Apathy and Executive Dysfunction in Alzheimer Disease

Esposito, Fabienne; Rochat, Lucien; Juillerat Van Der Linden, Anne-Claude; Lekeu, Françoise; Quittre, Anne; Charnallet, Annik; Van der Linden, Martial

How to cite

ESPOSITO, Fabienne et al. Apathy and Executive Dysfunction in Alzheimer Disease. In: Alzheimer disease and associated disorders, 2010, vol. 24, n° 2, p. 131–137. doi: 10.1097/WAD.0b013e3181c9c168

This publication URL: https://archive-ouverte.unige.ch/unige:29139
Publication DOI: 10.1097/WAD.0b013e3181c9c168

Apathy and Executive Dysfunction in Alzheimer Disease

Fabienne Esposito, MSc, Lucien Rochat, MSc,* Anne-Claude Juillerat Van der Linden, PhD,† Françoise Lekeu, PhD,‡ Anne Quittre, MSc,‡ Annik Charnallet, PhD,§ and Martial Van der Linden, PhD**

Abstract: Apathy, defined as a reduction in voluntary goal-directed behaviors, is one of the most common behavioral symptoms encountered in Alzheimer disease (AD). However, the processes underlying the different components of apathy are still unclear. The aim of this study was to explore a particularly important aspect of executive function in daily life: *multitasking* [assessed with the Modified Six Elements Task (MSET)], and its relationship with apathy in AD. Sixty-seven participants (37 AD patients matched with 30 control participants) were screened using the MSET. Simultaneously, a close relative of each patient was given the Apathy Inventory, which assesses 3 distinct dimensions of apathy (*lack of initiative*, *lack of interest*, and *emotional blunting*). AD patients presented significantly more multitasking deficits than control participants. In addition, regression analyses revealed that the number of rule breaks on the MSET (inability to perform several tasks in a predefined time observing a number of rules) was the best predictor of apathy, and especially of *lack of initiative*. These results suggest that the relation between *lack of initiative* and multitasking has a specific character and that mechanisms underlying multitasking constitute a key component of goal-directed behaviors.

Key Words: apathy, Alzheimer disease, multitasking, executive functions

(*Alzheimer Dis Assoc Disord* 2010;24:131–137)

Apathy is one of the most common behavioral symptoms of Alzheimer disease (AD).[1] It represents the main cause of suffering in AD patients' relatives and constitutes the first motive for admission into an institution.[2] Apathy can also exist in the preclinical phase of AD, alerting the clinician to a possible progression toward this disease.[3] Moreover, a longitudinal study by Starkstein et al[4] showed that apathy in AD was a significant predictor of a faster cognitive, functional, and emotional decline.

There is general agreement that diminished goal-directed behavior (GDB) is the core feature of apathy,[5] which is commonly divided into 3 dimensions: loss or decrease of initiative, loss or decrease of interest, and reduced emotion (affective blunting).[6] Levy and Dubois[7] argued that apathy was related to executive disturbances (eg, difficulties in maintaining goals, shifting, and planning) and to dysfunctions affecting emotional processes (eg, disruption of the association between affective or emotional signals and ongoing or forthcoming behaviors). Nevertheless, the processes underlying the different components of apathy are still unclear.

A few studies have tried to investigate the mechanisms underlying apathy in dementia, and particularly in AD. McPherson et al[8] showed that apathy in AD was significantly associated with poor performance on executive function tests, such as the Trail-Making Test and the Stroop color interference test. In addition, a study by Robert et al[9] showed that apathy in AD was significantly related to a divided attention impairment observed in the dual-task procedure developed by Baddeley et al.[10] More recently, Tsoi et al[11] showed that an executive dysfunction, especially deficits affecting verbal fluency (number of animals named in 1 min) and ideational fluency (unusual uses for a bottle), was a significant predictor of apathy in dementia.

However, most of the executive tests used in these studies focused essentially on isolated executive aspects (such as mental flexibility), without considering the demands of the real world, whereas in everyday life GDB requires multiple processes and self-initiated behaviors. It is likely that apathy appears preferentially in complex real-life situations, which require the organization and structuring of GDB in situations with few external constraints. Prototypical situations of this kind in daily life are those involving "multitasking" (the ability to run multiple tasks simultaneously).[12]

Multitasking characterizes numerous situations in daily life[13] that involve a number of delayed intentions (eg, "I have to go to work, prepare my talk for this afternoon and remember to pick the children up from school"). It is underlain by multiple mechanisms involved in GDB. Indeed, multitasking is characteristic of complex situations with few external constraints, and requires a number of executive competencies, such as selecting, organizing, and executing various tasks within a given time period.[12] Moreover, the performance of multiple tasks is related to the capacity to pay attention in a flexible way to internal representations ("stimulus-independent thought," ie, goals, action plans, emotions, etc) and external information ("stimulus-oriented thought," ie, information provided by the environment).[14] A disturbance specifically affecting this flexible allocation of attention toward internal and external information could therefore contribute to the presence of apathetic manifestations, and particularly to lack of initiative (GDB reduction), by making the person incapable of coordinating intentions and environmental stimuli. In

Received for publication May 7, 2009; accepted October 18, 2009.
From the *Cognitive Psychopathology and Neuropsychology Unit, University of Geneva; †Memory Clinic, Geneva University Hospital, Geneva, Switzerland; ‡Memory Centre, Department of Neurology, University Hospital of Liège, Belgium; and §Neuropsychology Unit, University Hospital of Grenoble, Grenoble, France.

