The ecological validity of traditional memory evaluation in relation with controlled memory processes and routinization

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Abstract

The neuropsychological evaluation of memory by traditional tests raises questions about their ecological validity, as the results on these tests often have little relation to the memory complaints. In an attempt to explain this lack of relationship, the present study had two objectives: (1) explore the ecological superiority of the Process Dissociation Procedure (PDP) over traditional memory tests and (2) explore the effects of routinization on the relationship between memory complaints and memory tests. Thirty-three participants aged 55–86 years were given the PDP (memory evaluation), two questionnaires evaluating daily memory complaints (QAM and CDS) and a questionnaire evaluating routinization (EPR). The results indicate that the PDP, with its measure of controlled processes, is more ecological than traditional memory tests for elderly people. As well, the participants’ lifestyle (routinized versus non-routinized) influenced their results on memory tests. The results are discussed in relation to neuropsychological evaluation and rehabilitation.

Keywords: Memory; Controlled processes; Ecological validity; Routinization

1. Introduction

Traditionally, explicit recall tests are used for the neuropsychological evaluation of memory. These tests are made up of “classic” free recall, cued recall and recognition tasks. Given that these tests were designed to detect memory problems, one would expect that their results would be related to the degree of memory complaints manifested by people in their daily lives. However, a number of studies that evaluated subjects’ complaints of everyday memory problems report only weak associations with the subjects’ results on classic memory tests (Jacoby, Jennings, & Hay, 1996; Pearman & Storandt, 2004; Reid & Maclullich, 2006). This lack of association raises numerous questions.

One hypothesis evoked to explain this situation proposes that the measurements made during classic memory tests are not “pure” (Jacoby, 1991) and do not allow one to distinguish implicit and explicit memory, as they purport to do (Jacoby et al., 1996). The presence of certain ambiguous data in the literature has led several authors to consider that explicit memory tasks are contaminated by implicit memory processes (Jacoby, Toth, & Yonelinas, 1993; Voss &
Paller, 2007). Conversely, implicit memory tasks are also said to be influenced, to a certain degree, by explicit memory processes (Butler & Berry, 2001; Fay, Isingrini, & Pouthas, 2005; Holender, 1986; Jacoby, 1991; Mitchell & Bruss, 2003; Reingold & Merikle, 1990; Richardson-Klavehn & Bjork, 1988). Thus, more and more researchers tend to adopt the view that there is a memory system wherein all memory tasks depend, in varying proportions, on processes that are both automatic and controlled (Adam, 2003; Jacoby, 1991; Jacoby et al., 1996; Toth, Reingold, & Jacoby, 1994). By automatic processes we mean processes involving aspects of memory that are unconscious and non-intentional and require few or no attentional resources. These processes are generally associated with implicit memory tasks. Controlled processes are intentional retrieval processes, which are conscious and require more attentional resources. These processes are generally associated with explicit memory tasks. It was within this framework of a single memory system that Jacoby (1991) developed the Process Dissociation Procedure (PDP), which allows one to separate and quantify the respective contributions of automatic and controlled processes involved in the same memory task.

The PDP compares a person’s performance in a condition in which the automatic and controlled processes act in concert (inclusion condition) to his or her performance in a condition in which the same processes act in opposition (exclusion condition). This test can be administered using a trigram completion task (Adam, Van der Linden, Collette, Lemauvais, & Salmon, 2005; Jacoby et al., 1993; Ste-Marie, Jennings, & Finlayson, 1996; Toth et al., 1994). In the inclusion condition, word stems are presented to participants, who must complete them with six-letter words they have previously memorized. If they are incapable of retrieving the target word, they must complete the stem with the first six-letter word that comes to mind. The processes act in concert: The participant may complete the stem by the target word either because it was retrieved consciously (C), or because the item came to mind automatically (A) when conscious retrieval failed (1−C). The latter condition is therefore equivalent to a contaminated measure, as in classic memory tests. The probability of completing the stem with the target word is then Inclusion = C + A(1−C). In the exclusion condition, the procedure is identical, except that the retrieval instructions ask participants to use the stem as an indicator to find a six-letter word that is not the same as the one presented during the memorization phase. The processes then work in opposition: the controlled processes work to avoid an error while the automatic processes tend to produce an erroneous response. Thus, the participant erroneously completes a stem by a word from the studied list if it comes to mind automatically (A), without conscious retrieval from its previous presentation (1−C). The probability of producing an error can then be described by Exclusion = A(1−C). From these two equations, we can quantify the respective contributions of controlled and automatic processes to participants’ performance by a simple algebraic transformation: C = Inclusion − Exclusion, and A = Exclusion/(1 − C).

