© 2004 SAGE Publications. Preprinted with permission from Environment & Behavior, accepted for publication.

AN INTERNET-BASED DESIGN GAME AS A MEDIATOR OF CHILDREN'S ENVIRONMENTAL VISIONS

MARKETTA KYTTÄ *is a Ph.D. candidate in environmental psychology at the Helsinki University of Technology. Her dissertation deals with the theoretical and empirical analysis of criteria of child-friendly environments. Her research interests cover ecological psychology, children's participation, methods for participation, and experiences of density.*

MIRKKA KAAJA, *M.Sc., is a practicing architect with research experience. She has participated in research projects concerning interactive planning and design with children and young people at the Helsinki University of Technology, Centre for Urban and Regional Studies.*

LIISA HORELLI, *Ph.D., is an environmental psychologist and academy research fellow who conducts research at the Helsinki University of Technology, Centre for Urban and Regional Studies. She has published widely on the participation of children, young people, and women in planning and development.*

ABSTRACT: This exploratory study examines how an Internet-assisted design game succeeds in bringing forth children's own visions for the environment where they live and their definitions of a good environment. Two connected concepts in environmental psychology, the theory of person-environment fit and the concept of affordances, are applied in the analysis of the results of the design process. The participants were 16 8-year-old children living in a suburb of Helsinki, Finland. The results indicate that children's design solutions are sensitive to the geographical context. The children generally enjoyed the Internet-based design game. The girls designed more affordances for simply being in peace, whereas the boys emphasized affordances for playing games. The study indicates that affordances can be applied as icons in design games. They also function as a viable concept in the operationalization of the person-environment fit; however, the theory of environmental fit and its operationalization need further development and empirical testing with larger samples.

Keywords: *child-friendly environments; participation; Internet game; affordances; person-environment fit*

ENVIRONMENT AND BEHAVIOR, Vol. 35 No. X, Month 2003 1-24
DOI: 10.1177/0013916503254839
© 2003 Sage Publications

The Internet has brought new opportunities for people to participate in the design and planning of their surroundings. Even children and youth have successfully been involved in experiments in participatory planning in which they have been aided by a set of enabling tools (Chawla, 2002; Horelli, 2002). This exploratory study examines how an Internet-assisted design game succeeds in bringing forth children's own visions for the location of where they live as well as their definitions of a good environment. These will be examined through two central and, in fact, connected concepts in environmental psychology: the theory of person-environment fit (P-E fit) and the concept of affordances.

ACTUALIZATION, DESIGNABILITY, AND PREFERENCE OF AFFORDANCES AS INDICATORS FOR P-E FIT

The P-E fit, or congruence, has been put forward as the basis of human well-being (cf. Bonnes & Secchiaroli, 1995; Stokols, 1979). Human beings tend to maximize the perceived congruence between their personal goals or preferences and their social and physical environment, for instance, when they are choosing their habitat or work place. If the fit is poor, the result can be felt as stressful. In the opposite case, the experience of well-being is enhanced by adequate congruence. Environmental stress can be alleviated if the individual has even a slight possibility of influencing the situation or of controlling the stressful causes of the environmental discrepancy.

The concept of P-E fit has been used quite extensively in the psychologies of work, career, and personality (Edwards, Caplan, & Van Harrison, 1998; Kroeger, 1995). Two traditions have dominated such research: the tradition of individual differences and the tradition of organizational psychology (Schneider, 2001). In both traditions, the fit refers to the congruence between personality characteristics, personal abilities or needs, and the social and organizational setting or, for instance, job-related requirements (Meir & Hasson, 1982). There has been limited research on the concept of P-E fit in environmental psychology. However, this concept has been applied to the

AUTHORS' NOTE: *This research was financially supported by the Finnish Academy. We are very thankful to Professor Harry Heft and Professor Eila Järvenpää for their comments and to Dr. Marjut Wallenius for help with the concept of person-environment fit. We would also like to thank the two anonymous referees for their comments.* *Address correspondence to Marketta Kyttä, Centre for Urban and Regional Studies, Helsinki University of Technology, PL 900, FIN-02015 TKK, Finland; e-mail: marketta.kytta@hut.fi.*

study of settings for elderly people (Carp, 1987) and children and people with disabilities (Zimring, Carpman, & Michelson, 1987). Wallenius (1999) has used P-E fit to examine the relationship between young adults and their environments. Participation in environmental design and planning has also been considered as an attempt to enhance environmental congruence (Horelli, 2002).

There are several ways to operationalize the P-E fit. In doing so, it is important to use commensurate constructs or dimensions that link together the environment and the person in question (Edwards et al. 1998). Stokols (1979, p. 36) defined congruence as the degree to which the environment favors relevant goals and needs. Environmental fit can thus be examined by assessing, on one hand, the supportiveness of the environment to one's actions or aims and, on the other hand, the motivational significance of these aims for a person (Stokols, 1979). Perceived congruence is a cofunction of environmental support and its importance for a person.

Wallenius (1996, 1999) applied Stokols's model when examining the environmental fit of young adults. She operationalized the P-E fit by mapping participants's future plans or projects (Little, 1983). Congruence was then defined as the extent to which the everyday environment supported the implementation of their personal projects.

A series of our studies (Horelli, 1998; Horelli, Kyttä, & Kaaja, 1998; Kyttä, 2002b) suggest that a good environment from children's perspective implies an adequate P-E fit. In the present study, this fit is operationalized by applying the concept of affordances. Affordance is a central construct of ecological perceptual psychology. It has traditionally been defined as the physical opportunities and dangers that a creature perceives while acting in a specific setting (Gibson, 1986; Heft, 1997). This article focuses on the opportunities that affordances provide. Objects afford grasping, twisting, throwing, running surfaces, climbing, and so forth. The concept can be extended to comprise even emotional, social, and cultural opportunities that the environment provides for the individual (Kyttä, 2002a). The affordance consists of both environmental and individual features. Thus, the affordance is located in the mediating terrain of the setting and the individual.

The environment has to provide something that the individual can perceive as a possibility, but the perception emerges only when the different characteristics of the individual (such as physical dimensions and abilities, social needs, and personal aims) are matched with the environmental features. It is viable to see affordances in terms of varying stages or levels rather than as an either/or phenomenon (Greeno, 1994). The first level comprises the potential affordances of the environment, which are not yet perceived. This set is, in principle, infinite. Actualized affordances of the existing

environment (cf. Heft, 1989) include those that have been (a) perceived, (b) used, and (c) molded or shaped (Figure 1; Kyttä, 2002b). Within the process of actualization, affordances are first perceived and then possibly used or shaped. In the last case, the selection of potential affordances for other actors is also modified. Many individual characteristics, social and cultural rules, and practices regulate those affordances that can be utilized or shaped including when, where, and how this is done.

Figure 1 demonstrates a distinction between the affordances offered by the existing environment and those of the ideal one. The former comprise the potential and actualized affordances of the existing environment. The listing of all the potential affordances of an ideal environment is infinite. We have adopted the personally preferred or prioritized affordances as a way to capture the elements of an ideal environment, although we are well aware that they represent only a subset of all potential affordances of the ideal environment. Designed affordances can also represent a subset of the affordances of the ideal environment and a vision of an ideal world that may never become part of the existing reality. Of course, some of the designed affordances may become actualized and, hence, part of the existing environment. Designed affordances may also reflect an attempt to bring the affordances of the existing environment and those of the ideal one closer together.

