

# Adaptation, problem solving and design of the home environment by elderly people

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# **Adaptation, problem solving and design of the home environment by elderly people**

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## **Preface**

This report contains a paper that was presented at the EDRA conference (Environmental Design Research Association) in 1995. It consists of a theoretical discussion and a description of the first pilot study, performed during a four year Ph.D. project on housing for the independently living elderly. This project is supported by the Institute for Gerontechnology (Eindhoven University).

It is the sequel to a descriptive report on the theoretical backgrounds of the interaction between the elderly individual and his/her home environment, entitled: 'Housing for the Independently Living Elderly; Theoretical Backgrounds'.

Paper presented at EDRA 26, March 1-5, 1995; Boston, Massachusetts

## **Adaptation, problem solving and design of the home environment by elderly people**

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Adaptation is the dynamic process of decreasing the discrepancy between an actual and a desired living situation. After discussing the theoretical backgrounds of the project, the paper will present the results of a pilot study on the adaptation strategies of elderly people when faced with a problem in their housing environment. In this pilot we examined everyday environmental problem solving behaviour of 16 elderly participants. Subjects were confronted with two problems in a housing situation and were asked to name solutions for them. Subjects talked aloud and were able to use drawing materials. Protocols and drawings were collected, after which design alternatives were discussed and evaluated by the subjects. Responses were judged on effectiveness, evaluated (using the arguments mentioned by participants), and categorized based on the adaptive style. The results give us an indication of the type of strategies (active or passive adaptation) older people use to solve problems in their own houses, and motivations for their choices. A first effort to develop a measurement method that encompasses the preferences of older people is made. Indications were found that personal preferences play an important role in the problem solving process. The ultimate goal of this research is to find strategies to enhance the proactive behaviour of elderly people in their home environment.

### **Introduction**

Autonomy and independence are basic wishes of every human being. The wish of the elderly to live independently for as long as possible has been acknowledged in virtually every western country. Due to the strong growth of the group of older people in our society, much research has already been focused on the housing environment of ageing persons.

During the ageing process, problems in the home become more frequent and more pronounced. These problems arise in situations where the affordances of the home do not or no longer match the needs and capacities of the inhabitants. If this kind of mis-match or incongruence exists, usually a process of adaptation starts. There are numerous ways of adapting, but the most common categorization of these alternatives is based on the subject which is adapted: either something within the person (psychological or cognitive adaptation) or the situation itself (environmental adaptation). Wister (1989) found that as people grow older, there is a shift from more active to more passive modes of adapting when he interviewed 280 elderly about housing adaptation and service utilization. He reported that older people would sooner adapt themselves psychologically, than adapt the physical environment to their needs. A model of adaptive behaviour of the ageing person that is often used is the model of Lawton and Nahemow (1973). In their model, adaptive behaviour is due to varying environmental press.

## **Environmental docility and proactivity**

Lawton and Nahemow (1973) presented a model of adaptive behaviour as the outcome of the interaction between a person of a given level of competence and an environment with a given level of press. Behaviour varied on a dimension of adaptive to nonadaptive. In 1982, Lawton posed the environmental docility hypothesis, originally formulated in 1970, which suggests that high competence is associated with relative independence of the individual from the behavioural effects of environmental press, while low competence implies heightened vulnerability to environmental press. In general, the hypothesis suggests that the lower the competence of an individual is, the less able this individual will be to adapt to varying environmental press.

In 1985 Lawton formulated the environmental proactivity hypothesis, which states that environmental resources are likely to be better used by people of higher competence. Proactivity is displayed when the person attempts to change himself or herself or when the person creates an environment to facilitate a desired behaviour. It is important to note that older people engage in proactive behaviour as well as others. Lawton found clear evidence for this statement in a pilot study in the Philadelphia Geriatric Center:

"It was found that virtually every impaired person had created some variant on a "control centre", whose result was most surely a bolstering of the sense of autonomy. [...] The community residents by this constriction reserved for themselves a larger social space, primarily psychological, represented by the idea that they still occupy their long-standing home, that they live in their old neighbourhood, that they are autonomous people living in the community, not in a dependent situation" (Lawton, 1985).