However, it should be noted that the PDP is not without its critics. The most controversial aspect is the assumption that controlled and automatic processes contribute independently to performance, that is, controlled processes can occur with or without automatic processes, and vice versa (see for example, Curran & Hintzman, 1995, 1997, for a refutation of the independence assumption; and Jacoby, 1998; Jacoby, Begg, & Toth, 1997; Jacoby & Shroot, 1997, for a response to these criticisms). Alternative hypotheses include the Redundancy and Exclusivity hypotheses (however, see Jacoby, Yonelinas, & Jennings, 1997, for a refutation of these hypotheses). The major argument put forward by Jacoby and colleagues in favor of the independence assumption is that several studies have identified variables that produce dissociated effects on the estimates of controlled and automatic processes (e.g., Debner & Jacoby, 1994; Hay & Jacoby, 1996; Jacoby, 1991, 1998, 1999; Jacoby et al., 1993; Jennings & Jacoby, 1993, 1997; Kelley & Jacoby, 2000; Yonelinas & Jacoby, 1995). Another criticism of the PDP is that A and C estimated in a memory task could reflect controlled or automatic processes not related to memory, for instance inhibitory processes (Nigg, 2001; see however, Hay & Jacoby, 1999, who demonstrated that A and C, as evaluated with the PDP, do reflect memory processes).

Considering that the PDP is a good procedure for obtaining a pure measure of controlled memory processes, some authors (Jacoby et al., 1996; Jennings & Hay, 1994) have proposed that performances obtained with the PDP constitute a more ecological measure of memory capacities given that daily memory difficulties are related almost exclusively to controlled processes. In this context, Jennings and Hay (1994) demonstrated that the memory complaints of older adults, evaluated with a self-evaluation questionnaire of daily memory and attention difficulties, was strongly correlated (.56) with the estimation of controlled processes calculated with the PDP model, but not with the estimation of automatic processes (.08). Moreover, they observed weak correlations (.33) between the self-evaluation questionnaire and performance on a classic recognition task where the controlled and automatic processes were not dissociated.

The weak relationship between results on memory tests and the degree of memory complaints also raises the possibility that people’s complaints are influenced by the type of functioning they favor in their daily lives, and more specifically by routinization. This hypothesis has recently been explored in a study by Bergua et al. (2006),
which revealed a positive association between general cognitive complaints and preferences for routines. However, the
asociation was never analyzed with regard to memory complaints specifically, and accordingly, a PDP model was not
part of the hypothesis in the Bergua et al. (2006) study.

Routinization refers to the level of repetition of the same behaviors and to routines that follow a particular order that
is difficult to modify (Bousson, 2002). For example, doing the same things everyday, at the same hours of the day, is
considered to be routinized behavior. Routinization becomes more and more pronounced with age (Kastenbaum, 1984;
Reich & Zautra, 1991) and may constitute an adaptive means to protect the individual from the dangers or stress caused
by new situations (Bousson, 2002). Accordingly, preference for routines should increase with growing awareness of
cognitive decline (Bergua et al., 2006). Thus, two individuals with the same results on a memory test could present
different degrees of daily memory complaints, because of their different lifestyles: the first living a routinized life in a
stable environment and needing few memory resources, the second living a non-routinized life involving new situations
that require more memory resources. In this way, if an individual has a strongly routinized lifestyle that would explain
why that person presents poor results on memory tests yet has few daily memory complaints. A non-routinized person,
who also performs poorly on memory tests, might complain more about everyday memory difficulties. Thus, whether
or not a subject leads a routinized life may influence the relationship between memory complaints and the results
obtained on memory tests.