It is not just affordances per se but, rather, the availability of preferred affordances as well as the opportunity to shape or design them that are considered indicators of the perceived P-E fit and even criteria for a child-friendly environment (cf. Kyttä 2002a, 2002b). In Figure 1, the perceived, used, and shaped (i.e., actualized) affordances of the existing environment) are a small subset of all potential affordances. This subset corresponds to Stokols's (1979, p. 37) environmental facilitation of the individual's activities. The motivational significance, on the other hand, can be assessed by children's personal preferences for affordances. The designed affordances can be regarded as an effort to regulate the P-E fit, as they correspond more closely to the qualities of the existing and ideal environments.

A child-friendly environment abounds with varying affordances that support the activities and aims of children. However, the actual situation is constrained by factors such as restrictions on mobility and sociocultural rules concerning the use of affordances (Kyttä, 2002a, 2002b).

Affordances should also be seen as part of the ecosocial environment in its totality. Barker's (1968) concept of *behavior setting* has proven to be useful in this respect. The behavior setting refers to the temporally and spatially bounded pattern of behavior in a fixed place. The place provides a physical and social system in which the activities are predictable. The behavior setting can also be regarded as a cluster of affordances—a place where features with

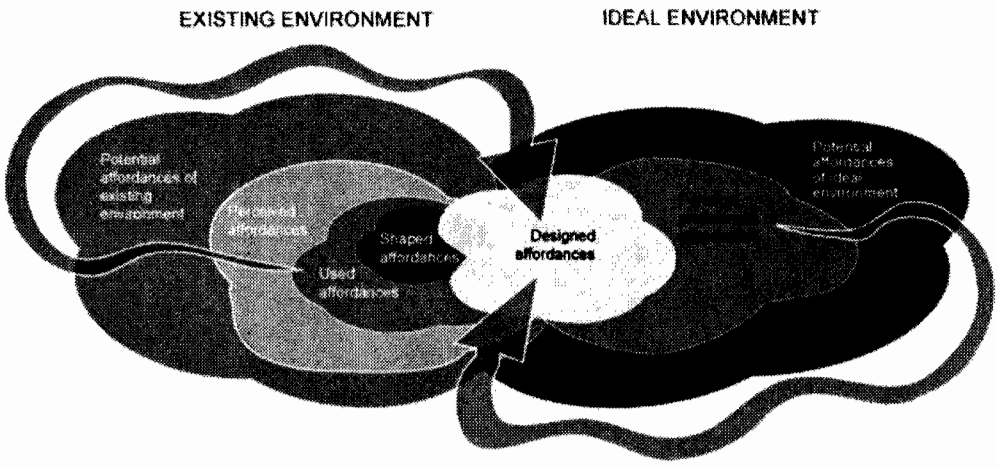

Figure 1: The Design of Affordances as an Attempt to Increase or Regulate the Perceived Person-Environment Fit.
NOTE: The existing environment is on the left, and the ideal environment is on the right.

particular affordance properties are likely to be found (Heft, 2001). Children's environments can thus be seen to comprise behavior settings that consist of clusters of significant affordances.

Recent participatory experiments with children in Finland and elsewhere have demonstrated that children are capable producers and evaluators of ideas for the settings where they live (Chawla, 2002; Horelli et al. 1998). Participation does not, however, take place in and of itself but needs to be supported by a great variety of enabling tools and resources and with the partnership of adults (Horelli, 1997, 2002). On the basis of our previous experience, we examined whether (a) children strive to strengthen the perceived congruence in their designs and (b) children tend to design affordances that are deficient in their current settings.

The Internet has proven to be a cost-effective way to gather information and exchange ideas. In Finland, the Internet has made it possible to reach new target groups such as children (Horelli & Kaaja, 2002). All schools in Finland have an Internet connection. Almost half of all Finns have access to the Internet at home, and the Internet is more frequently used in families with children than in other types of households. When the Department of Parks and Forests of Helsinki City wanted to experiment with the use of the Internet in designing an Adventure Forest with children in the Pihlajisto suburb in Helsinki, our research group at the Helsinki University of Technology was willing to take responsibility for both technical implementation and follow-up.

Figure 2: The Community of the Study: The Pihlajisto Suburb in Helsinki, Finland.

This article is based on a cluster of projects on the development of Internet-assisted participatory planning with children (cf. Horelli & Kaaja, 2002; Kaaja, Rantanen, & Horelli, 2002). Thus, the two exploratory research questions concerning the strengthening of the perceived congruence and the improvement of deficient affordances through design are embedded in the larger question of how well an Internet-based design game is able to mediate children's environmental intentions or visions.

METHOD

COMMUNITY AND PARTICIPANTS OF THE STUDY

The research location is Pihlajisto—a suburb of Helsinki—located seven kilometers northeast of the city center with approximately 3,000 residents. The landscape of Pihlajisto is dominated by three- to eight-story-high concrete dwellings (Figure 2).

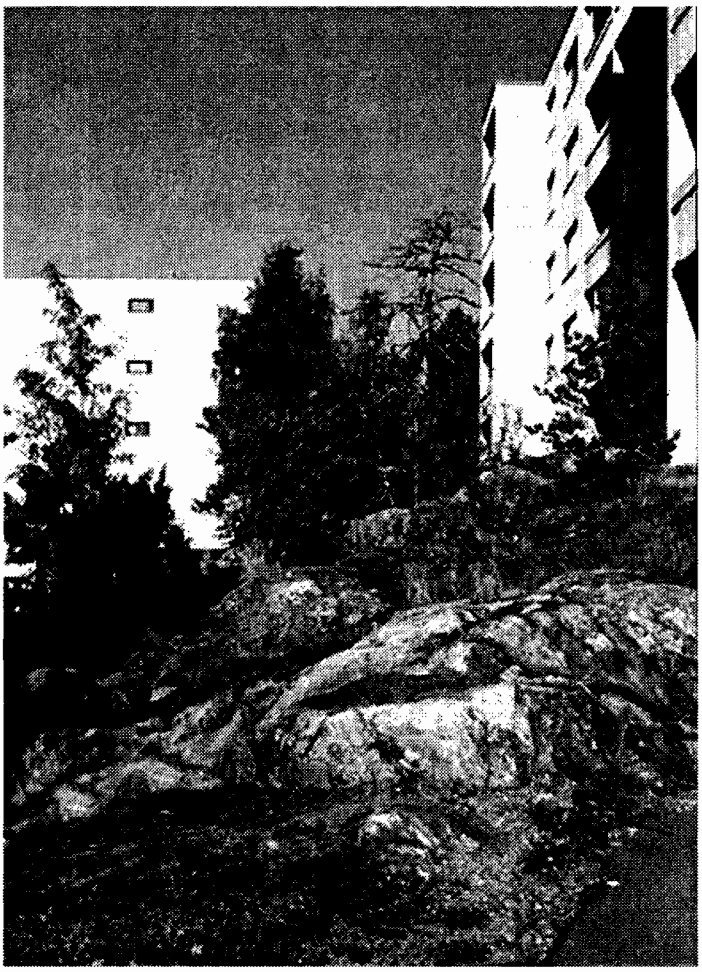

Figure 2: (continued)

situated between two rocky ridges in the southern part of Pihlajisto close to a motorway. The Adventure Forest was already an object of design at the beginning of the 1990s when the local residents participated in a special project that allowed them to construct structures for the Adventure Park such as bridges, small huts, and slides. Since then, the use of the forest has declined, and the play structures as well as the whole environment are in a bad state. The forest, nevertheless, functions as a protective zone between the motorway and the residential area. The area is crossed by a path that is scheduled to be transformed into a pedestrian and bicycle route. Stunted pine trees grow on the cliff-tops; more than 50-year-old, column-like aspens are spread over the small valley area; and clusters of elms, aspens, birches, maples, and black alders surround the area (cf. Figures 3 and 4).