We can see here that adaptive behaviour can be placed on the ranges of two different dimensions: the passive (environmental docility) - active (proactivity) dimension and the psychological - environmental dimension. These dimensions do seem to partially overlap though: the proactivity hypothesis states that higher competence is related to better use of resources of the environment, which implies environmental adaptation, whereas environmental docility is presumably more related to psychological adaptation. What type of adaptation is best (cognitive or environmental, active or passive) is dependent on the type of problem and on several characteristics and resources of the individual. Brandtstädter and Renner (1990) posited two complementary coping mechanisms to maintain life satisfaction, involving accommodation of goals to losses and obstacles (flexible goal adjustment) as well as active modification of the environment in the service of ongoing goal attainment (tenacious goal pursuit). The choice to pursue or modify personal goals may reflect differences in the kinds of losses experienced or the availability of supportive resources. Both modes of coping may operate simultaneously in concrete situations. However, we expect that in the initial stage of a coping episode, assimilative tendencies dominate; accommodative tendencies, on the other hand, should be activated to the extent that active, assimilative attempts to change the situation become ineffective (Brandtstädter and Renner, 1990).

In accordance with the environmental docility hypothesis, many new housing environments specifically built for the elderly, are designed with extreme care and attention for support and the compensation of decreasing competence. This was also argued by Lawton (1990), where he states that the task of designing on behalf of older people has most often been construed in terms of prosthetics, that is, compensating for personal loss through environmental support. The proactive aspect has not received that much attention yet. According to the proactivity hypothesis, people are more likely to use environmental resources actively and efficiently as competence increases. The competence needed here is related to efficiently solving environmental problems occurring in the home.

### **Problem solving**

If we want to study the competence of people to solve problems in their home environment, we could try to incorporate knowledge from the problem solving field. Knowledge from traditional studies on problem solving is not sufficient here, because of the differences in the types of problems and problem solving processes that are studied. Problems in traditional research are mainly of a symbolic nature (chess, symbolic logic, cryptarithmic puzzles). In this context we are not dealing with abstract problems, but with ecologically valid and recognizable situations, for which solutions are necessary that have a certain value for the individual and which can actually occur in the individual's life. According to Hartley (1989), these 'everyday problem solving processes' are modelled better by the choice and decision paradigms than by any of the conventional problem-solving paradigms. For this reason, attention should be paid to both cognitive skills and the preferences of individuals that influence choices and decisions in the problem solving process.

Knowledge that seems more appropriate stems from the field of everyday problem solving. In fact, one could call the competence we are studying here 'everyday environmental problem solving competence'. The term 'environmental' narrows the research down to problems that are somehow related to the physical environment, either because the solution is to be found in environmental adaptation or because an incongruent environment is causing the problem. In this sense, the problems could be studied as design problems. Design problems have been taken as an example of real-world problems that can be studied within Newell and Simon's theory of human problem solving (Newell & Simon, 1972). Four aspects are important here: the cognitive system of the problem solver (possibilities and limitations of human information processing), the characteristics of design problems (ill-structured and involving a large body of domain knowledge), the design task environment, and the design process itself (de Vries, 1994).

Because everyday problem solving may be influenced by cognitive aspects, experience and personal preferences, it is hard to predict the relationship of this competence with age. There is considerable evidence that performance on traditional problem solving tasks decreases

with age after early adulthood (Botwinick, 1984; Giambra & Arenberg, 1980). Little is known about the influence of age on decision processes (Hartley (1989). Results in the literature on everyday problem solving are somewhat ambiguous. For instance Denney and Pearce (1989) conclude from their research that performance is very clearly influenced by experience. Although this should give higher age groups the advantage, older age groups did not perform as well as middle-age groups. They did perform as well as young adults. Cornelius (1987) found a positive linear correlation between performance and age. Results seem to depend heavily on the problem topics, question type and scoring method. Denney (1989) hypothesized that optimally exercised abilities may not or only moderately decline with age. This would explain the relatively high scores of elderly on everyday problem solving tasks, compared to traditional problem solving tasks. Whether or not age is an important qualifier in the performance on everyday environmental problem solving tasks is an important question to answer.