In this context, the current study had two objectives. The first was to replicate the results of Jennings and Hay
(1994), who demonstrated that the daily memory complaints of elderly people are strongly correlated with controlled
processes, but not automatic processes, and also that an evaluation model with the PDP is ecologically superior to
a classic measure of cued recall where the processes are not dissociated. The second objective consisted of further
exploring the role of routinization as a potential confounding factor that may modulate the relations between results
on memory tests and the level of daily memory complaints.

2. Methods

2.1. Participants

A total of 33 participants, aged 55 and older, agreed to take part in the study. All participants spoke French as their
first language and presented normal cognitive functioning, according to their results on the Mattis Dementia Rating
Scale (Mattis, 1976) and on the Mini-Mental State Exam (MMSE; Folstein, Folstein, & McHugh, 1975) (see Table 1).
Participants presenting cognitive or psychiatric problems, a history of depression or previous cranial traumas or who
were taking medications that might alter memory functions were excluded. All participants gave their written consent
to participate in the study. The project was accepted by the ethics committee of the Research Center on Aging of the
Sherbrooke Geriatrics University Institute, Sherbrooke (Canada). Table 1 presents the participants’ characteristics.

2.2. Materials and procedure

The different tests were administered in about 2.5 h. All participants were given a stem completion task applying
the Process Dissociation Procedure (PDP: as adapted by Adam et al., 2005). In addition, they all had to answer the

Table 1
Demographic characteristics, questionnaires and PDP results

<table>
<thead>
<tr>
<th>Group results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age 71.17 ± 8.5 (55–86)</td>
</tr>
<tr>
<td>Education 11.66 ± 4.7</td>
</tr>
<tr>
<td>MMSE 28.94 ± 1.0</td>
</tr>
<tr>
<td>Mattis 138.40 ± 4.54</td>
</tr>
<tr>
<td>EPR (50) 27.2 ± 4.5</td>
</tr>
<tr>
<td>QAM (320) 132.8 ± 26.9</td>
</tr>
<tr>
<td>CDS (195) 69.5 ± 14.9</td>
</tr>
<tr>
<td>PDF—inclusion 0.62 ± 0.14</td>
</tr>
<tr>
<td>PDF—controlled processes 0.42 ± 0.18</td>
</tr>
<tr>
<td>PDF—automatic processes 0.28 ± 0.11</td>
</tr>
</tbody>
</table>
Memory Self-evaluation Questionnaire (QAM: Van der Linden, Wyns, Coyette, von Frenckell, & Seron, 1989), the Cognitive Difficulties Scale (CDS—French version: Derouesne et al., 1993), and the Routinization Preferences Scale (EPR: Bouisson, 2002).

The PDP, adapted in the form of a trigram completion task (Adam et al., 2005), applies the process dissociation procedure formulated by Jacoby (1991) and allows for a quantitative assessment of automatic and controlled processes. The task, which has 14 equivalent versions, is administered on a computer using E-Prime software system Version 1.0 (Schneider, Eschman, & Zuccolotto, 2002). It includes both an inclusion condition and an exclusion condition, with 56 items each. In each condition, each six-letter word is presented in the center of the screen for 3 s. The participant must read the words out loud and memorize them. At certain points (intervals of 0, 3 or 12 items), the stems, consisting of the first three letters of a word the participant has already memorized, are presented for 15 s. In the inclusion condition, the participant must complete the stem aloud from the previously memorized items. If the participant cannot recall the target word, he or she is asked to recall the first six-letter word that comes to mind that starts with those three first letters. Conversely, in the exclusion condition, participants must not complete the stem with a word that was memorized. Rather, they must find a new six-letter word that begins with the first three letters. For each condition, participants are not allowed to complete the stem with a proper noun, a plural, or a conjugated verb (except for past participles). If participants generate a response that does not meet these criteria, they are informed of the error and encouraged to formulate a new response. As well, for 3 s before each presentation of a stem, the word “old” in blue (inclusion condition) or “new” in red (exclusion condition) is presented on the screen. During this period, the experimenter briefly repeats the instructions, by saying, in the inclusion condition, “What is the six-letter word that you have previously seen that begins with these first three letters?” If the participant does not find the word, the experimenter says, “If you don’t remember, try to give the first six-letter word that comes to mind.” In the exclusion condition, the experimenter says, “You must not give a word you have seen before, but find a new six-letter word that begins with these first three letters.” To ensure the validity of the procedure, two methodological controls were applied. First, for each condition, 16 control items, where the stem cannot be associated with a target word, are presented to evaluate the rate of random completion. This rate of completion serves (a) to ensure that the participants use the same response criteria in both the inclusion and exclusion conditions, by comparing the base level for each condition and (b) to verify that the automatic processes correspond to the unconscious influence of memory by showing that the estimates of automatic processes are significantly over baseline levels (chance). The second methodological control consisted of presenting some stems without any recall of instructions (pre-presentation lag 0) to ensure that the participants have understood the instructions (while pre-presentation lags 3 and 12 measure memory processes; for more details, see Adam et al., 2005).