According to Kyttä's (2002b) earlier study, Pihlajisto is not a bad suburb for children, as such, but the available affordances tend to be concentrated in the core area of the neighborhood. The surrounding nature is not easily accessible to children, probably because of mobility restrictions.

The participants of this study were 8 girls and 8 boys living in Pihlajisto. When the research began, the average age of the boys was 8.4 years and that of the girls was 8.5 years. Permission from the parents was sought before the children undertook the study. This was done while delivering questionnaires to the parents concerning children's independent mobility (the issue of independent mobility is not analyzed in this study). Out of 19 8-year-old children living in Pihlajisto, 86% were allowed to take part in the study. Thus, the participants ($N = 16$) cover all children in the 2nd grade who live in the area and whose parents gave them permission to participate in the study. However, 1 child was unable to participate in the study because of learning difficulties.

All the children in the study were familiar with the Adventure Forest. However, the children no longer use the forest frequently. Six out of the 16 children go to the forest very rarely, 5 quite rarely, and only 4 children go there quite often or very often.

THE INTERNET GAME

The Internet application consisted of an information package concerning the Adventure Forest—an Internet-based design game, feedback screens, and the Internet interface[1] through which the saved results of the game could be browsed. The design game was, and still is, available on the Internet for anyone interested in playing it.[2] The prototype game was first developed and tested with 63 pupils (grades 4-6) at the Pihlajisto Elementary School. The idea of the game was based on the potential activities that the Adventure Forest of Pihlajisto might facilitate. The activities originated from the affordance taxonomy created by Heft (1988) and Kyttä (2002b) (see Table 1). Instead of asking children to make their own designs for the Adventure Forest, they were asked to express the kind of activities they would like to have there and to locate them in the forest.[3] This was done by encouraging the children to play the Internet design game. The game was played by simply dragging the activity symbols or icons with the mouse onto the map of the Adventure Forest (see Figure 4).

The technical constraints of the game entailed that the children were able to use 3 icons from each of 24 affordances when they played the design game. Thus, a total of 72 (i.e., 3×24) affordance icons were available in the game. The number of activity symbols each player used in the design game was automatically counted from the saved documents. It was also possible to

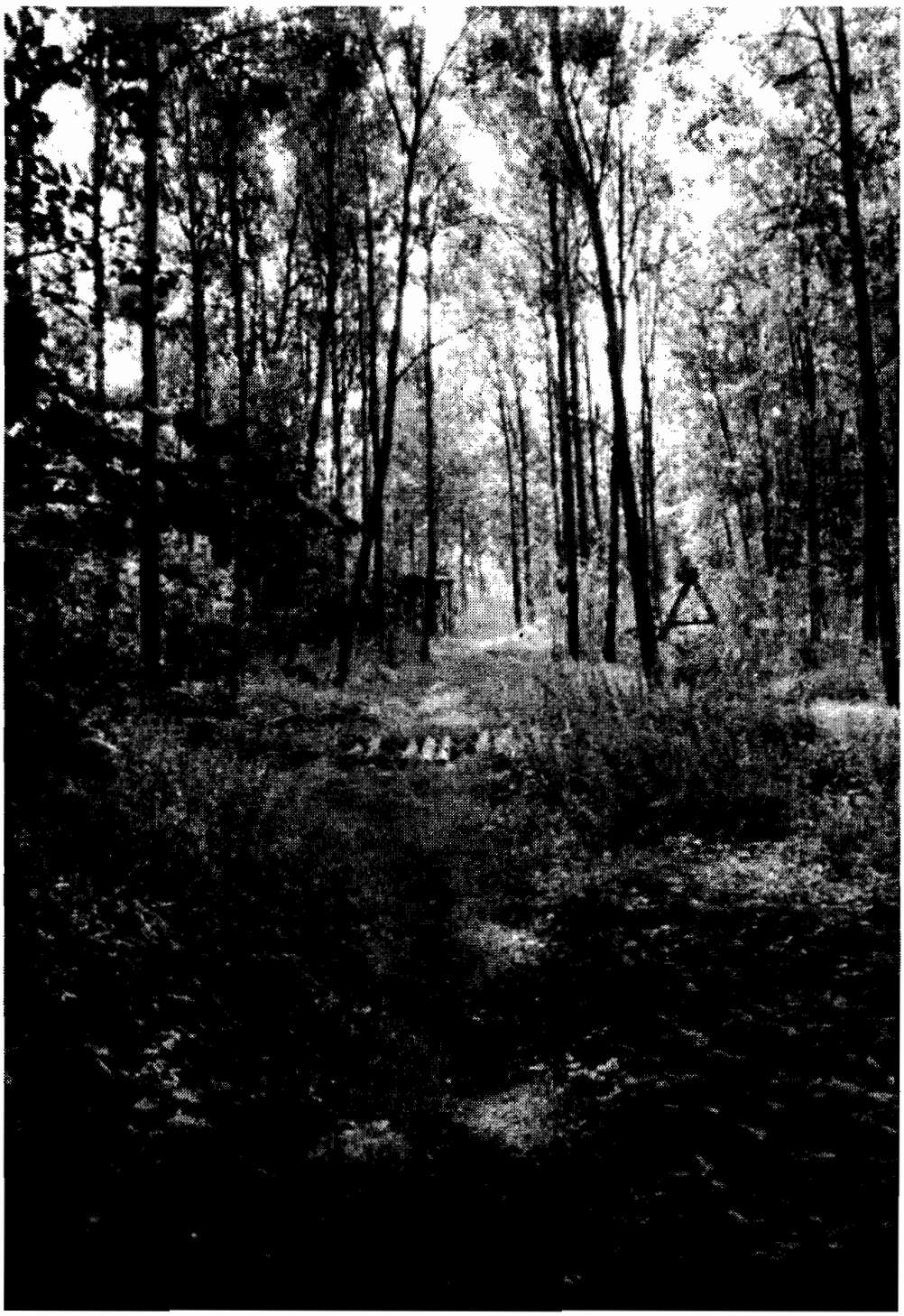

Figure 3: The Adventure Forest.

assess the locations of the affordances, because the map on which the activity symbols were placed contained a series of coordinates.