Reprints: Fabienne Esposito, MSc, Cognitive Psychopathology and Neuropsychology Unit, University of Geneva, 40, Boulevard du Pont d'Arve, CH-1211 Geneva 4, Switzerland (e-mail: Fabienne.Esposito@unige.ch).

addition, Burgess et al[15] showed that multitasking was related to (1) the ability to remember the rules of a task, (2) the ability to form an appropriate plan, and (3) the ability to follow a plan, comply with rules, shift between tasks and carry out delayed intentions.

Shallice and Burgess[16] developed the Six Elements Task (SET), which assesses multitasking capacities. The SET looks at the ability to schedule and monitor the execution of an action plan, is relatively open-ended, and requires that participants decide of their own accord when to initiate and terminate subtasks.[15] Studies have shown low correlations between the SET and traditional laboratory executive tests, whereas there are strong correlations between the SET and multitasking deficits in daily life.[17] This suggests that disabilities in situations involving multitasking are not reflected in performance on tests of executive functions that do not involve multitasking. Currently, a simplified version of the SET is commonly used, the Modified Six Elements Task (MSET).[18] The MSET, like the SET, is relatively open-ended and requires self-initiative. Specifically, it requires the capacity to create, maintain, and activate delayed intentions, as the right time to switch to a given task is not signalled by the situation.[15] From this perspective, the inability to create or consider internal signals that act prospectively as triggers for the initiation of behavior,[17] as well as the inability to flexibly allocate attention toward internal and external information,[14] may explain poor performance on the MSET and reduced GDB. A recent study highlighted a strong relationship between poorer performance on the MSET and a series of externalizing behavior changes in traumatic brain injury patients (eg, irritability and lack of planning), but also, to a lesser extent, with internalizing changes such as depression.[19] These results suggested that the cognitive processes involved in the MSET are prerequisites for regulating emotion and promoting optimal behavior. In addition, a study by Burgess et al[20] found a significant correlation between the factor "intentionality"—a key concept in apathy—of the Dysexecutive Questionnaire (DEX)[18] and the MSET.

The objective of the current study was to explore the relations between multitasking and apathy, and particularly lack of initiative, which is characterized by a reduction in GDB (decline in self-initiated and environment-stimulated behaviors[5]). More specifically, we assume that multitasking situations tap particularly well into a specific set of cognitive processes, which are essential for competency in daily life and GDB. In this context, we investigated the relationships between the three dimensions of apathy (initiative, interest and emotion), assessed with the Robert et al. Apathy Inventory (AI),[21] and multitasking performance, assessed with the MSET. Considering that initiative is very dependent on executive processes (such as planning, set-shifting, self-generation of rules, self-retrieval of information from episodic memory, and prospective memory[7]), we hypothesized that multitasking difficulties (more rule breaks and fewer subtasks on the MSET) constitute the best predictor of the lack of initiative dimension of apathy.

METHODS

Participants and Procedure

A total of 67 participants took part in this study. The patient group was recruited in the Geneva Memory Clinic (University Hospital of Geneva, Switzerland), in the Grenoble Neuropsychology Unit (University Hospital of Grenoble, France) and in the Liège Memory Centre (University Hospital of Liège, Belgium). All the patients met the National Institute of Neurological and Communicative Disorders and Stroke Alzheimer Disease and Related Disorders Association criteria for probable AD[22] on the basis of a detailed neurologic, psychiatric, and neuropsychologic examination. The patients were at the early stage of the disease and consisted of 37 nonconsecutive patients (21 men and 16 women). They were aged between 57 and 90 years (M = 73.38, SD = 8.04) and their educational level varied from 9 to 17 years of education (M = 13.14, SD = 2.84). Only patients for whom a close relative could complete a hetero-evaluation questionnaire on apathy were included in the study (of the persons who completed this questionnaire, 78% were spouses and 22% were adult children). The control group consisted of 30 participants (14 men and 16 women) aged between 58 and 92 years (M = 73.83, SD = 8.52). Their educational level varied from 8 to 19 years of education (M = 13.4, SD = 2.72). They were recruited from the general population and matched for age, sex, and number of years of education with the AD patients. Both groups performed the Mini-Mental State Examination (MMSE)[23] (for the French validation Ref. 24); the Mattis Dementia Rating Scale (DRS)[25] (for the standards of this scale Ref. 26); the MSET[18] (a simplified adaptation of Shallice and Burgess test[16]); and the Hospital Anxiety and Depression Scale (HAD)[27] (for the French validation of this scale Ref. 28). The order of these questionnaires was counterbalanced. Inclusion criteria for the control participants were scores within the normal range on the MMSE and the DRS. Apathy was not assessed in the control participants. All participants gave their written consent to participate, and the study was approved by the ethics committee of the University Hospital of Geneva.