The QAM (Van der Linden et al., 1989) measures the memory problems participants encounter in their daily lives. It comprises 62 questions categorized according to ten types of forgetting (or rubrics: conversations, people, news events, forgotten facts of one’s personal life, distractions, objects, books and films, use of objects, etc., see also Table 2), such as “Do you forget the content of a conversation you just had?”, “Do you forget how to use certain objects?”.

<table>
<thead>
<tr>
<th>QAM questions</th>
<th>Varimax rotated component loadings</th>
<th>Component 1</th>
<th>Component 2</th>
<th>Component 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Do you think you have memory problems 1</td>
<td>.317</td>
<td>.827</td>
<td>−.101</td>
<td></td>
</tr>
<tr>
<td>Conversations</td>
<td>.841</td>
<td>.288</td>
<td>.018</td>
<td></td>
</tr>
<tr>
<td>Films and books</td>
<td>.502</td>
<td>.521</td>
<td>.449</td>
<td>.570</td>
</tr>
<tr>
<td>Distractions</td>
<td>.367</td>
<td>.565</td>
<td>.397</td>
<td>.397</td>
</tr>
<tr>
<td>Persons</td>
<td>.538</td>
<td>.538</td>
<td>.397</td>
<td>.397</td>
</tr>
<tr>
<td>Instructions</td>
<td>−.074</td>
<td>−.046</td>
<td>.929</td>
<td></td>
</tr>
<tr>
<td>News events</td>
<td>.746</td>
<td>.155</td>
<td>.319</td>
<td></td>
</tr>
<tr>
<td>Places</td>
<td>.585</td>
<td>.293</td>
<td>.599</td>
<td></td>
</tr>
<tr>
<td>Things to do</td>
<td>.379</td>
<td>.340</td>
<td>.613</td>
<td></td>
</tr>
<tr>
<td>Forget personal facts</td>
<td>.909</td>
<td>.052</td>
<td>.035</td>
<td></td>
</tr>
<tr>
<td>Do you think you have memory problems 2</td>
<td>−.054</td>
<td>.864</td>
<td>.130</td>
<td></td>
</tr>
<tr>
<td>General questions</td>
<td>.274</td>
<td>.618</td>
<td>.320</td>
<td></td>
</tr>
</tbody>
</table>

Bold are results showing the inclusion of a question into one component.
you forget appointments?” The participant must respond to these statements on a 6-point scale, from never to always. Norms and their analysis are available according to age (18–70), cultural and social level (1–3) and gender. Test–retest reliability (in between 1 and 2 months), estimated for a group of 25 cognitively normal subjects (aged 18–64 years), has been demonstrated for each rubric (mean $r = .80$). The correspondence between responses from 20 subjects and responses from their spouses was examined. Correlations were obtained for three rubrics: Conversations, Distractions and Forget personal facts (mean $r = .55$). Moreover, this measure is widely used in neuropsychology because of its clinical utility.