In his proactivity hypothesis Lawton (1985) states that people of higher competence are likely to use environmental resources in a better way. We believe that a relevant competence in this context can be operationalized as everyday environmental problem solving ability. Performance may also be dependent on the affordances of the built environment. If people are better able to think of solutions for problems in their home environment in a for them satisfying way, they are more likely to actively adapt their situation to meet their wishes. They themselves will be in control over their environment. The term environment specifically refers to the physical environment here, which turns the problem solving task into a design-type task.

Several methods have been used in everyday problem solving research to measure problem solving competence. While some researchers have contended that scoring according to the best single solution given is a good indicator of problem-solving ability, Denney and Pearce (1989) state that there is evidence in the literature that the ability to generate a number of alternative solutions is a very good indicator of problem-solving ability. In their study they used the number of safe and effective solutions as an indicator of problem solving ability. They stated that in their study, the solutions, once they were judged to be both safe and effective, were indistinguishable in terms of quality. In their study on everyday problem solving in adulthood and old age, Cornelius and Caspi (1987) administered a multiple-choice inventory to their subjects. For each problem they presented 4 alternative actions, each of which represented a possible response mode. Solutions were then judged on effectiveness by a number of raters. Effectiveness was defined in line with the ideas of Goldfried and D'Zurilla (1969), who defined effective behaviour as a pattern of responses to a problematic situation which alters the situation so that it is no longer problematical, and at the same time produces a maximum of positive consequences and a minimum of negative ones.

Raters were asked to give one effectiveness score for every solution, based on this broad definition. Basically one should ask at least two questions though: 1. is this solution really a solution to the problem presented (effectiveness in a narrow sense). 2. what are the positive and negative consequences of this solution. The problem with this second question is that it comprises value judgements. The only way to evaluate solutions in a meaningful way, is to incorporate both questions into the quality measurement; the problem however is that the evaluation of the solution should be based on the preferences and criteria of the problem solver, not the rater. We should be extra careful in evaluating solutions mentioned by elderly and comparing them with solutions mentioned by young people, because their preferences can differ significantly. One of the reasons for the pilot described below was to develop a quality measurement method, beside number of produced solutions, based on criteria that are important to elderly problem solvers. Solutions should also be scaled on the dimension active - passive and the dimension cognitive - environmental.

### **The pilot study**

Operationalizing 'press' (Lawton's model) as problems that occur in the home, enables us to study adaptive behaviour of elderly people by studying the solution they choose for this problem. Competence is operationalized as everyday environmental problem solving performance.

The presently described pilot study is a first explorative effort to study everyday environmental problem solving by elderly people. The results will give us an indication of the type of solutions people think of and how they evaluate them, the strategies (active or passive adaptation) older people use to solve problems in their own houses, how these strategies correlate with the success of adaptive behaviour, and the motivations for their choices. A second goal was to develop a measurement method of problem solving performance that aptly considers the preferences of elderly people.

### Participants

Sixteen subjects, 60 - 76 years of age ( $M= 66.1$ ,  $SD= 4.86$ ), males and females equally represented, were invited to the laboratory, separately ( $N=10$ ) or in couples ( $N=6$ ). The sample consisted of people with a relatively high education level, living independently in the community, alone or with their partners. The education level was distributed equally over males and females, men were more likely to be married ( $p<.05$ ).

### Materials/method

In order to study the everyday environmental problem solving performance, two real life (ecologically valid) problems were constructed. These problems had to be imageable, realistic, and equally important to men and women. It was important that there was a very diverse scala of possible solutions and that these solutions were not too obvious. It was



equally important though to keep the level of complexity of the 'design' task low enough, because the goal of this pilot study was not to investigate mental processes/problems during complex design problem solving. The two problems are described below.

#### Problem 1

Suppose you suffered from a rheumatic affection in your hands. Due to this affection you experience some trouble in moving your hands and exercising force with them. Complex movements, like the turning and pushing of a door latch, become more and more difficult. You are now at a point where you can no longer open and close the doors inside your house any more.

#### Problem 2

Suppose a good friend of yours has the following problem. This friend is your age, his circumstances are comparable to yours. On the next page you see a floor-plan of his house. He prefers to sit in his easy-chair when he is reading, watching television or having friends and family over.