Neuropsychologic Measures and Apathy Assessment

DRS[25]

Cognitive impairment was assessed with the DRS. The DRS is a dementia screening instrument that yields an index of global cognitive functioning including 5 cognitive subscales: Attention, Initiation and Perseveration, Construction, Conceptualization, and Memory. The Initiation/Perseveration subscale measures executive functions (category fluency and complex sequencing abilities) and has been shown to correlate significantly with other executive tests.[29] Total DRS score ranges from 0 to 144, with higher scores reflecting better performance.

MSET[18]

The MSET is one of the subtests of the Behavioral Assessment of the Dysexecutive Syndrome,[18] which assesses the ability to manage time, multitasking capacities, planning, and prospective memory. It involves dividing the available time between 3 simple tasks (description, picture naming, and arithmetic), each of which is split into 2 sections (A and B). Participants are not permitted to carry out the first section (A) of a given subtask followed immediately by the second section (B) of the same subtask or vice versa; otherwise, they are free to organize their efforts with the overall objective of carrying out 1 part of each of the 3 tasks in 10 minutes. Note that the time

allowed is too short to perform the tasks in their entirety, so the participants have to be careful to do a bit of everything and not linger over a subtask. What constitutes an adequate performance is not defined by external signals; participants have to decide for themselves when to switch between tasks, choose objectives that are suitable, and decide when they have achieved them.[15] In this way, the MSET contains all the characteristics of everyday multitasking situations outlined above. Note that the main performance index on this test is the raw score, which is based on the number of subtasks attempted minus the number of rule breaks committed (with a range from 0 to 6). The variables retained are (1) the number of subtasks performed and (2) the number of rule breaks.

AI[21]

The AI is a reliable questionnaire, which provides a brief separate quantitative assessment of the 3 dimensions of apathy: *emotional blunting* (lack of emotional responses, eg, "*Is he/she as affectionate and does he/she express emotion as usual?*"), *lack of initiative* (diminished GDB, decrease in finalized activities, eg, "*Does he/she initiate a conversation and make decisions?*"), and *lack of interest* (diminished goal-directed cognition, decrease in the importance or the value attributed to one's own person or activities, eg, "*Does he/she seem interested in the activities and plans of others?*"). The questions deal with behavioral changes that have occurred since the beginning of the disease. We used the hetero-evaluation form in which questions (yes/no) are asked to determine whether behavior changes are present or absent. If the response is negative, the clinician assigns the score of 0 and proceeds to the next item. If the response is positive, the clinician explores the frequency and gravity of the item with simple questions (*"How frequently do these problems arise?" and "How severe are these problems? To what extent do they disturb or handicap the patient?"*). For each of the 3 dimensions, the maximum score (frequency of 1 to 4 multiplied by gravity of 1 to 3) is 12, giving a maximum total score of 36. The AI has good internal consistency and test-retest reliability[21] and has been validated in French.

Statistical Analyses

Exploratory analyses of the data revealed that most of the variables were normally distributed; therefore, parametric tests were performed. Thus, *t* tests for independent samples were used to compare the performance of AD patients and control participants on neuropsychologic tests, and specifically to investigate whether AD patients had significantly more difficulties in multitasking on the MSET than control participants. Second, Pearson parametric correlations were examined to explore the relationships between the AI, the MSET, and the demographic and clinical data. Finally, multiple regression analyses were performed to find out which components best predict the *lack of initiative* dimension of apathy.

RESULTS

Exploratory Analyses

Exploratory analyses of the skewness and kurtosis of each test and (sub) scale revealed that most of the data were normally distributed, considering that absolute values for skewness and kurtosis greater than 3 and 20, respectively, are judged to be extreme.[30] Specifically, except for the DRS construction subscale, for which the skewness is −3.08 and the kurtosis 10.05, the results showed that skewness ranged from −2.22 to 2.18 and kurtosis from −1.12 to 6.50. Thus, there was no indication of a strong deviation from normality.

