What am I doing in Timbuktu: Person–environment picture recognition for persons with intellectual disability

Henrik Danielsson, Jerker Rönnberg and Jan Andersson

Henrik Danielsson, Jerker Rönnberg and Jan Andersson, What am I doing in Timbuktu: Person–environment picture recognition for persons with intellectual disability, 2006, Journal of Intellectual Disability Research, (50), 2, 127-138.
http://dx.doi.org/10.1111/j.1365-2788.2005.00766.x

What am I Doing in Timbuktu:

Person-Environment Picture Recognition for Persons with Intellectual Disability

Henrik Danielsson and Jerker Rönnberg

The Swedish Institute for Disability Research

Linköping, Sweden

Jan Andersson

The Swedish Defence Research Agency

Linköping, Sweden

Abstract

Background The aim of this study was to examine the effects of familiarity of depicted persons and environments in recognition of photographs for pupils with different degrees of intellectual disability.

Method 45 pupils with intellectual disability participated.

Results An interaction effect between the 2 variables, person and environment, was found in addition to main effects for both the variables. Pictures of the test person himself or herself in familiar environments were easier to recognize than in unfamiliar environments, whereas the opposite was found for pictures of other familiar persons. No interaction effects of degree of intellectual disability were found.

Conclusions The interaction pattern is explained in terms of absent, present or implausible semantic associations between the person and the environmental context. The results are discussed in relation to augmentative and alternative communication with photographs.

Keywords: Intellectual disability, Picture recognition, Person recognition, Environment recognition, Familiarity

What am I Doing in Timbuktu: Person-Environment Picture Recognition for Persons with Intellectual Disability

Introduction

The purpose of this study was to examine the effect of familiarity in recognition of persons and environments depicted in photographs for pupils with different degrees of intellectual disability, that is, children attending special schools for persons with intellectual disability (ID) in Sweden.

Persons with ID commonly use picture or symbol systems for communication (Beukelman & Mirenda, 1998; von Tetzchner & Martinsen, 2000). Examples of such systems are Bliss and Picture Communication System (Johnson, 1981), often abbreviated PCS. In Scandinavia, an alternative or complement to traditional picture systems has started to be used more frequently; pictures taken with digital cameras (henceforth called photographs) (e.g., Hansen & Bruus-Jensen, 2000; Jönsson, Philipson, & Svensk, 1998; Jönsson & Svensk, 1995).

Some of the practical advantages of using photographs, compared to symbol systems, found by Danielsson and Svensk (2001), are that they are cheap to produce, easy to duplicate, easy to share with others (electronically by Internet or e-mail), and that they can depict something familiar to the user of the picture system (showing "my friend Mark" instead of "a man"). One disadvantage of photographs is that each person has his or her own personal pictures which sometimes required contextual knowledge to be meaningful to others. As the number of photographs grows over time, reorganization of the pictures is necessary. It can also be problematic to show abstract concepts, such as "any dog" instead of "a specific dog" (Danielsson &

Svensk, 2001), and they require computer and camera knowledge of the user or an assistant. Photographs taken with a digital camera are, compared to pictures in other picture systems, used in traditional ways as well as in new ways. They are, for example, used for planning (schedules), documenting activities, depicting situations of choice (photographs of different alternatives), and for enhancing self-awareness (Danielsson & Svensk, 2001). Photographs used for documentation of activities commonly show a person doing something in an environment. Typically, the person on the picture is the person him- or herself or a familiar person, but also unfamiliar persons can be depicted. This is the ecological motive for including the person-on-picture factor in this study, with pictures of (a) the test person him- or herself, (b) familiar persons, and (c) unfamiliar persons.

The present study is directed toward the part of picture-based communication that has to do with the ability to recognize the photograph to be used, in a larger set of photographs. