyday activities, there are other factors that influence performance. Some sub-tasks might not be relying so much on cognition but to a greater extent on other influences, such as "requiring help to put on clothes" (Dressing) or "not being thorough enough" (Washing). For this reason, 11 of the 60 sub-tasks could not be categorized into either of the five cognitive clusters. There may be an element of lacking social awareness, in that the PwD is less aware of what is considered appropriate in personal hygiene. However, particularly in the elderly population, there may be some physical and sensory problems and disabilities that might make it difficult for a PwD to take a shower every day, or to get dressed in the morning. Future research also might consider exploring whether ethnicity contributes to certain sub-tasks, information which was not collected as part of this study. Potentially, different ethnic groups have different perceptions of which activities need to be performed in old age still, as in some ethnic groups, younger generations can take over meal preparations or cleaning duties regardless of the level of ability of the older person or PwD.

Conclusions

This study has important implications for clinical practice. The R-IDDD2 allows the in-depth investigation of everyday functioning deficits in the early stages of dementia. Even if PwD display little to no difficulties with an overall activity, assessing the activity's sub-tasks can help highlighting small deficits. This can contribute to improved recognition of this symptom and thus aid timelier diagnosis in clinical practice. Using the R-IDDD2 can also be useful in care management planning. It is important for carers to only help with those sub-tasks that are impaired, but leave the PwD to continue performing those sub-tasks that are relatively spared. Future research can use the R-IDDD2 to further explore the relationship between cognition and everyday functioning, an area receiving increasingly more attention due to its implication for the development of cognitive interventions.

Description of authors' roles

C.G. designed the study, was responsible for data collection, analyzed the data, and wrote the paper. C.G. and D.M. designed the questionnaire. D.M. provided feedback on drafts of the paper.

Conflict of interest

None.

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