Group Comparisons

Group comparisons on the neuropsychologic tests (MMSE, DRS, MSET) using independent sample *t* tests are reported in Table 1. It should be noted that all analyses were 2-tailed, with the α level set at 0.01 to reduce type I errors due to multiple tests or comparisons. The results

TABLE 1. Means and Standard Deviations of Group Comparisons on the MMSE, DRS, HAD, and MSET for AD and Control Groups (Independent Sample *t* Test) and Means and Standard Deviations on the AI for the AD Group

	AD Patients (N = 37)	Controls (N = 30)		
Measures	**M (SD)**		***P***	**99% CI**
MMSE	23.76 (2.69)	28.97 (1.03)	0.000001*	(−6.59-−3.83)
DRS total	121.92 (8.97)	138.27 (3.54)	0.0000001*	(−20.96-−11.73)
Attention	34.59 (1.92)	35.93 (1.05)	0.001*	(−2.38-−0.30)
Initiation/perseveration	29.62 (4.24)	35.73 (1.36)	0.0000001*	(−8.26-−3.97)
Construction	5.76 (0.64)	6.0	0.04	(−0.55-0.07)
Concept	35.0 (4.22)	37.07 (1.66)	0.014	(−4.24-0.11)
Memory	17.16 (4.00)	23.5 (1.76)	0.0000001*	(−8.42-−4.25)
HAD anxiety	7.92 (4.4)	6.57 (2.8)	0.15	(−1.11-3.81)
Depression	4.81 (3.27)	3.5 (2.53)	0.08	(−0.62-3.24)
MSET no. rule breaks	1.35 (0.92)	0.13 (0.35)	0.0000001*	(0.75-1.69)
No. subtasks	4.97 (1.17)	5.93 (0.25)	0.000038*	(−1.54-−0.38)
Apathy Inventory total	6.57 (7.01)	—	—	—
Lack of initiative	2.84 (3.47)	—	—	—
Lack of interest	2.73 (3.19)	—	—	—
Emotional blunting	1.00 (2.04)	—	—	—

Effect sizes were reported within their 99% confidence interval (CI).

*$P < 0.01$, statistically significant.

AD indicates Alzheimer disease; AI, Apathy Inventory; DRS, Dementia Rating Scale; HAD, Hospital Anxiety and Depression Scale; MMSE, Mini-Mental State Examination; MSET, Modified Six Elements Task.

TABLE 2. Correlations Between AI Dimensions and Demographic and Clinical Data

	Lack of Initiative	Lack of Interest	Emotional Blunting	MSET No. Rule Breaks	MSET No. Subtasks
MSET no. rule breaks	0.51*†(0.12-0.76)	0.25 (−0.18-0.60)	0.13 (−0.30-0.52)	—	—
MSET no. subtasks	0.05 (−0.37-0.46)	−0.07 (−0.47-0.36)	0.12 (−0.31-0.51)	—	—
Age	0.25 (−0.18-0.60)	−0.04 (−0.45-0.38)	0.07 (−0.36-0.47)	0.35 (−0.08-0.67)	−0.13 (−0.52-0.30)
No. years of education	−0.21 (−0.56-0.23)	0.04 (−0.38-0.45)	−0.25 (−0.60-0.18)	−0.23 (−0.59-0.21)	−0.26 (−0.61-0.17)
MMSE	−0.21 (−0.56-0.23)	−0.20 (−0.24-0.57)	0.14 (−0.29-0.53)	−0.13 (−0.52-0.30)	−0.01 (−0.42-0.41)
DRS	−0.06 (−0.46-0.36)	−0.01 (−0.42-0.41)	−0.10 (−0.50-0.33)	−0.21 (−0.56-0.23)	−0.04 (−0.45-0.38)
Attention	0.05 (−0.37-0.46)	0.02 (−0.40-0.43)	−0.23 (−0.59-0.21)	−0.12 (−0.51-0.31)	−0.14 (−0.53-0.29)
Initiation/ perseveration	−0.01 (−0.42-0.41)	0.01 (−0.41-0.42)	0.02 (−0.40-0.43)	0.12 (−0.31-0.51)	0.11 (−0.32-0.50)
Construction	0.14 (−0.29-0.53)	0.12 (−0.31-0.51)	0.11 (−0.32-0.50)	−0.04 (−0.45-0.38)	0.25 (−0.18-0.60)
Concept	0.06 (−0.36-0.46)	0.12 (−0.31-0.51)	−0.10 (−0.50-0.33)	−0.01 (−0.42-0.41)	−0.12 (−0.51-0.31)
Memory	−0.30 (−0.13-0.64)	−0.23 (−0.59-0.21)	−0.08 (−0.48-0.35)	−0.55*† (−0.79-−0.17)	0.01 (−0.41-0.42)
HAD anxiety	0.11 (−0.32-0.50)	0.07 (−0.36-0.47)	0.19 (−0.25-0.56)	0.01 (−0.41-0.42)	−0.09 (−0.49-0.34)
Depression	0.35 (−0.08-0.67)	0.08 (−0.35-0.48)	0.39 (−0.03-0.69)	−0.05 (−0.46-0.37)	0.11 (−0.32-0.50)

Effect sizes were reported within their 99% CI.
*$P < 0.01$.
†0 not included in the 99% confidence interval.
AI indicates Apathy Inventory; DRS, Dementia Rating Scale; HAD, Hospital Anxiety and Depression Scale; MMSE, Mini-Mental State Examination; MSET, Modified Six Elements Task.

revealed significant group differences on the MMSE and the DRS, except the DRS construction and concept subscales, for which we observed a trend toward significance (construction, $P = 0.04$; concept, $P = 0.014$). In addition, group differences were also statistically significant for the MSET: AD patients made significantly more rule breaks and attempted significantly fewer subtasks than control participants. As regards depression and anxiety, although there was no significant difference between groups, scores were slightly higher in the AD group than in the control group, particularly for depression ($P = 0.08$).

