Environmental Effects in the Performance of Daily Tasks in Healthy Adults

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OBJECTIVE. We examined the effect of switching from a familiar to an unfamiliar setting on household task performance in healthy adults. We also examined the influence of the cognitive functions abstract reasoning and memory on the ability to adapt to different environments.

METHOD. Thirty healthy adults were observed in two different settings while they performed two daily tasks. We evaluated process skill abilities in task performance, time needed to perform each task, memory functioning, and abstract reasoning.

RESULTS. Performance of both tasks required significantly more time in the unfamiliar kitchen. Scores on process skill abilities were significantly lower in the unfamiliar kitchen. We found no associations between environmental effects and abstract reasoning or memory.

CONCLUSION. We found environmental effects on task performance in healthy adults. These findings have important implications for rehabilitation practice. Addressing facilitation of transfer of training effects to familiar environments is of great importance to rehabilitation programs.

The performance of daily tasks may be influenced by the environment (Darragh, Sample, & Fisher, 1998). Patients with acquired brain injury living at home showed better performance of daily tasks in their own homes than in unfamiliar environments, thus demonstrating an environmental effect on task performance. In one of the few studies investigating transfer in healthy adults, Park, Fisher, and Velozo (1994) examined the effect of home versus clinical settings on daily task performance. Their participants were healthy older adults (i.e., people without a diagnosis of brain injury) who were asked to perform daily tasks at home and in an unfamiliar setting. Both motor and process abilities (i.e., cognitive abilities needed to perform a task) were observed during task performance in both settings. Motor ability, reflecting the underlying motor skill capacities necessary to perform a task, remained stable in both settings. Process abilities, reflecting the capacity to logically organize and adapt a series of actions over time to complete a task, were affected by a change in setting; participants performed better at home than in an unfamiliar setting.

Participants in the current study were older adults with a mean age of 82.2 yr. Because age is said to influence flexibility in performance (Van der Elst, Van Boxtel, Van Breukelen, & Jolles, 2006), it is important to investigate how a change of setting affects...
task performance in a group of healthy adults falling within a broader age range.

Educational psychology holds that to facilitate skill transfer, a person must be able to apply learning in new situations (Byrnes, 1996; Salomon & Perkins, 1989). A principle or strategy can only be transferred if it is actively decontextualized. To bridge the gap between two different environments or tasks, the person must comprehend the similarities between the two situations or tasks (Salomon & Perkins, 1989). This similarity in situations and tasks can range from being concrete and obvious to being very abstract. Thus, the ability to identify similarities—that is, abstract reasoning ability—seems to be an important prerequisite for the occurrence of transfer. In addition, if two situations must be compared to identify similarities, one can hypothesize that memory functions influence the occurrence of transfer. Clearly, characteristics of different situations must be remembered to compare characteristics with a new situation.

We examined the effect of switching from a familiar to an unfamiliar setting on task performance in healthy adults. In addition, we hypothesized that the ability to adapt to different environments can be influenced by the cognitive functions of abstract reasoning and memory.

Method

Participants

Participants were recruited from our personal environment. Healthy adults were eligible for this study if they were between ages 40 and 75 and if they lived independently. Exclusion criteria were (1) the person does not make coffee with a coffeemaker, (2) history of brain injury, (3) premorbid or present neurological pathologies, (4) present motor deficits influencing activities of daily living (ADL) task performance, (5) premorbid or present psychogeriatric pathologies, (6) alcohol or drug addiction, (7) ongoing use of antidepressant or sedative medication, or (8) insufficient knowledge of the Dutch language. Potential participants were asked specific questions about their present and premorbid health status. The decision to exclude potential participants was based on answers to the questions. All participants received verbal and written information about the study and gave verbal and written consent to participate in accordance with procedures approved by an ethics committee based in Hoensbroek, the Netherlands.

Study Design

Participants were observed in two different settings while performing two daily tasks: making coffee using a coffeemaker and preparing a sandwich. The first set of observations occurred in the participant’s own kitchen; the second set of observations took place in the research institute’s unfamiliar kitchen. In the participant’s own kitchen, the participant used his or her own coffeemaker to prepare coffee. At the research institute, a different coffeemaker was used, reflecting the idea that coffeemakers used in therapy in clinical settings differ from what patients have at home and thus require a different set of cognitive and motor functions.

We chose the task of coffee preparation because it is said to be of average motor and process skill complexity, according to the classification of tasks of the Assessment of Motor and Process Skills (AMPS; Fisher, 1997). In addition, during the performance of this task, a person must interact with the environment properly to complete the activity. In a study in which occupational therapists had to evaluate disabilities in task performance in stroke patients, 90% of therapists chose to observe disabilities during coffee-making tasks (van Heugten, Dekker, Deelman, Stehmann-Saris, & Kinebanian, 1999). We expected performance of sandwich preparation to be less influenced by changes in the environment because interaction with the environment is less important in sandwich making. We chose a sandwich-making task because it has the same level of motor and process skill complexity as coffee preparation (Fisher, 1997).

Performances of both tasks in both environmental situations (familiar vs. unfamiliar) were rated, and the time needed to perform each task was recorded. In addition, we documented patient characteristics and used neuropsychological tests to assess cognitive functioning. Participants were asked to estimate how many times a day they made coffee and in how many different settings because these variables were expected to influence coffee-making performance in the unfamiliar setting. An experienced occupational therapist conducted the measurements. The study protocol was approved by the ethics committee based in Hoensbroek.

Observations of Daily Tasks

In this study, task performance was evaluated on the basis of how participants used the process skills required by a specific activity. Park et al. (1994) demonstrated that in healthy older adults, motor skill abilities did not vary in different settings. Because we assessed younger healthy adults in this study, we did not expect differences in motor skill abilities to occur. Therefore, we observed only process skill abilities. To do this, we developed a rating scale inferred from the AMPS that provided a less time-consuming evaluation of task performance than the full AMPS.

In addition, we chose to observe process skill abilities that we expected would relate to the coffee-making task. For each task, we evaluated nine process skill abilities: (1) searching and locating (the ability to look for and locate tools and materials in a structured, logical way); (2) goal-oriented working (the ability to work in a goal-oriented way); (3) handling (the ability to support, stabilize, and hold tools and materials in an appropriate and safe way); (4) noticing and responding (the ability to respond appropriately to environmental cues); (5) accommodating, adjusting, and benefiting (the ability to adapt behavior to solve problems encountered in an applicable way); (6) pacing (the ability to maintain an effective rate of task performance); (7) attending (the ability to focus attention on the task); (8) initiating (the ability to start task performance or a new action that is part of the task sequence without hesitation); and (9) continuing and sequencing (the ability to perform actions that make up the task in an effective and logical order using time and energy in an efficient way).

All process skills were rated on a 4-point scale: 1 = severely ineffective use of process skills resulting in unacceptable task...
performance; 2 = ineffective use of process skills resulting in disturbance of task performance; 3 = questionable use of process skills, not resulting in disturbance of task performance; and 4 = easy and consistent use of process skills. For both tasks performed in unfamiliar settings, we report the number of participants showing disturbance of task performance.

**Neuropsychological Evaluation**

The Cognitive Screening Test (de Graaf & Deelstra, 1991) is used to assess general mental status. The maximum score on this test is 20. The Auditory Verbal Learning Test (AVLT) is used to assess episodic memory (Brand & Jolles, 1985). Fifteen words are presented orally, and the participant is asked to name all words he or she remembers. This procedure is repeated 5 times, and after 20 min, delayed recall and recognition are tested. The variable of interest is the number of words recalled after the 20-min delay; the maximum score is 15. Raven’s Standard Progressive Matrices (SPM) is a nonverbal test used to assess abstract reasoning (Raven, Court, & Deelman, 1991) is used to assess general mental status. The maximum score on this test is 20. The Auditory Verbal Learning Test (AVLT) is used to assess episodic memory (Brand & Jolles, 1985). Fifteen words are presented orally, and the participant is asked to name all words he or she remembers. This procedure is repeated 5 times, and after 20 min, delayed recall and recognition are tested. The variable of interest is the number of words recalled after the 20-min delay; the maximum score is 15. Raven’s Standard Progressive Matrices (SPM) is a nonverbal test used to assess abstract reasoning (Raven, Court, & Deelman, 1991). It consists of 60 items, and the variable of interest is the total number of correct answers. We used the AVLT and Raven’s SPM in this study to investigate the association among transfer, memory, and abstract reasoning.

**Statistical Analysis**

Descriptive statistics were used to present participant characteristics and neuropsychological test results. To assess differences in time needed to perform each task in the two settings, we used paired-sample t tests. To evaluate differences in ADL functioning between the home setting and the unfamiliar environment, we also used two paired-sample t tests assessing the effect of a different setting on the process skill scores for coffee making and sandwich preparation. To further explore the differences in task performance, for each ADL task in both settings, we report the number of participants in each score category for all individual process skills.

To evaluate the influence of sex, age, and cognitive functioning (i.e., memory and abstract reasoning) on environmental effects in task performance (i.e., task performance in an unfamiliar setting vs. a familiar setting), we used Fisher’s exact tests (Agresti, 1996), which are applicable to data that do not follow a normal distribution and are derived from a small sample. To perform these tests, dichotomous variables must be created. For each task, we created one dichotomous variable reflecting the difference between the two settings on the total process skill scores: better performance at home versus no difference in setting or better performance in the unfamiliar kitchen.