The CDS (McNair & Kahn, 1984, French version developed by Derouesne et al., 1993) is a self-report questionnaire of perceived cognitive difficulties as manifested in activities of daily living. There are 39 statements relating to cognitive disorders such as concentration, attention, memory, expression, praxis and others. For example, the scale includes the following statements: “I forget to call back if someone phoned me,” “I have difficulty staying focused on a task or an occupation,” and “I forget ingredients when I cook.” The participant must respond to these statements based on a 5-point Likert scale ranging from never to very often. The total scale score ranges from 0 to 156 (higher scores indicating greater perceived cognitive difficulties). Derouesne et al. (1993) administered the CDS to 1628 cognitively normal participants aged 45–75 years. They found that scores on the scale correlated only weakly with scores on objective measures of memory and attention. Moreover, the time frame for assessment of perceived cognitive difficulties was consistent with that for depression and anxiety. Cronbach’s internal consistency for the current sample was estimated at $\alpha = .94$ and .96, respectively for the first and second evaluations.

The EPR (Bouisson, 2002) measures the routinized aspect of one’s daily life with the aid of 10 statements that evaluate the desire to change daily habits and the preference for doing tasks in a specific order. The EPR contains statements that refer to a routinized lifestyle such as “I can’t tolerate it when my things are moved around” and “I prefer to get up and go to bed at the same time everyday.” It also contains statements that refer to non-routinized lifestyle such as “I like unexpected situations” and “I really like to move and change activities.” The participant must respond on a 5-point scale, from not at all true to very true. The total score is calculated in terms of a preference for routine and ranges from 10 to 50. Bouisson (2002) showed that the ERP has (1) acceptable internal consistency ($\alpha = .73$) and (2) high test–retest reliability ($r = .84$; reliability being tested over a 2-week period). The ERP is also short enough to use with elderly participants and is valid as a measure of actual behavioral routinization in daily life (Bouisson & Swendsen, 2003).

3. Results

Group results are presented in Table 1. Concerning the PDP task, the inclusion score (i.e., the memory-contaminated measure) and estimates of controlled and automatic memory processes were collapsed across lags 3 and 12 to provide a single, more sensitive, estimate of these processes.¹

3.1. Associations between memory complaints and measures of memory

The first objective was to verify whether a pure measure of controlled processes for retrieval of information from memory would allow a better understanding of complaints made by older adults than a more classic measure (a contaminated measure). To do so, simple regression analyses were performed between the inclusion score (contaminated measure) and the total scores for the QAM and CDS, and thus with the complaints reported by the group. A significant trend was observed between the inclusion score and the QAM ($r = .33; t = −1.9, p = .062$). The inclusion score was not related to the CDS ($r = .20; t = −1.2, p = .25$). For controlled processes, a significant relationship was observed with the QAM ($r = .43; t = −2.7, p = .012$). Scores obtained for the controlled processes and the CDS were not related, although they showed a significant trend ($r = .29; t = −1.7, p = .097$). Finally, the relationship between automatic processes and the level of complaints was also analyzed. The scores from automatic processes were not related to scores obtained on the QAM or the CDS ($rs < .05; ps > .80$).

¹ Performance at Lag 0 was not considered as the memory load is very weak and this lag served as a control to verify if subjects were correctly following their instructions.
To see whether certain parts of the QAM might be better related to memory measures than to the total score, a principal component factorial analysis was performed. Using a varimax rotation, three components emerged with eigenvalues greater than 1, explaining 74.6% of the variance. The values of the three components were 6.2, 1.4 and 1.3, respectively (see Table 2). The first component contained the questions for conversations, persons, news, and personal events. These questions contain mainly autobiographical elements (episodic and semantic) related to memories of events and information, as well as a small component referring to the inhibition of automatic processes during conversations (i.e., repeating the same thing several times). Together, these questions seem to refer generally to controlled retrieval of memories. The second component contains the two identical questions “Do you think you have memory problems?”, questions about forgetting films and books, and the general questions. All these questions share common elements related to working memory (following the line of a film, doing two things at the same time, learning while under stress, etc.). The last component contains the questions about distractions, instructions, places and things to be done. The first group of questions (distractions) concern attentional elements in relation to routinized behavior, while the other three require an array of cognitive functions and so are related to complex activities.²

The three components are significantly correlated with scores for controlled processes, especially the third component referring to complex activities ($r = -.34, p = .052$; $r = -4.0, p = .03$; $r = -.49, p = .004$, respectively). In all cases, low scores for controlled processes indicate more complaints. No component was related to scores for inclusion, though some significant trends were found for components 2 and 3 (component 1, $p = .13$; component 2, $p = .08$; component 3, $p = .07$).