Correlation Analyses

In the AD group, Pearson correlations were computed between AI clinical dimensions (lack of initiative, lack of interest, emotional blunting), MSET (number of rule breaks and number of subtasks), MMSE, DRS, HAD, age, and number of years of education (Table 2). Correlation analyses revealed that the *lack of initiative* score correlated positively and significantly with the number of rule breaks: the higher the *lack of initiative* score was, the greater the number of rule breaks. As for the *lack of interest* and *emotional blunting* scores, the correlations were not significant. Note that there were no significant correlations between the three AI dimensions and the number of subtasks on the MSET.

As regards the MSET, it is interesting to note that the memory subscale of the DRS correlated significantly with the number of rule breaks. In other words, the poorer the memory performance, the more rule breaks there were. Moreover, there was also a positive trend between age and the number of rule breaks ($r = 0.35$, $P = 0.034$), as well as a negative trend between the DRS memory subscale score and the *lack of initiative* score ($r = -0.30$, $P = 0.073$). However, there was no significant correlation between the DRS executive factor (initiation/perseveration subscale) and the *lack of initiative* score. As well, no significant correlations were found between the AI dimensions, age, years of education, MMSE, and DRS. Finally, the depression score on the HAD correlated marginally with *emotional blunting* ($r = 0.39$, $P = 0.018$) and *lack of initiative* ($r = 0.35$, $P = 0.035$).

Regression Analyses

A regression analysis was performed to find out which components best predicted *lack of initiative*. A regression analysis allows one to highlight the relative importance of each predictor and determine the specific effect of each one, because it takes into account the relations between the various predictors entered in the regression. We therefore computed a multiple linear regression using the number of rule breaks on the MSET, the depression score on the HAD, the memory subscale of the DRS and the MMSE

TABLE 3. Multiple Regressions for Lack of Initiative

Dependent Variable	Predictor Variable	B	SE	*t*	*P*	β
Lack of initiative	(Intercept)	2.50	4.46	0.56	0.57	—
	No. rule breaks	2.16	0.61	3.52	0.001*	0.57†
	Depression (HAD)	0.42	0.14	2.95	0.006*	0.40†
	Memory (DRS)	0.12	0.16	0.75	0.46	0.14
	MMSE	−0.28	0.19	−1.44	0.16	−0.22

*$P < 0.01$.
†0 not included in the 99% CI.
CI indicates confidence interval; DRS, Dementia Rating Scale; HAD, Hospital Anxiety and Depression Scale; MMSE, Mini-Mental State Examination.

score as predictors, and the *lack of initiative* score as the dependent variable (Table 3). There was no multicollinearity and the results showed that the number of rule breaks was the best predictor of *lack of initiative*, although depression was also a significant predictor of *lack of initiative* [adjusted $R^2 = 0.362$, $F(4,32) = 6.10$, $P < 0.00091$].

DISCUSSION

The main aim of this study was to investigate the relationships between the 3 dimensions of apathy assessed by the AI and multitasking performance on the MSET in AD patients. Our results first showed that the AD group made more rule breaks and completed fewer subtasks than the control group; this result is in line with studies showing executive deficits in AD.[31] Second, as regard to apathy in the AD group, correlation and regression analyses revealed that (1) the number of rule breaks on the MSET was the best predictor of *lack of initiative*; (2) *lack of initiative* did not significantly correlate with the MMSE score, nor with any subscore of the DRS, and in particular the subscore for executive functioning; (3) there was no significant correlation between the other dimensions of the AI and the MMSE or DRS; (4) depression was also a significant predictor of *lack of initiative*; and (5) depression also correlated strongly with *emotional blunting*.

These results suggest that the relationship between lack of initiative (reduction in GDB, as evidenced by a decrease in self-initiated and environment-stimulated behaviors[5]) and multitasking performance (underlain by multiple processes allowing one to run multiple tasks simultaneously[15]) has a relatively specific character. More precisely, mechanisms underlying multitasking seem to constitute key components of GDB, which may be affected in patients suffering from lack of initiative. Besides, unlike the DRS initiation/perseveration subscale (usually considered as a measure of executive functioning), the MSET measures processes specific to multitasking situations often encountered in everyday life such as the flexible allocation of attention toward internal and external information.[14] In addition, the MSET requires the capacity to create, maintain, and activate delayed intentions and thus to self-initiate behaviors.[15]