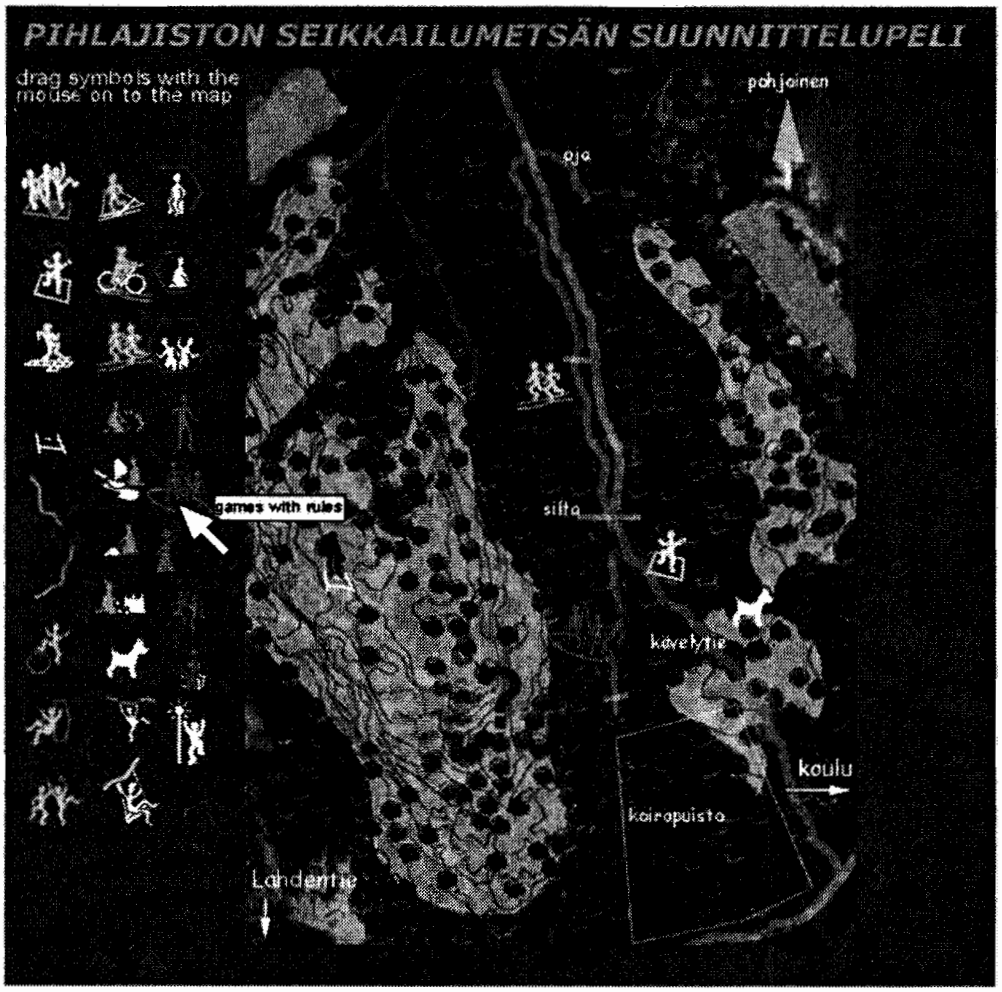

Figure 4: The Map of the Adventure Forest in the Design Game.
NOTE: The game can be played by dragging the icons that represent different affordances with the mouse onto the map.

The map that was used in the Internet-based game was constructed by combining an aerial photograph and a map with altitude contour lines that were colored and manipulated with clarifying signs or objects. The game was made simple and plain because of the limited budget.

Technically, the game consisted of three components: a JavaScript/ HTML-based game module, saving, and browsing scripts. The scripts were in the cgi-format written in the Python programming language. The Python script uses the Nucleic Acid Database from which the documents are read by using another script.

After saving the results of the design game, the children were asked to explain their main ideas for the Adventure Forest by filling out special forms that popped up in the windows. The player was asked to write his or her name

or nickname, age, sex, postal address, e-mail address, and ideas concerning the Adventure Forest. All the games and the filled-out forms were automatically saved by the server.

MEASURES

The method in the study consisted of the children's individual interviews, questionnaires, e-mailed feedback, and the design games played on the Internet.

The Interview for the Actualized Affordances

The perceived, used, and previously shaped affordances of the existing environment were investigated using semistructured interviews. The interview was designed to find out what the neighborhood as a whole offers children in the physical and social sense. Thus, the actualized affordances covered the whole Pihlajisto suburb, whereas the design game covered only a subarea of it—namely, the Adventure Forest.

The original interview comprised 40 questions and 36 different affordances. It was developed by Kyttä (2002b) on the basis of Heft's (1988) functional taxonomy of children's outdoor environments. Only a subsample of 24 affordances was analyzed here.

Table 1 shows the affordances that were included in the interview. After some general questions about the children's outdoor activities, friends, and the quality of their home yard, the children were presented with a list of questions concerning environmental affordances. An example of an individual question is:

> Now I want to ask you about different activities and whether or not there is a place where you can do these things. Is there, in your neighborhood, a place for running?

- Yes: Do you do it often?
  - $\bullet_1$ No (there is a place but I don't do it often)
  - $\bullet_2$ Yes: Where do you do it?
    - in my home (inside)
    - in my home yard
    - somewhere in the neighborhood (within walking distance)
    - somewhere else, where? _____
  - $\bullet_3$ There isn't a place for running but I (we) made such a place.
- No

TABLE 1
The Affordance Taxonomy of the Study (in bold)

Environmental Qualities That Support Certain Affordances	*Affordances*	*Environmental Opportunities for Sociality Affordances for Sociality*
Flat, relatively smooth surfaces	**Affords cycling**	**Affords role playing**
	Affords running	**Affords playing rule games**
	Affords skipping	Affords playing home
	Affords skating	Affords playing war
	Affords playing hopscotch	Affords being noisy
	Affords skiing	**Affords following/ sharing adults's business**
	Affords playing	
Relatively smooth slopes	**Affords coasting down**	
	Affords skateboarding	
Graspable/detached objects	**Affords throwing**	
	Affords digging	
	Affords building of structures	
	Affords playing with animals	
	Affords using plants in play	
Attached objects	**Affords jumping over**	
	Affords jumping down from	
Nonrigid, attached object	**Affords swinging on**	
	Affords hanging	
Climbable feature	**Affords climbing**	
	Affords looking out from	
Shelter	**Affords hiding**	
	Affords being in peace and quiet	
Moldable material (dirt, sand, snow)	**Affords molding something**	
	Affords building of snow	
Water	Affords swimming	
	Affords fishing	
	Affords playing with water	

NOTE: The taxonomy is based on Kyttä's (2001) and Heft's (1988) taxonomies.

Different answers to the questions reflect varying levels of affordances—namely, the perceived (marked with $_1$), used ($_2$), and previously shaped ($_3$) affordances. Here, the category of the actualized affordances of the neighbor-

hood was the combination of these three classes. The actualized affordances were measured by a dichotomous scale: (1) present or (0) absent in the neighborhood, in the home yard, or in the immediate surroundings.

The Questionnaire for Preferred Affordances

A questionnaire covering 24 affordances from the affordance taxonomy in Table 1 was developed for measuring the personal preferences of affordances. The children were asked to assess how pleasant or unpleasant they found each affordance, that is, how much they preferred these activities. The children answered by using five-point scales with images of faces that represented levels of agreement (☺) and disagreement (☹) (Kunin, 1955). Scores on the items ranged from 2 (for total agreement) to –2 (for total disagreement). The context of the activities was not defined more closely. The children were simply asked to think about outdoor activities.

The Analysis of the Results of the Game

The affordances chosen by children were analyzed by counting the used icons from each affordance type. The locations of the designed affordances were assessed in terms of the geographical coordinates of the individual icons. Finally, the Adventure Forest was divided into five different types of terrain into which the clustering of affordances were analyzed.

The Questionnaire Concerning the Game

Immediately after playing the game, each child was asked to fill out a questionnaire. The children were asked to answer the following seven questions with a five-point scale: (a) how easy and interesting they found the game, (b) whether the symbols and maps were readable and understandable, (c) whether the instructions were clear, (d) whether it was easy to find additional information on the pages, (e) whether sending messages and filling in the forms was easy, (f) how well the game represented the activities and games in the Adventure Forest, and (g) to what extent the children believed they can have a say concerning the Adventure Forest by playing the design game.

After the game, the children were also able to send an e-mail to the planners responsible for the area. They were asked to describe how much they were able to express their ideal image of the Adventure Forest by playing the design game.

PROCEDURE

The research was implemented in three phases. The individual affordance interviews were conducted in the spring of 2001, the design game and the feedback questionnaire were presented 3 months later (autumn 2001), and, finally, the questionnaire concerning the personally preferred affordances was filled in after another 3 months. The data collection was divided into these three phases to avoid influence between the different parts of the empirical study. Thus, the children would not remember the answers they gave in the earlier phases of the study. All three phases were conducted during school lessons.

Children played the design game in the computer classroom where each child could use his or her own computer. Before playing, the children were sensitized to the procedure by being asked to close their eyes and picture in their minds visiting the Adventure Forest. They were also asked to imagine what the ideal Adventure Forest would look like, what they could do there, and what it would feel like to be there. The playing proceeded step by step and the teacher and the researcher-facilitators took care that the children understood the instructions. A fairly quiet play situation was provided for each child.

STATISTICAL ANALYSIS

All computations were conducted using the Statistical Package for the Social Sciences (SPSS) program, version 10.0 (2001). Independent-samples *t* tests were used for comparisons between genders. A bivariate correlation was used to test the associations between the designed, personally preferred, and actualized affordances.

RESULTS

CHILDREN'S ATTITUDES TOWARD THE INTERNET GAME

Children's attitudes toward the Internet game were quite positive as a whole (cf. Figure 5). The general estimate of the game, that is, the mean of all subscales, was 3.6 (maximum of 5). Scores on the items ranged from 1 (*for total disagreement*) to 5 (*for total agreement*). The general estimates for the girls (mean 4.0) were slightly higher than those for the boys (mean 3.5), but the difference was not significant, $t = 0.97$, $df = 14$, $p = .350$. The scores for the girls were somewhat more positive in all subscales than those for the

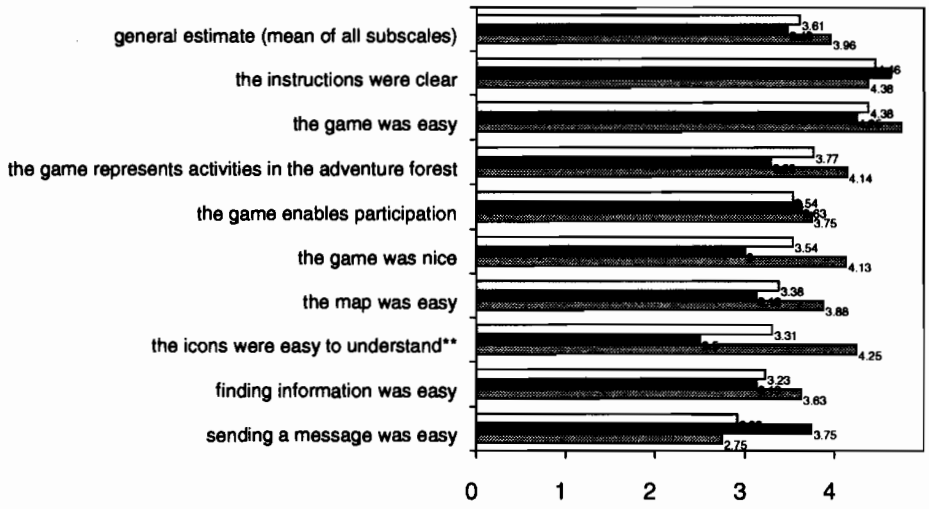

Figure 5: Children's Attitudes Regarding the Game.

boys, but the difference was significant only in the intelligibility of the icons, $t = 2.59$, $df = 14$, $p = .021$. On average, the issue that the children experienced most positively was the intelligibility of the rules of the game. They also found the game easy to play. The most difficult issues were sending the e-mail message and finding information on the Internet Web pages.

DESIGNED AFFORDANCES

Children used, on average, 19.4 icons when they played the game. Given that 72 was the maximum number of icons, the children used, on average, 27% of the available icons. Girls used fewer icons (mean 16.0) than boys (mean 23.3), but the gender difference was not significant, $t = 1.4$, $df = 11$, $p = .179$.

Figure 6 lists the means of the designed affordances that children selected. The most popular designed affordances were "hanging" (mean 1.75 out of the maximum 3 icons), "playing with animals" (mean 1.44), and "playing with water" (mean 1.25). The least popular affordances included "following/ sharing adults's activities" (mean 0.25), "using plants in play", "skipping," and "playing role games" (mean 0.31). Significant gender differences were found in two types of affordances: The girls designed more opportunities to be in peace and quiet, $t = -2.2$, $df = 14$, $p = .04$, whereas the boys wanted to play games more often than the girls, $t = 2.4$, $df = 14$, $p = .03$.

Table 2 presents the geographical location of the affordance icons. All the games are analyzed here. The Adventure Forest was divided into five types of

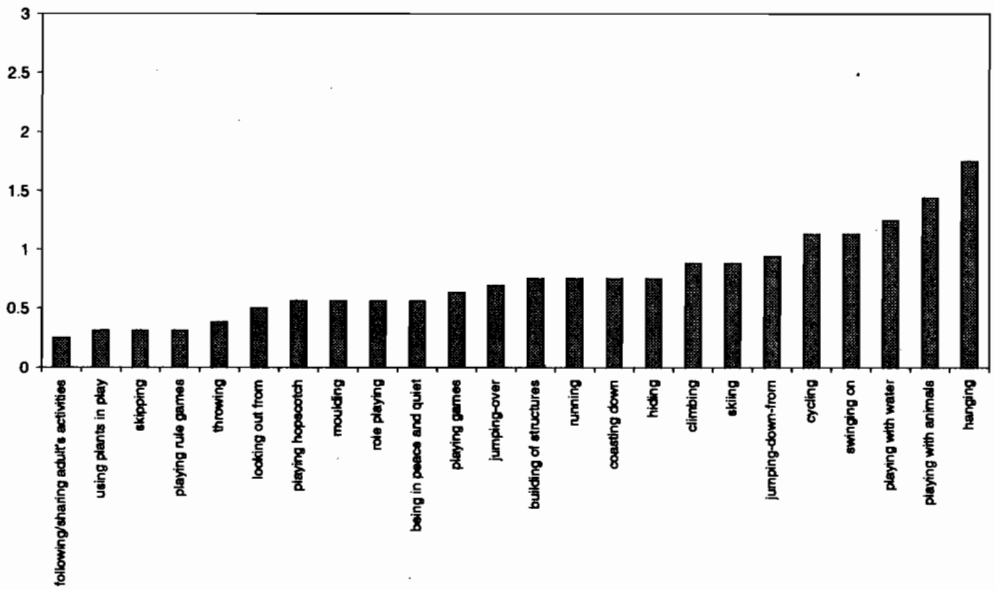

Figure 6: The Means of the Designed Affordances in the Design Game.

terrain: the valley and the ditch, the open rocks, the slope in the woods, the ridge on the east side of the valley, and the southern slope. More affordances were designed on the northern rather than on the southern part of the Adventure Forest. Each type of terrain was differentiated from one another: A unique selection of affordances were gathered in each terrain type.

THE ASSOCIATION BETWEEN DESIGNED AND ACTUALIZED AFFORDANCES

The distribution of designed affordances was first compared to the distribution of actualized affordances, that is, the perceived, used, or shaped affordances from the interviews. Figure 7 presents the means of each affordance type. The actualized affordances have been arranged in an ascending order according to the average scores of each affordance type. Thus, the least frequently shared affordance type (the affordance type that was actualized only by a few children), such as the following/sharing adults's activities, is presented first and the most frequently shared affordance type (playing games) is presented last. Then, the comparison of the designed affordances to the existing affordances becomes possible.

The association between the designed and actualized affordances was studied with a correlation analysis by using each affordance type as a unit of analysis. The mean of frequencies of each affordance type represents the average level of actualization and design of an affordance type.

TABLE 2
The Placing of the Affordance Icons in the Five Types of Terrain

	A Large Number		*A Small Number*	
Type of Place	*Number of Symbols (n)*	*(Affordances Used Most Often in Each Type of Terrain)*	*Number of Symbols (n)*	*(Affordances Not Used at All or Used Only Once in Each Type of Terrain)*
Valley and the ditch	22	Playing with water	1	Following/sharing adult's business, hiding, throwing, jumping from
	10	Building of snow and other structures	0	Looking out to the landscape, using plants in play
Open rock	10	Picnicking	1	Playing with water, skipping, running, cycling, swinging on
	9	Jumping down from	0	Playing hopscotch, building of snow and other
structures				
	7	Throwing		
Slope in the woods	11	Swinging on	1	Role playing, playing rule games, following/ sharing adult's business
	10	Cycling, playing with animals	0	Throwing, playing with water
	9	Skiing, climbing		
Ridge east of the valley	10	Playing with animals	1	Playing hopscotch, cycling, jumping over
	8	Skiing	0	Using plants in play, looking out to the landscape
	6	Coasting down		
Southern slope	4	Role playing	1	Adventuring, picnicking, throwing, being sheltered (from bad weather, etc.)
	3	Following/sharing adult's business, more light/artificial light appliance	0	Playing hopscotch, skipping, playing games, running, coasting down, viewing the landscape, swinging on, molding, playing with water, using plants in play, being in peace in quiet, jumping down, jumping over, being together

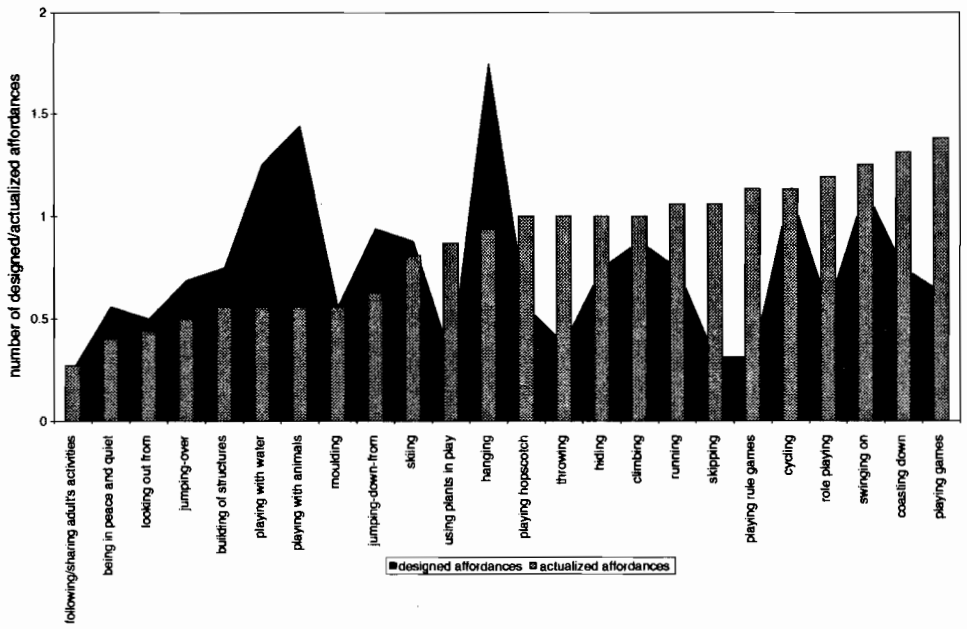

Figure 7: The Means of the Designed and Actualized Affordances.

The designed and the existing affordances were not associated with each other (Figure 5). The correlation of the means (of all affordance types) between the designed and the actualized ones was not significant, Pearson's $r = .075$, $n = 24$, $p = .728$.

THE ASSOCIATION BETWEEN PERSONALLY PREFERRED AND DESIGNED AFFORDANCES

The distribution of the designed affordances is compared to the distribution of personally preferred affordances in Figure 8. The personally preferred affordances are arranged in an ascending order according to the average scores of each type of affordance. Thus, the least frequently shared preferred type (playing hopscotch) is presented first and the most frequently shared (climbing) last. Then, the comparison of the personally preferred affordances to the designed ones becomes possible.

Figure 8 illustrates the association between the personally preferred affordances and the designed affordances. The association between the designed and actualized affordances was studied by using each affordance type as a unit of analysis. A positive correlation between the two exists, Pearson's $r = .443$, $n = 24$, $p = .030$. The association between the personally preferred affordances and the designed affordances was further studied with a regression analysis,[4] which revealed that the personally preferred

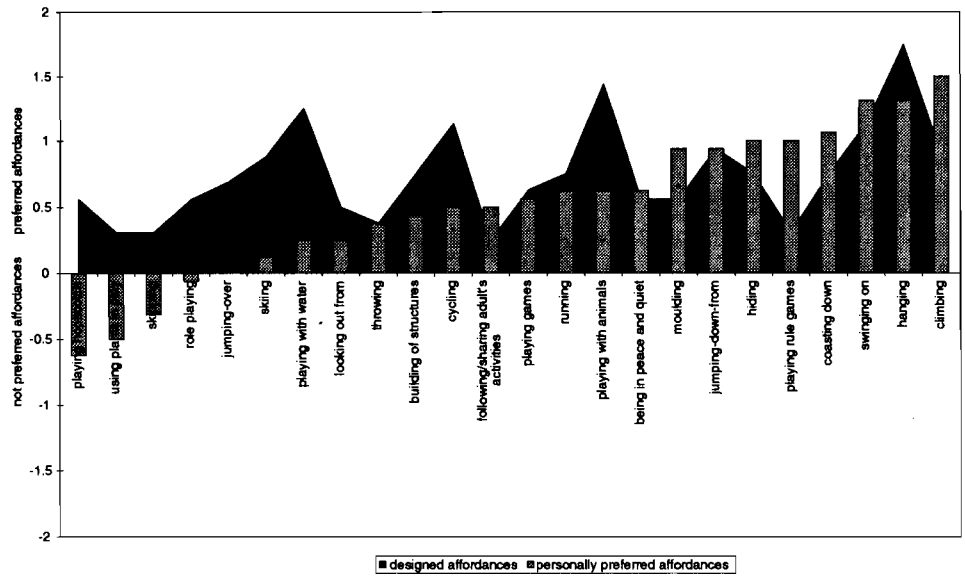

Figure 8: The Means of the Designed and Personally Preferred Affordances.

affordances explained 20% of the variance of the designed affordances, $R^2 = .196$, $\beta = .443$, $p = .030$.

THE ASSOCIATION BETWEEN ACTUALIZED AND PERSONALLY PREFERRED AFFORDANCES

The actualized affordances were not associated with personally preferred affordances. A low positive correlation between the two exists, Pearson's $r = .127$, $n = 24$, $p = .553$, but it is not significant.

DISCUSSION

The Internet-based design game was approached favorably by the participating children who found the game easy to play and the directions comprehensible. The results corroborate the hypothesis that the Internet provides children and young people with a natural form of communication.

The affordances designed by the girls and boys differed significantly in two types. The girls designed more affordances for "being in peace and quiet," whereas the boys designed affordances for "playing games." Corresponding results were obtained when 11-year-old children planned improvements for their school yard in a small Finnish town. The girls designed solutions dealing with nature and peaceful activities, whereas boys produced

ideas that were associated with playing games and building structures for sports (Horelli et al., 1998). In general, the girls liked the Internet-based game better than the boys, but boys used more icons than the girls.

The way children placed the affordance icons on the map disclosed sensitivity to the context (cf. Horelli et al., 1998). The east side of the valley was considered to be suitable for observing animals and the rocky slopes for "hanging from" and for bicycling. On the southern slope, children wanted to play role games and watch adults. The latter was justified, because the place was close to the dog park where adults often came with their dogs. The children could have been expected to design affordances for looking out at the landscape from the top of the rocky hill. However, children wished to eat sandwiches in this place. Appleton's (1975) prospect-refuge theory makes this selection comprehensible, as it is joyful to eat sandwiches in a place that allows both sheltered viewing and an opportunity to see without being seen (see also Horelli & Vepsä, 1995). The prospect-refuge theory has an evolutionary perspective, as certain places seem to afford eating without being eaten.

The central research question in our study was whether children's designs reflect an effort to improve the congruence between themselves and their environment. We studied this by looking at the associations between the actualized, personally preferred, and designed affordances.

The personally preferred affordances correlated positively with the designed affordances. The children tended to design personally preferred affordances. Thus, there is some support that the Internet game might provide a means for ascertaining affordance preferences. On the other hand, the actualized and personally preferred affordances were unrelated. This can be interpreted as a poor congruence between children's environmental preferences and the actual, existing environment, meaning that Pihlajisto may be a poor environment in terms of children's needs (cf. a previous study by Kyttä, 2002b).

Also, the designed affordances did not correlate with the actualized affordances of the existing environment. A negative correlation was expected, as it was hypothesized that the children would strive to support the deficient affordances of their settings (cf. Kyttä, 2002b) and improve the fit between themselves and the environment. In fact, certain affordances, like the affordances for water play and playing with animals, were among the deficient affordances and, at the same time, among the most frequently designed affordances.

The low correlation might, however, mirror the fact that the actualized affordances represented the affordances of the whole neighborhood, whereas the analysis of the designed solutions concerned only part of the area—namely, the Adventure Forest. Thus, context sensitivity may have guided the

designing more than the perceived shortcomings of the whole neighborhood. Nevertheless, a negative correlation between the designed and the perceived affordances should not always be expected. Children may not always want to strengthen deficient affordances. For example, "following adults's activities" and "looking out from somewhere" were these kind of affordances. Likewise, even an abundance of affordances might urge children to desire more of the same kind, which was the case with affordances for hanging, swinging, and cycling.

The limitation of this exploratory study was the small size of the sample. Irrespective of this, the research gave some support to the idea that the P-E fit can be operationalized through the concept of affordances or, more specifically, by the availability and designability of preferred affordances. The latter may potentially increase the perceived P-E fit of the children. However, the theory of environmental fit and its operationalization still needs further development and testing with larger samples.

How did the design game function as a mediator and interpreter of children's visions? Is it possible that a design game, based on affordances, does not reach all the essential issues that are associated with children's ideal images of the environment? The children answered this question by describing to what degree they were able to tell about their environmental visions through the game:

> I tried to make everything as fun as possible and I succeeded. The result was good. I dreamt that the dog-park would stay. (a girl who signed as "Adventure Forest")
>
> My dream was a quiet park with wild nature. My dream came true with the computer but I would like to wipe out the nettles. (a girl who signed as "A half-hectare forest")

The question concerning the mediation of the visions can be further examined by comparing the Internet design solutions to a description of an ideal environment produced through conceptual mapping. Haikkola (2001) asked 9- to 12-year-old children from the same Pihlajisto Elementary School to describe verbally the central features of both their current settings and those of an ideal one.

Although the object of design in the Internet game was a restricted area (the Adventure Forest) and Haikkola's study covered the whole neighborhood, the results shared the same direction. The importance of water play, nature, and diverse activities were conspicuous in both studies and in both methods. Similar results have been obtained in almost all Finnish studies of children's ideal environments (cf. Horelli et al., 1998). These items might

also be considered as some of the criteria that define a child-friendly environment.

Nevertheless, the use of affordances as elements of design works only if the types of affordances have been tailored according to the characteristics of the group under study. The classification of affordances, originally created by Heft (1988) and developed by Kyttä (2002b), was geared to the functional transactions of children under the age of 10. The classification might not function as well with older children, as the functional relationship with the environment will shift into a more social one with children more than the age of 12 (Chawla, 1992).

The affordance framework in the Internet-based design game probably creates a bias in the results toward an activity orientation. This can be explained by the fact that the concept of affordances is based on the tenets of ecological perceptual psychology, which accentuate the immediate and functional relationship with the environment. On the other hand, the application of verbal methods may stress environmental characteristics that are associated with cognitive conceptualizations of the setting, which seem to activate the perceptual channels of information processing. Participatory design and planning should be simultaneously supported by both approaches and different kinds of methods.

In any case, the Internet-based design game is just one of a large variety of enabling tools in design and planning (Horelli, 2002). Some of its advantages are ease of use and opportunities to reach a large number of children in a developed country like Finland (cf. Horelli & Kaaja, 2002). The design game also provides the professional designer with information that is compatible and clearly functional. For instance, the wish to have an opportunity to sit gives the designer more freedom than the description of a bench. Also, clusters of affordances (Heft, 2001) give the designer important information, as he or she will then understand those affordances that should be linked together in certain spaces. The weakness of this design game was that the analysis of the results did not take place automatically and needed manual work. It was also discovered that the Internet-based game was not suitable for all children, such as children with learning difficulties.