Your friend suffers from diabetes. This disease causes the muscle strength to decline. Over the last years his legs have become weaker and less mobile. His walking speed has declined significantly. Still he wants to live independently for as long as possible.

His doctor gave him drugs to prevent water retention in his body. Due to these drugs, he frequently and unexpectedly gets the urge to urinate.

The problem is that it is getting harder for him to reach the lavatory in time. Actually he cannot make it there in time any more without help.

(Subjects received a floor-plan of the house, on which the route from the easy-chair to the lavatory was indicated by a dotted line).

#### Procedure

After a short inventory, with which data on standard background variables were collected, the first problem was presented to the subject. He /she was then asked to think of solutions for this problem. Subjects were told they could use drawing materials if they wanted to. The problem solving tasks were video-taped. After the subjects said that they had finished, they were asked to evaluate the formulated solutions and to choose the one they would apply themselves. Then the second problem was presented. Solutions were again evaluated. The sessions ended with a final inventory on attitudes towards adaptations and technical aids.

#### Data

The written protocols were analyzed on content: the number and type of solutions were recorded, as were the criteria and arguments people used when evaluating or discussing a certain solution. From the evaluation interviews again the criteria and arguments people named spontaneously were recorded.

The evaluation of problem solving performance was executed in the following way: The arguments and criteria subjects named were collected and counted per problem and in total. The assumption is that the criteria that are most important and valid for the elderly, are the ones mentioned most frequently during the problem solving and evaluation task. Solutions were rated on all of these criteria by judges and then weighted according to the counts and combined into one quality scale. This way, solutions were evaluated on the criteria men-

tioned by the subjects. Judges were two environmental psychologists with experience in the field of housing. These judges also rated the effectiveness (in the narrow sense: is this a solution for the problem presented?) on a 5-point scale (ineffective to effective) and the type of adaptation on a 5-point scale of passive - active and a 4-point scale of cognitive - environmental (cognitive, combination, environmental, none).

This produced a number of indicators for the everyday environmental problem solving performance: the number of effective solutions and the quality and effectiveness scores of the best solution. The effectiveness and quality scores of the selected solution function as an indication adaptive behaviour. Finally satisfaction with the chosen solution was rated by the subjects on a 5-point scale.

### Results

In total, subjects produced 30 different solutions for the first problem and 29 solutions for the second one. The average number of solutions given per subject are listed in table 1, as well as the number of effective solutions. The average length of the experiment was about 1.5 hour per subject.

	Number of solutions			
	Singles		Couples	
	total	M (SD)	total	M (SD)
Problem 1	3.0 (1.76)	2.3 (1.83)	6.0 (1.00)	5.0 (1.00)
Problem 2	3.3 (1.70)	2.4 (1.26)	5.7 (1.53)	4.0 (1.73)

Table 1: Number of solutions mentioned by participants for problem 1 and problem 2.

### *The quality measure*

The criteria the subjects mentioned during the problem solving task and the interview were recorded. They are listed in table 2, with their frequency of appearance and their relative weight in the quality dimension. Some arguments were mentioned in both problem solving tasks, others appeared more often in one problem than in the other. The most marked differences are related to the criteria 'appearance towards others' and 'hygiene', that were only mentioned during the second task. The reason for this is that although all the criteria that were mentioned are relevant to the problem solver, not every problem has solutions with positive or negative consequences related to every criterion. So although the frequencies of appearance were different for the two tasks, only one quality measure was constructed. If according to the rater a certain criterion was irrelevant for a certain solution, this solution should get the neutral score on the particular criterion.

Argument	pr 1	pr 2	total	weight	Argument	pr 1	pr 2	total	weight
Ease of use	12	12	12	4	Independence	4	7	9	3
Costs	11	9	11	4	Hygiene	-	9	9	3
Ease of realization	7	9	11	4	Reliability	1	7	7	2*
Appearance towards others	-	11	11	4	Safety (accidents)	3	-	3	1
Simplicity	5	8	10	3	Practice	-	4	4	1
Living comfort	5	8	10	3 *	Regulations/ rules	-	2	2	1 *

Table 2: Frequency and weight of arguments mentioned by subjects in problem 1, 2 and in total.