### 3.2. The influence of routine on the relation between memory complaints and measures of memory

The second objective of this study was to evaluate whether living a routinized lifestyle would influence memory complaints and thus the relationship between memory complaints and scores obtained on memory tests. Routinization was therefore considered here as a confounding variable. The hypothesis is that two individuals with the same scores on a memory test could have different levels of complaints due to their different lifestyles (a routinized style, which represents a low memory load, or a non-routinized style, which represents a greater memory load).

In the first stage, simple regression analyses were carried out between total scores for the EPR (routine) and the total scores for the QAM (complaints). The total score on the routinization scale was not related to memory complaints, as measured by the QAM ($r = .21; t = -1.2, p = .23$). The total score on the EPR was not related to the three components of the QAM either ($p > .10$).

Because the EPR contains questions about both routine behaviors and non-routine behaviors, and because the total score is calculated as a function of preference for routine, a principal component factorial analysis was done on all of the questions to see whether the instrument could be split into two components: one routine component, composed of questions pertaining only to routine behaviors, and one non-routine component. The hypothesis was that the non-routine component should be more related to complaints than the routine component. Using a varimax rotation, two components emerged with eigenvalues greater than 1, explaining 55.3% of the variance. The values of the two components were 2.4 and 1.5, respectively (see Table 3). The items grouped under component 1 related to routinized behaviors. Component 2 had all the questions about non-routinized behavior. Two questions could not be classified and dealt with routine behaviors: “In general, I like to do the same things every day” and “I prefer to get up and go to bed at the same time every day.” These two questions were excluded from further analyses.

Regression analyses between the EPR and memory complaints were therefore redone using the total scores for these two components, routine and non-routine. The routine component was not related to memory complaints, as measured by the QAM ($r = .07; t = -.37, p = .72$). On the other hand, the non-routine component was significantly related to total scores on the QAM ($r = .37; t = -2.2, p = .035$); the less routinized a lifestyle a person leads, the more memory complaints he or she has. More specifically, the non-routine component was associated with component 2 of the QAM (working memory) ($r = .37; t = -2.2, p = .037$), but not with component 1 (controlled retrieval of memories) or with component 3 (complex activities), although there was a significant trend ($p > .08$).

² It is worth mentioning that the association of certain questions with particular cognitive constructs is an a posteriori assumption, based on the grouping of questions by component factorial analysis. It seems clinically valid but other associations may be plausible.
Table 3
Results of EPR principal component analyses

<table>
<thead>
<tr>
<th>EPR questions*</th>
<th>Varimax rotated component loadings</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Component 1 (routinized behaviors)</td>
</tr>
<tr>
<td>I don’t like people who are late</td>
<td>.611</td>
</tr>
<tr>
<td>I can’t stand my things being moved around</td>
<td>.631</td>
</tr>
<tr>
<td>I like unexpected situations</td>
<td>−.413</td>
</tr>
<tr>
<td>I don’t like waiting at mealtimes</td>
<td>.686</td>
</tr>
<tr>
<td>I like to move and change activities</td>
<td>.229</td>
</tr>
<tr>
<td>I don’t like it when someone takes my seat</td>
<td>.781</td>
</tr>
<tr>
<td>I like to meet new people</td>
<td>−.112</td>
</tr>
</tbody>
</table>

Bold are results showing the inclusion of a question into one component.  
* Cited with permission of the author.

Table 4
Results for the relation between complaints from the QAM and the controlled processes score of the PDP (controlled for the non-routinized component or not)

<table>
<thead>
<tr>
<th>Variables</th>
<th>Beta</th>
<th>t</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total QAM—controlled processes</td>
<td>−.430</td>
<td>−2.654</td>
<td>.012</td>
</tr>
<tr>
<td>Total QAM—controlled processes/non-routinized component</td>
<td>−.353</td>
<td>−2.133</td>
<td>.041</td>
</tr>
<tr>
<td>QAM component 2 (working memory)—controlled processes</td>
<td>−.395</td>
<td>−2.397</td>
<td>.023</td>
</tr>
<tr>
<td>QAM component 2 (working memory)—controlled processes/non-routinized component</td>
<td>−.316</td>
<td>−1.878</td>
<td>.070</td>
</tr>
</tbody>
</table>

Legend: / = controlled for.