It should be noted that in the apathy criteria, a distinction is made between self-initiated and environment-stimulated behaviors. Indeed, Robert et al[21] distinguish between loss of self-initiated behaviors (eg, starting a conversation) and loss of environment-stimulated behaviors (eg, responding to conversation); they emphasize that apathy may persist in the presence of external stimulation. This distinction also applies to interest (spontaneous vs. environment-stimulated curiosity) and emotion (spontaneous emotion vs. emotional responsiveness to stimuli). Our study showed that initiative is closely related to multitasking, which is underlain by multiple mechanisms, such as prospective memory, shifting, planning, and coordination between internal and external information. We assume that a dysfunction of one of these components can affect self-initiated and/or environment-stimulated behaviors. For instance, prospective memory requires the occurrence of the appropriate event or time to activate the memory of the intention, without external solicitations, and prompt the subject to initiate an action[32]; thus, it seems to be linked to self-initiated behavior. As for the capacity to pay attention to internal representations and external information, it could be connected to both self-initiated (considering internal signals, eg, one's feelings to initiate an action) and environment-stimulated behaviors (considering external signals, eg, suggestions by a friend to initiate something).

Another aspect of our results merits further discussion: although the number of rule breaks on the MSET was a significant predictor of lack of initiative, the number of subtasks was not. This may suggest that different processes are involved in these 2 aspects of the MSET. Rule breaks could depend on prospective and retrospective memory,[12,33] as our results confirmed (significant correlation between rule breaks and DRS memory subscale), but also on planning capacities, consideration of internal signals acting as triggers for voluntary changes, and correct reevaluation of goals.[17,33,34] As for the number of subtasks, it could be linked to the inability to strategically plan, organize, and update current information, and to monitor ongoing performance.[33] A study by Alderman et al[35] with brain-injured participants showed 2 patterns of failure (number of rule breaks or failure to initiate tasks) in the simplified version of the Multiple Shopping Errands Test (The Multiple Shopping Errands Test, a "real-life" multitasking test carried out in a shopping center, requires the participant to buy specific things, obtain some information, be in a particular place at a particular time, and follow several rules while doing these things[35]). These 2 patterns were associated with different executive problems in everyday life. Patients who broke the rules were judged by caregivers to have memory problems, seemed less inhibited (ie, tended to ask for help more readily) and failed to act on the information that they received (difficulties following goal-oriented plans). By contrast, patients who failed to initiate tasks were reported by caregivers to be apathetic and essentially to lack emotion, as assessed with the negative factor of the DEX. The Alderman et al study suggests that people with multitasking difficulties may fail to initiate tasks or may initiate tasks but fail to complete them correctly (rule breaks) because of executive problems. Our results were a bit different, insofar as the number of subtasks was not associated with apathy. However, the multitasking situation used by Alderman et al[35] is quite different from the MSET: it is conducted in a real environment, the rules are more concrete, and the number of subtasks is higher (12 subtasks). Indeed, the small number of subtasks to carry out on the MSET (only 6) means that it is probably not sensitive enough and reduces the interindividual variability. Furthermore, there is no specific evaluation of apathy in the Alderman et al study, although the negative symptom factor of the DEX includes some apathetic symptoms (such as emotional blunting). In further studies, then, it would be interesting to use a more ecologic task with more subtasks, such as the Multiple Shopping Errands Test, and to examine its links with apathy, as assessed with the AI.

Regarding depression, the positive trend observed with emotional blunting is probably due to the overlap of the contents of certain items of the scales used. Indeed, 5 items out of 7 in the HAD refer to the presence/absence of pleasure (eg, "*I take pleasure in the same things as formerly*") or the presence/absence of positive affect (eg, "*I am in a good mood*"), 2 aspects that are characteristic of emotional blunting. Further studies should therefore explore relationships between the dimensions of apathy and

a particular aspect of depression that is not characteristic of emotional blunting, such as negative mood (sadness and hopelessness). As for the link between depression and lack of initiative, it could be due to the presence of 3 items related to pleasure (eg, *"I am looking forward to doing particular things"*). In fact, pleasure is partly underlain by anticipatory mechanisms (capacity to feel pleasure in future situations[36]), which seem to support initiative.[37] We suggest that a deficit in anticipatory pleasure may explain a decline in initiative, because of the lack of sensitivity to reward and the inability to project oneself into future pleasant situations.[37] Nevertheless, this hypothesis should be examined more directly.

As for lack of interest (the third AI dimension), it refers to the incapacity to feel or manifest an attraction for an object or an activity.[21] According to Silvia,[38] interest is closely related to cognitive appraisals, which are determinants of emotions.[39] In particular, 2 specific cognitive appraisal processes seem to be related to interest: (1) an evaluation of the event's novelty and complexity, and (2) an evaluation of the event's comprehensibility.[40] These 2 appraisal processes can occur automatically and outside of awareness,[41] which could explain why the MSET (which mainly involves controlled processes) did not correlate with lack of interest.