\*: not included in quality measure due to insufficient reliability

The inter-rater reliability of the scores on the various criteria were rather low on average. Criteria with the lowest reliability scores were left out of the quality measure. Criteria with moderate reliability were studied and included if the judges did not assign contradictory scores to a solution. Correlations between the scores of the two raters on the included criteria varied between .53 and .84 (all  $p < .000$ ).

Correlations between the scores on the effectiveness, the passive-active, and the cognitive-environmental scales were all significant ( $p < .01$ ) but also rather low (.53 - .65), except for the effectiveness scales of problem 2 ( $r=.0855$ ), which were not correlated at all.

#### *Adaptation strategies*

On a scale from passive to active (1-5), the average score of the selected adaptation strategy was 3.64 for problem 1 and 3.65 for problem 2. The adaptation strategy for problem 1 was cognitive for one subject, environmental for 8 subjects and mixed for 7 subjects. For problem 2 the numbers are 3 times cognitive, 4 times environmental and 9 times mixed. Simple correlations were computed between the passive - active adaptation strategy scale, the quality scale and the effectiveness scale. A significant positive correlation was found between the effectiveness and passive - active scale ( $r=.35$ ,  $p=.006$ ). Oneway Anovas of these scales with the cognitive - environmental adaptation scale only showed a significant effect of cognitive - environmental adaptation on passive - active adaptation ( $p=.0037$ ).

#### *Satisfaction*

Correlations were computed between the satisfaction score of a solution and its scores on the quality and effectiveness scales. No significant relationships were found.

When simple correlations were computed between the satisfaction of the subject with his favourite solution and the various indicators of his problem solving performance (the number of produced solutions and the quality and effectiveness of the best solution), no significant coefficients were found for either problem. No significant correlations were found

either between the satisfaction scores and the quality and effectiveness of the chosen solution.

#### *The three performance indicators*

For problem 1, correlations between the three indicators of problem solving performance (number of effective solutions, effectiveness and quality of the best solution) were computed. There was a significant relationship between the effectiveness of the best solution of a subject and the number of effective solutions found by the subject ( $r=.57$ ,  $p=.03$ ). The effectiveness and quality scale were not correlated. For problem 2, the effectiveness scale was not reliable. There was a nearly significant correlation ( $r=.5475$ ,  $p=.053$ ) though between the quality of the best solution and the number of effective solutions.

#### *Differences between best and chosen solution*

For problem 1, subjects did not choose the best (based the sum of the effectiveness and the quality score) solution from the ones they had thought of in more than 50% of the cases. In 90% of these instances, the effectiveness score of the chosen solution was lower than the score of the objectively optimal solution, but its quality was higher than the optimal alternative. For problem 2 this analysis could not be performed, due to the inefficiency of the effectiveness scale.

### Discussion and Conclusion

The number of solutions mentioned per subject varied substantially. Apparently discussing a problem with others helps producing alternatives, since the number of solutions mentioned by couples was almost twice as high as the one produced by singles.

#### *The quality measure*

Beside the criterion 'ease of use', the criteria 'costs' and 'ease of realization' were mentioned most often. It seems that these aspects can form a real barrier in solving problems in the home environment. From the protocols we also learned that for some subjects it was very difficult to judge their solutions on these rather technical criteria.

Inter-rater reliability scores for some scales were rather low. There are some possible causes for this, that should be prevented in the experiment. The first one is that the problem descriptions were kept as open and close to subjects' own circumstances as possible. The reason for this was to make the situation more imageable for the subjects. Beside this, subjects did not describe their solutions in detail. These two factors made it very difficult for the raters to give accurate and objective scores, because there was no detailed description of the problem situation nor of the solution. In the future this can be prevented by delineating the problem situations more strictly and asking for more precise descriptions of solutions from the subjects. A third possible reason is that the definitions of the criteria were made based on the statements of the 16 subjects, with the intent to stay as close to their words as possible. A more precisely defined set of criteria, formulated in advance might have been easier to rate objectively.

In this pilot study the different criteria have been combined into one quality measure. Due to the small sample, it was not possible to perform a meaningful factor analysis of the various criteria. In future research, this may result in the construction of several different quality measures.