We used the dichotomous variables to construct three 2 × 2 cross-tabulations for each of the two separate tasks, investigating whether the observed differences in the total process skill scores were related to the following differences within the sample: (1) sex (male or female); (2) age (<55 or ≥55); (3) performance on the 20-min delay condition of the AVLT (<9 words remembered or ≥9 words remembered); and (4) performance on the Raven’s SPM (<50 correct answers or >50 correct answers). The latter three dichotomous variables, reflecting differences within the sample, were created using the median of the continuous variables.

We used Fisher’s exact tests to evaluate possible associations within the cross-tabulations. In addition, we used Fisher’s exact tests to evaluate whether the dichotomous variable reflecting the difference between the two settings on the total process skill score for the coffee-making task was related to (1) the number of times a day that participants made coffee (1 time/day or >1 time/day) and (2) the number of different settings in which participants made coffee (no different settings or one or more different settings). We created the dichotomous variables reflecting differences within the sample using the median of the continuous variables.

In all analyses, the level of significance was set at .05. Analyses were carried out using SPSS 14.0 for Windows (SPSS, Inc., Chicago). Most variables did not follow a normal distribution. Therefore, we repeated all analyses in which t tests were used using the Wilcoxon signed-rank test. We report only parametric test results here because conclusions based on the parametric test results were the same as those based on the nonparametric test results. In addition, the t test is considered robust with data moderately departing from a normal distribution (Hays, 1994).

**Results**

**Participant Characteristics**

Participants (N = 30) were recruited from November 2005 to June 2006. Participants’ mean age was 54.6 yr (standard deviation [SD] = 10.7). Most participants were university educated and were female. On average, participants used their coffee maker at home 1.7 times a day (SD = 1.2). Participant characteristics are displayed in Table 1. Table 2 shows the neuropsychological test results. Mean AVLT scores and mean number of correct answers on the Raven’s SPM were congruent with the norm scores for healthy people in the same age category and with the same level of education (Bouma, Mulder, & Lindeboom, 1996; Van der Elst, Van Boxtel, Van Breukelen, & Jolles, 2005).

**Environmental Effects**

Both coffee making and sandwich preparation required significantly more time in the unfamiliar kitchen than in the participants’ own kitchen (coffee making, t[28] = 4.74, p < .000; sandwich preparation, t[29] = 4.54, p < .000). In both coffee making and sandwich preparation, participants usually used a coffee maker at home 1.7 times a day (SD = 1.2). On average, participants used their coffee maker at home 1.7 times a day (SD = 1.2).

**Table 1. Participant Characteristics**

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<thead>
<tr>
<th>Characteristic</th>
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Note. N = 30.

*For education, low = primary school or less; middle = high school, vocational school, or technical school; high = university.
tasks, the total score on process skill abilities was significantly lower in the unfamiliar kitchen than in the participants’ own kitchen (coffee making, $t_{29} = 4.07, p < .000$; sandwich preparation, $t_{29} = 2.54, p = .017$; see Table 3).

Table 3 shows the number of participants in each score category for all individual process skills on both tasks. Variations in process skill scores occurred only in the unfamiliar setting. Process skills observed in the participants’ own kitchens were nearly optimal for both tasks.

Variables Influencing Adaptation to New Environments

Fisher’s exact tests did not show any associations between the differences in total process skill scores of the two separate tasks and (1) sex (coffee making, $p = 1.00$; sandwich preparation, $p = .645$), (2) age group (coffee making, $p = 1.00$; sandwich preparation, $p = .682$), (3) performances on the AVLT’s 20-min delay condition (coffee making, $p = .715$; sandwich preparation, $p = .682$), and (4) performance on the Raven’s SPM (making coffee, $p = .299$; sandwich preparation, $p = .417$). In addition, we found no significant associations between the two settings on the total process skill score for the coffee-making task and the number of times a day that participants made coffee ($p = .299$) or the number of different settings in which participants made coffee ($p = 1.00$).

Discussion

Results showed that the daily functioning of healthy adults with a high educational level was influenced by the environment. This finding supports those of Park et al. (1994), who showed that in healthy older adults, process skill abilities in the performance of daily tasks were affected by the environment.