To conclude, the main result of this study is the finding of a specific relationship between lack of initiative and multitasking performance. An examination of the specific questions that make up the lack of initiative indicates that the initiative subscale refers to decision-making and self-initiated/environment-stimulated prosocial GDB, aspects that are involved in multitasking. More generally, our results suggest that the construct of apathy is too broad and made up of independent elements that have different relationships with aspects of everyday functioning. Beyond this aspect, although congruent with other studies that highlighted relationships between executive dysfunction and apathy in dementia (eg, Tsoi et al[11]), the results obtained in this study do not really allow us to posit a specific directionality of these relationships. Consequently, longitudinal studies are clearly needed to clarify the predictive role of specific executive disorders for the lack of initiative dimension of apathy. Moreover, further studies are also required to clarify the links between multitasking and the various apathy dimensions, by more directly exploring multitasking components (such as the flexible allocation of attention toward internal and external information, as well as planning or prospective memory). For example, it would be interesting to use a task developed by Gilbert et al[42] to assess a core component of multitasking: the ability to flexibly allocate attention toward either internal representations (stimulus-independent thought) or external information (stimulus-oriented thought). In this task, participants have to process stimuli in 2 alternating experimental phases: a stimulus-oriented thought phase (cognitive processes provoked by incoming sensory information) and a stimulus-independent thought phase (cognitive processes that are not related to any information in the immediate sensory environment). More generally, future studies should explore the variety of mechanisms involved in the facets of apathy, including not only executive mechanisms, but also motivational aspects (eg, anticipatory pleasure), emotional aspects (eg, negative mood), and aspects linked to personal identity (eg, self-esteem).

REFERENCES

1. Fernandez Martinez M, Castro Flores J, Perez de Las Heras S, et al. Prevalence of neuropsychiatric symptoms in elderly patients with dementia in Mungialde County (Basque Country, Spain). *Dement Geriatr Cogn Disord*. 2008;25:103–108.
2. Benoit M, Andrieu S, Lechowski L, et al. Apathy and depression in Alzheimer's disease are associated with functional deficit and psychotropic prescription. *Int J Geriatr Psychiatry*. 2008;23:409–414.
3. Robert PH, Berr C, Volteau M, et al. Apathy in patients with mild cognitive impairment and the risk of developing dementia of Alzheimer's disease: a one-year follow-up study. *Clin Neurol Neurosurg*. 2006;108:733–736.
4. Starkstein SE, Jorge R, Mizrahi R, et al. A prospective longitudinal study of apathy in Alzheimer's disease. *J Neurol Neurosurg Psychiatry*. 2006;77:8–11.
5. Robert PH, Onyike CU, Leentjens AF, et al. Proposed diagnostic criteria for apathy in Alzheimer's disease and other neuropsychiatric disorders. *Eur Psychiatry*. 2009;24:98–104.
6. Starkstein SE, Leentjens AF. The nosological position of apathy in clinical practice. *J Neurol Neurosurg Psychiatry*. 2008;79:1088–1092.
7. Levy R, Dubois B. Apathy and the functional anatomy of the prefrontal cortex-basal ganglia circuits. *Cereb Cortex*. 2006;16:916–928.
8. McPherson S, Fairbanks L, Tiken S, et al. Apathy and executive function in Alzheimer's disease. *J Int Neuropsychol Soc*. 2002;8:373–381.
9. Robert PH, Migneco O, Koulibaly MP, et al. Cingulate and attentional correlates of apathy in Alzheimer's disease. *Brain Cogn*. 2001;47:300–303.
10. Baddeley AD, Della Sala S, Gray C, et al. Testing central executive functioning with a pencil-and-paper test. In: Rabbitt P, ed. *Methodology of frontal and executive function*. Hove, UK: Psychological Press; 1997:61–80.
11. Tsoi T, Baillon S, Lindesay J. Early frontal executive impairment as a predictor of subsequent behavior disturbance in dementia. *Am J Geriatr Psychiatry*. 2008;16:102–108.
12. Burgess PW. Strategy application disorder: the role of the frontal lobes in human multitasking. *Psychol Res*. 2000;63:279–288.
13. Burgess PW, Alderman N, Forbes C, et al. The case for the development and use of 'ecologically valid' measures of executive function in experimental and clinical neuropsychology. *J Int Neuropsychol Soc*. 2006;12:194–209.
14. Burgess PW, Simons JS, Dumontheil I, et al. The gateway hypothesis of rostral prefrontal cortex (area 10) function. In: Duncan J, Phillips L, McLeod P, eds. *Measuring the mind: speed, control, and age*. Oxford: Oxford University Press; 2005:217–248.
15. Burgess PW, Veitch E, de Lacy Costello A, et al. The cognitive and neuroanatomical correlates of multitasking. *Neuropsychologia*. 2000;38:848–863.
16. Shallice T, Burgess P. Deficits in strategy application following frontal lobe damage in man. *Brain*. 1991;114:727–741.
17. Goldstein LH, Bernard S, Fenwick PB, et al. Unilateral frontal lobectomy can produce strategy application disorder. *J Neurol Neurosurg Psychiatry*. 1993;56:274–276.
18. Wilson BA, Alderman N, Burgess PW, et al. *Behavioral assessment of the dysexecutive syndrome*. Bury St Edmunds, UK: Thames Valley Test Company; 1996.
19. Rochat L, Ammann J, Mayer E, et al. Executive disorders and perceived socio-emotional changes after traumatic brain injury. *J Neuropsychol*. 2009;3:213–227.
20. Burgess PW, Alderman N, Evans J, et al. The ecological validity of tests of executive function. *J Int Neuropsychol Soc*. 1998;4:547–558.
21. Robert PH, Clairet S, Benoit M, et al. The apathy inventory: assessment of apathy and awareness in Alzheimer's disease, Parkinson's disease and mild cognitive impairment. *J Geriatr Psychiatry*. 2002;17:1099–1105.