In the second stage, the non-routine component was introduced into the relation between memory complaints and the scores for controlled processes, to see if it plays a modulator role. The measure retained for memory complaints is the one evaluated by the total score on the QAM, which is related to the non-routine component and also to controlled processes. Simple regression analyses, introducing the non-routine component as a confounding variable, were performed (see Table 4). The results indicate that the non-routine component influences the relationship between complaints (total on QAM) and controlled processes by 8% (Beta changes from −.43 to −.35). Because the non-routine component was strongly related to the second component of the QAM (working memory), the same analysis was done for these two variables. The results indicated that the non-routine component also influenced the relation between complaints (QAM component 2) and controlled processes by 8% (Beta changed from −.395 to −.316); however, this relation was not significant (p = .07).

4. Discussion

The first objective of this study was to replicate the results obtained by Jennings and Hay (1994), who demonstrated that everyday memory complaints from older adults are correlated with controlled processes but not with automatic processes. They also showed that a method of memory evaluation with the PDP allows one to identify an isolated measure of controlled processes that is better correlated with memory complaints than is a classic recall measure. The results obtained allowed us to partially replicate Jennings and Hay’s (1994) results. First, the controlled processes evaluated with the PDP were shown to be significantly correlated with memory complaints evaluated with the QAM questionnaire, but not with the CDS questionnaire. Next, the automatic processes evaluated with the PDP were not significantly correlated with memory complaints, either on the QAM or on the CDS. Finally, the results of the inclusion task of the PDP, which replicated a classic cued recall test, were not significantly correlated with memory complaints. These results suggest that, by obtaining an isolated measure of controlled processes, the PDP allows an evaluation that better predicts daily memory difficulties than a “traditional” memory task (that is, a task contaminated by automatic processes). The results obtained are therefore in accord with the position of several authors (Adam, 2003; Jacoby et al., 1996; Jennings & Hay, 1994) who propose that a purer measure of controlled processes of information retrieval from memory constitutes a more ecological
and valid approach, and is therefore better adapted to evaluations of memory difficulties encountered in everyday life.

The second objective was to verify whether routinization could modulate the relationship between results on memory tests and the degree of daily memory complaints, as a routine lifestyle may represent an adjustment strategy to cope with memory loss. Bergua et al. (2006) found a positive association between general cognitive complaints and preferences for routines. The results of our study more specifically demonstrated that routine has an impact on the relationship between memory test results and memory complaints. The relation between controlled processes and complaints (QAM) was attenuated when the non-routine component was introduced into the model. The routinization factor, especially being non-routinized, acts as a confounding variable. Thus, it can be suggested that, of two people whose memory capacities are similar, the one who has a lifestyle that is more non-routinized risks manifesting more memory complaints than the one whose lifestyle is routinized.

Therefore, our results emphasize the importance of anamnesis in neuropsychology and suggest that lifestyle is a non-negligible factor that should be considered in future studies. However, the important and thorny problem of the “causal relationship” has still to be considered. Indeed, the question is whether a person becomes more routinized because his or her cognitive problems are increasing, or whether the fact that that the person has a routinized lifestyle influences the development of the cognitive problems. Probably, there is a reciprocal relation between cognitive functioning and routinization.

In the context of the effect of cognitive functioning on lifestyle, the results obtained in normal aging suggest that individuals presenting a heightened level of memory complaints, who consider their problems to be disabling, could be relieved in part by living in an environment that solicits less controlled processes, and in part by installing aspects of routine in their lives. More specifically, it is possible that individuals who live in environments with more memory supports (e.g., using written supports such as diaries, memos and written instructions) would experience less demand for controlled processes. Studies that have explored using memory supports with environmental cues by comparing the performance of younger individuals with that of older individuals have produced mixed results. Thus, Craik and Byrd (1982) observed that older adults benefited more from a cued environment than the younger ones, while Light (1991) and Craik and Jennings (1992) obtained different results in similar studies. Jacoby et al. (1996) hypothesized that these studies did not take controlled processes or automatic processes into account in the form of environmental support offered and that this lack was at the origin of the divergent results observed. Another alternative that would allow for the reduction of memory complaints would be to install aspects of routine into everyday life. Thus, developing fixed sequences of actions as daily routines (e.g., get up, get dressed, eat, brush teeth, etc.), or even putting in place daily activities at fixed times (i.e., each leisure activity takes place on the same day each week), could possibly reduce memory complaints.