We hypothesized that the ability to adapt to different environments can be influenced by the cognitive functions of abstract reasoning and memory. Although the educational psychology literature states that abstract reasoning is necessary in transfer (Byrnes, 1996; Salomon & Perkins, 1989) and although it can be inferred that memory must play an important role in transfer as well, we did not find an association between environmental effects and abstract reasoning or memory. The sample’s mean scores on the neuropsychological tests used in this study were in line with the norm scores for these tests. Individual scores on the two tests did, however, show a relatively wide range of scores. Therefore, our findings cannot be explained by the use of tests that are not sensitive enough to detect individual differences in our sample.

In reference to our findings, it might be interesting to consider the ecological validity of the neuropsychological tests used. These tests measure the neuropsychological constructs of memory and abstract reasoning. Measuring a construct, however, does not automatically relate to the way in which participants use the construct in daily life. Recently, the way in which neuropsychological tests can predict everyday functioning has been questioned (Chaytor & Schmitter-Edgecombe, 2003). It is possible that the tests used in our study were not sufficiently ecologically valid to reflect the way in which participants used their abstract reasoning and memory functions while performing daily tasks. This possibility might explain why associations between environmental effects and abstract reasoning or memory were not found.

We found no associations between an environmental effect for the coffee-making task and either the number of times a day that participants made coffee or the number of different settings in which participants commonly prepared coffee. These findings suggest that neither the number of times that this specific task is performed nor the number of environments in which the task is performed affects the ease with which someone performs the task in an unfamiliar environment.

Limitations

A methodological shortcoming of this study relates to the primary outcome measure. To evaluate task performance, we assessed the way in which participants used the process skills required to perform a task. These process skill abilities were rated on a scale inferred from the AMPS (Fisher, 1997). Although the AMPS is a reliable and validated test (Park et al., 1994), no assumptions can be made about the psychometric characteristics of the inferred rating scale used in this study; however, little reason exists to suspect that this rating scale’s reliability was inferior to that of the AMPS itself. The way in which task performance
was observed and scored in this study was directly inferred from the AMPS itself.

In addition, although we found statistically significant differences between the task performances in the two different environments, we should note that the differences were very small. Although the rating scale used in this study had scores ranging from 0 to 36, it showed a ceiling effect, with all mean scores observed in this study ranging from 34.90 to 35.97. The use of a rating scale that shows more variability in healthy adults’ test scores would be preferable; however, we were not aware of such a test.

**Implications for Occupational Therapy Practice**

The aim of rehabilitation is to restore patients to maximum independence and return them to their own home and participation in society (Wilson, 2000).

Environmental effects play a central role in the occurrence of transfer of learning from the clinical setting to the home environment. For patients to function as independently as possible in their own home, tasks taught in the rehabilitation setting should be transferred to the home setting. Transfer of treatment effects is crucial for a rehabilitation program’s clinical success (Cicerone et al., 2005; Geusgens et al., 2007).

Few research studies have shown how patients transfer skills learned during rehabilitation to new situations. On the basis of this study’s findings, one can expect that patient functioning will be affected by the environment. Therefore, it is important that therapists working with brain-injured patients be aware of the environmental effects that may impede or facilitate transfer of learning from rehabilitation to the home setting. To facilitate such transfer, the connection between newly learned information and environmental context must be made clear to patients. This clarification of the connection could be achieved by practicing a specific skill in varied contexts until the patient is able to understand the fundamental task elements that remain constant in each environment.

Research has also shown that patients must possess some awareness of their cognitive deficits if they are to implement new strategies independently. Patients will be more motivated to learn new strategies if they are aware of their deficits and acknowledge that new strategies are necessary to improve participation in desired occupations. Increasing awareness of deficits is an important starting point in rehabilitation programs. For a full review of studies evaluating transfer-of-training effects in cognitive rehabilitation and implications for clinical practice, see Geusgens et al. (2007).

**Recommendations for Future Research**

Future research should further evaluate the influence of cognitive functions on the ability to adapt to different environments, using neuropsychological tests that are known to be ecologically valid and that do not show a ceiling effect when administered to healthy adults. Because few neuropsychological tests possess these specific characteristics, however, developing good ecological tests will be necessary. A key process in developing such tests will be to relate test scores to daily functioning. Thus, neuropsychological test scores can only be ecologically valid if the scores are validated by observations of task performance in daily life. In addition, assessing methods to facilitate transfer, especially in a rehabilitation population, would be of great importance because applying these concepts in clinical practice would greatly improve the clinical success of rehabilitation programs.

**Conclusion**

In this study, we show that task performance in healthy, middle-aged adults is affected by the setting in which the task is performed. Different environments likely also affect task performance in clinical
populations (e.g., people with brain injury, geriatric patients), resulting in important implications for rehabilitation practice. Thus, it is important to address facilitation of transfer in all clinical populations receiving rehabilitation services. ▲

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References