22. McKhann G, Drachman D, Folstein M, et al. Clinical diagnosis of Alzheimer's disease: report of the NINCDS-ADRDA work group under the auspices of the department of health and human services task force on Alzheimer's disease. *Neurology*. 1984;34:39–44.
23. Folstein MF, Folstein SE, Mc Hugh PR. 'Mini-mental state': a practical method for grading the cognitive state of patients for the clinician. *J Psychiatr Res*. 1975;12:189–198.
24. Derouesné C, Pointreneau J, Hugonot L, et al. Au nom du groupe de recherche sur les évaluations cognitives (GRECO). Le mini mental state examination (MMSE) : un outil pratique pour l'évaluation de l'état cognitif des patients par le clinicien. *Presse Méd*. 1999;28:1141–1148.
25. Mattis S. Mental status examination for organic mental syndrome in the elderly. In: Bellack L, Karasu TE, eds. *Geriatric psychiatry: a handbook for psychiatrists and primary care physicians*. New York: Grune & Stratton; 1976:77–121.
26. Lucas JA, Ivnik RJ, Smith GE, et al. Normative data for the Mattis Dementia Rating Scale. *J Clin Exp Neuropsychol*. 1998; 20:536–547.
27. Zigmond AS, Snaith RP. The hospital anxiety and depression scale. *Acta Psychiatr Scand*. 1983;67:361–370.
28. Lépine JP, Godchau M, Brun P, et al. Utilité des échelles d'auto-évaluation de l'anxiété et de la dépression en médecine interne. *Acta Psychiatr Belg*. 1986;86:608–615.
29. Green RC, Woodard JL, Green J. Validity of the Mattis Dementia Rating Scale for detection of cognitive impairment in the elderly. *J Neuropsychiatry Clin Neurosci*. 1995;7:357–360.
30. Weston R, Gore PA. A brief guide to structural equation modeling. *The Counseling Psychologist*. 2006;34:719–751.
31. Collette F, Van der Linden M, Salmon E. Executive dysfunction in Alzheimer's disease. *Cortex*. 1999;35:57–72.
32. Einstein GO, McDaniel MA, Richardson SL, et al. Aging and prospective memory: examining the influences of self-initiated retrieval processes. *J Exp Psychol Learn Mem Cogn*. 1995; 21:996–1007.
33. Siklos S, Kerns KA. Assessing multitasking in children with ADHD using a modified six elements test. *Arch Clin Neuropsychol*. 2004;19:347–361.
34. Vilkki J. Neuropsychology of mental programming: an approach for the evaluation of frontal lobe dysfunction. *Appl Neuropsychol*. 1995;2:93–106.
35. Alderman N, Burgess PW, Knight C, et al. Ecological validity of a simplified version of the multiple errands shopping test. *J Int Neuropsychol Soc*. 2003;9:31–44.
36. Gard DE, Germans Gard M, King AM, et al. Anticipatory and consummatory components of the experience of pleasure: a scale development study. *J Res Pers*. 2006;40:1086–1102.
37. Orbell S, Sheeran P. Motivational and volitional processes in action initiation: a field study of the role of implementation intentions. *J Appl Soc Psychol*. 2000;30:780–797.
38. Silvia PJ. What is interesting? Exploring the appraisal structure of interest. *Emotion*. 2005;5:89–102.
39. Roseman IJ, Smith CA. Appraisal theory: overview, assumptions, varieties, controversies. In: Scherer KR, Schorr A, Johnstone T, eds. *Appraisal processes in emotion: Theory, methods, research*. New York: Oxford University Press; 2001: 3–19.
40. Silvia PJ. *Exploring the psychology of interest*. Oxford: Oxford University Press; 2006.
41. Smith CA, Kirby LD. Toward delivering on the promise of appraisal theory. In: Scherer KR, Schorr A, Johnstone T, eds. *Appraisal processes in emotion: theory, methods, research*. New York: Oxford University Press; 2001:121–138.
42. Gilbert SJ, Frith CD, Burgess GC. Involvement of rostral prefrontal cortex in selection between stimulus-oriented and stimulus-independent thought. *Eur J Neurosci*. 2005;22: 1423–1431.