The association between routinization and cognitive functions probably also involves executive functioning. Indeed, executive functions refer to various processes (inhibition, planning, shifting, updating, control, etc.) whose main purpose is to facilitate a subject’s adaptation to novel situations, especially when action routines are not sufficient (Miyake, Friedman, Emerson, Witzki, & Howerter, 2000; Shallice, 1982). In this context, it seems evident that reduced executive functioning (as observed in normal aging) might promote a routinized lifestyle. Further research will be necessary to address this issue.

However, even though the installation of routines and environmental memory supports offers the possibility of reducing memory complaints, some data from the cognitive literature suggest that using these aids could also have negative consequences on cognitive functioning. Indeed, several studies have demonstrated that active involvement in physically, intellectually and socially rich and cognitively stimulating activities (and thus potentially non-routinized activities) is a key factor allowing some people to prevent the cognitive decline associated with normal aging or Alzheimer’s disease (Adam, Bay, Bonsang, Germain, and Perelman, submitted; Lindsay et al., 2002; Scarmeas & Stern, 2003; Wang, Karp, Winblad, & Fratiglioni, 2002; Wilson et al., 2002).

This view refers to the concept of “cognitive reserve” (proposed by Stern, 2002, 2003; Scarmeas & Stern, 2003), which suggests that innate intelligence or aspects of life experience such as educational or occupational attainments constitute a reserve, represented by a set of skills or repertoires that allows some people to prevent the cognitive decline associated with normal aging or Alzheimer’s disease. Recent studies have tried to identify parameters contributing to the development of a cognitive reserve such as (1) education (e.g., Le Carret et al., 2003), (2) occupation (Schooler, Mulatu, & Oates, 1999), (3) professional or leisure activities (Capurso et al., 2000; Scarmeas, Levy, Tang, Manly, & Stern, 2001; Wilson et al., 2002), (4) rich social environment (Berkman, Glass, Brissette, & Seeman, 2000), and (5)
active lifestyle (for a review, see Fillit et al., 2002; Fratiglioni, Paillard-Borg, & Winblad, 2004). All these variables may have an opposite relationship with routinization.

As well, other studies done with older adults have demonstrated that routinization can limit the stimulating potential of new situations (Langer, 1981, cited in Jacoby et al., 1996) and even increase levels of anxiety and depression, caused by a reduced sense of control in the face of unexpected situations and lower self-esteem caused by routine (Bouisson, 2002). Thus, a non-routinized person who has memory complaints, but does not consider them problematic, should be encouraged to keep the non-routinized aspects of their daily life. And one avenue to reduce the memory complaints of a person who considers them to be disabling, could take the form of a compromise between routinization and cognitive stimulation. For example, implementing a fixed schedule that includes cognitively rich activities would allow the introduction of a routine that diminishes the daily memory load, while at the same time providing beneficial new stimulation.

In conclusion, the results obtained in this study clarify the questions of authors who have highlighted the weak relations between the results on traditional memory tests and actual memory complaints (Jacoby et al., 1996; Reid & Maclullich, 2006). The results support the remarks of authors who claim that the PDP is ecologically superior to traditional memory tests (Adam, 2003; Jacoby et al., 1996). They also indicate that routinization, more specifically being non-routinized, is a variable that seems to play an important role in older adults’ memory complaints. Finally, the results obtained suggest that dissociating controlled and automatic processes and taking lifestyle into account, could significantly contribute to the neuropsychological assessment of older adults with memory complaints. From the perspective of cognitive management for persons with memory difficulties, future studies should explore the potential for a combination of routinization and a sufficient level of cognitive stimulation.

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