The professional designer of the Adventure Forest can take the children's designs as a starting point for further elaboration. The designer will be able to actualize children's preferred affordances through professional design and will be able to use the clusters of affordances located in different spaces as the building material for future behavior settings (cf. Heft, 2001). The physical form given to the behavior settings will be the responsibility of the adult designer. However, the information concerning the preferred affordances will legitimize and inspire the form-giving of the professional.

NOTES

1. Available at http://www.kaupunginosat.net/seikkailu/pelidata_uusi/peliselaus.html
2. Available at http://www.kaupunginosat.net/seikkailu/
3. The game contains five icons that represent affordances that are not much dealt with in this article. Information concerning the following affordances was not available in the data collected through interviews and questionnaires: being sheltered, being together, picnicking, adventuring, and more light/artificial light appliance. The optional icon, that is, the icon that can be freely described, will not be dealt with in this article. This is because the game was designed after the interviews were carried out, and it had wider objectives than this study.
4. The regression analysis also included the existing affordances. As could be expected, on the basis of the low correlation between the existing and designed affordances, the existing affordances did not significantly explain the variance of the designed affordances.

REFERENCES

Appleton, J. (1975). *The experience of landscape*. London: Wiley.

Barker, R. G. (1968). *Ecological psychology: Concepts and methods for studying the environment of human behaviors*. Stanford, CA: Stanford University Press.

Bonnes, M., & Secchiaroli, G. (1995). *Environmental psychology: A psycho-social introduction*. London: Sage.

Carp, F. M. (1987). Environment and aging. In D. Stokols, & I. Altman (Eds.), *Handbook of environmental psychology, Vol. 1* (pp. 329-360). New York: John Wiley.

Chawla, L. (1992). Childhood place attachments. In I. Altman & S. M. Low (Eds.), *Place attachment. Human behavior and environment. Advances in theory and research, Vol. 12* (pp. 63-86). New York: Plenum Press.

Chawla, L. (Ed.). (2002). Toward better cities for children and youth. In *Growing up in an urbanising world* (pp. 219-242). London: Unesco Publishing/Earthscan Publications.

Edwards, J. R., Caplan, R. D., & Van Harrison, R. (1998). Person-Environment Fit Theory: Conceptual foundations, empirical evidence, and directions for future research". In G. L. Cooper (Ed.), *Theories of organizational stress* (pp. 28-67). Oxford, UK: Oxford University Press.

Gibson, J. J. (1986). *The ecological approach to visual perception*. Hillsdale, NJ: Lawrence Erlbaum Associates. (Originally published in 1979)

Greeno, J. G. (1994). Gibson's affordances. *Psychological Review, 101*(2), 336-342.

Haikkola, L. (2001). *Lasten tulkintoja ympäristöstään. Pihlajiston ala-asteen oppilaat hyvän ympäristön määrittelijöinä" [The children of Pihlajisto as interpreters of a child-friendly environment]*. Unpublished manuscript, Helsinki University of Technology, The Centre for Urban and Regional Studies, Finland.

Heft, H. (1988). Affordances of children's environments: A functional approach to environmental description. *Children's Environments Quarterly, 5*(3), 29-37.

Heft, H. (1989). Affordances and the body: An intentional analysis of Gibson's ecological approach to visual perception. *Journal for the Theory of Social Behaviour, 19*(1), 1-30.

Heft, H. (1997). The relevance of Gibson's ecological approach to perception for environment-behavior studies. In G. T. Moore & R. W. Marans (Eds.), *Advances in environment, behavior, and design, Vol. 4* (pp. 71-108). New York: Plenum Press.

Heft, H. (2001). *Ecological psychology in context: James Gibson, Roger Barker, and the legacy of William James's radical empiricism.* Mahwah, NJ: Lawrence Erlbaum Associates.

Horelli, L. (1997). A methodological approach to children's participation in urban planning. *Scandinavian Housing and Planning Research, 14,* 105-115.

Horelli, L. (1998). Creating child-friendly environments: Case studies on children's participation in three European countries. *Childhood, 5*(2), 225-239.

Horelli, L. (2002). A methodology of participatory planning. In R. Bechtel & A. Churchman (Eds.), *Handbook of environmental psychology* (pp. 607-628). New York: John Wiley & Sons, Inc.

Horelli, L., & Kaaja, M. (2002). Opportunities and constraints of "Internet-assisted urban planning" with young people. *Journal of Environmental Psychology, 22*(1), 191-200.

Horelli, L., Kyttä, M., & Kaaja, M. (1998). *Lapset ympäristön ekoagentteina [Children as eco-agents of their environment].* Espoo, Finland: Teknillinen korkeakoulu, arkkitehtiosasto, julkaisu 49.

Horelli, L., & Vepsä, K. (1995). *Ympäristön lapsipuolet [Step-children of the environment].* Helsinki, Finland: ITLA.

Kaaja, M., Rantanen, H., & Horelli, L. (2002). *Web-pohjainen Pihlajiston Seikkailumetsän suunnittelupeli [An Internet-based design game for Pihlajisto Adventure Forest].* Unpublished research report, Espoo, Finland: YTK.

Kroeger, N. W. (1995). "Person-environment fit in the final jobs of retirees. *Journal of Social Psychology, 135*(5), 545-551.

Kunin, T. (1955). The construction of a new type of attitude measure. *Personnel Psychology, 8,* 65-77.

Kyttä, M. (2002a, July). *Children's independent mobility and the actualization of affordances: An intriguing relationship.* Paper presented at the International Association for Person-Environment Studies, Coruna, Spain.

Kyttä, M. (2002b). The affordances of children's environments. *Journal of Environmental Psychology, 22*(1), 109-123.

Little, B. R. (1983). Personal projects. A rationale and method for investigation. *Environment & Behavior, 15,* 273-309.

Meir, E. I., & Hasson, R. (1982). Congruence between personality type and environment type as a predictor of stay in an environment. *Journal of Vocational Behavior, 21,* 301-317.

Schneider, B. (2001). Fits about fit. *Applied Psychology: An International Review, 50*(1), 141-152.

SPSS for Windows. (2001). *Statistical Package for the Social Sciences (SPSS), Version 10.* Chicago, SPSS, Inc.

Stokols, D. (1979). A congruence analysis of human stress. In I. G. Sarason & C. D Spielberger (Eds.), *Stress and anxiety, Vol. 6* (pp. 27-53). New York: Wiley.

Wallenius, M. (1996). Arkiympäristön tuki hyvinvoinnin lähteenä. Henkilökohtaisten projektien näkökulma ihmisen ja ympäristön yhteensopivuuteen; yhteys elämäntyytyväisyyteen ja masentuneisuuteen [The support of the everyday environment as a source of well-being] (*Acta Universitas Tamperensis*, ser. A, vol. *530*). Vammala, Finland: Vammalan kirjapaino.

Wallenius, M. (1999). Personal projects in everyday places: Perceived supportiveness of the environment and psychological well-being. *Journal of Environmental Psychology, 19,* 131-143.

Zimring, C., Carpman, J. R., & Michelson, W. (1987). Design for special populations: Mentally retarded persons, children, hospital visitors. In D. Stokols & I. Altman (Eds.), *Handbook of environmental psychology, Vol. 1* (pp. 919-949). New York: John Wiley.