#### *Adaptation strategies*

There was a significant relationship between the effectiveness scale and the passive/active adaptation strategy scale. The correlation coefficient indicated that active adaptation strategies were rated as more effective than passive adaptations. As expected there also was a relationship between the two adaptive strategy scales, that showed that environmental adaptations were rated as more active than cognitive adaptations. We have to be careful with these results though, since we have studied only two problem situations. Different problems or circumstances may yield different results.

#### *Satisfaction*

There was no significant correlation between satisfaction and any of the indicators of problem solving performance, nor with the quality and effectiveness of the chosen solution. This points at a possible inefficiency of the satisfaction measurement, due to insufficient variance. This is in accordance with findings in earlier research (Lawton, 1987), that indicate that elderly tend to give high satisfaction scores. This effect may even be more pronounced here, because subjects were asked to evaluate the solution they had just created. Without the satisfaction measurement, it is hard to conclude whether or not the effectiveness and quality measurement can make a valuable contribution in the investigation of everyday problem solving performance. There are some indications though that both the scales do play a role in this process: in about half of the cases in problem one, subjects did not choose the most effective solution, but the one with the highest score on the quality dimension. There are several possible explanations for this finding.

One explanation is that subjects may not have been able to appraise the effectiveness and other criteria of their solutions. Subjects were very insecure about the costs and realizability of certain solutions. For this, some knowledge about building processes is needed. Subjects also hesitated to try and sketch their ideas. It is very hard to evaluate environmental adaptations without drawings or maquettes though. When asked to draw or sketch their ideas, subjects almost reacted in panic and then reluctantly scratched a few lines on a sheet of paper.

A second possible explanation is that there is a trade-off between the effectiveness of the solution and other implications and consequences (combined in the 'quality' scale). This would plea for the consideration of the preferences of the subject when judging his problem solving ability.

#### *The three performance indicators*

The fact that there was no correlation between effectiveness and quality of solutions clearly shows that these are separate aspects of the solution. The traditional measure of problem

solving performance, number of effective solutions was correlated with the effectiveness of the best solution in problem 1 and almost significantly correlated with the quality of the best solution in problem 2. This again shows that there is a difference between effective and good solutions. The fact that there is no correlation between these measures of performance and the quality and effectiveness of the chosen solution, again shows that there are other factors beside effectiveness that influence adaptation processes.

If the number of solutions is used as a measure of problem solving ability, the elderly generally perform less well than others (Denney, 1989). It may very well be possible though, that elderly, out of everyday experience, immediately discard ineffective or unwanted alternatives. It is also a possibility that elderly are less willing to invest a lot of time, effort, money etcetera, to gain more (i.e. a more effective solution). These processes and trade offs will never be understood if we do not consider preferences of the elderly while judging their problem solving ability.

It is important to reemphasize that this pilot was meant to study the everyday environmental problem solving performance in an explorative way and to start developing an extra indicator of this performance. The tasks were chosen to represent problems faced in everyday life but the two tasks are by no means a systematic sampling from all possible problems. Secondly, the sample was relatively small.

Although there was no significant correlation of any of the performance measures (including the more traditional number of solutions) with satisfaction, some findings do indicate the possible important contribution of these measurement methods.

The pilot also gave a first impression of the criteria older people use to evaluate solutions for everyday problems and of their environmental problem solving behaviour. In future research, these criteria, their effect on adaptations and the differences in preferences between younger and older people should be studied more thoroughly.

Beside the cognitive (competence) aspects and the affective aspects of adaptation, there is a third important category of factors that influence adaptive behaviour of people in their environment: the affordances of this environment where adaptability or flexibility is concerned. The relationship between these affordances and adaptive behaviour are a subject of future research.

As Lawton (1990) stated, the proactive side of elderly housing is served less well than the docility side. If the relationships of personal competence and environmental affordances with adaptive ability and behaviour are clear, these should provide us with two categories of instruments to enhance adaptive behaviour among (elderly) people: one category heightens the individual's 'adaptive competence', the other category heightens the environments 'adaptive affordance'. By learning to apply choice and self-direction in the everyday uses of their own housing, occupants of any level of intactness or impairment can actively affect their overall quality of life.

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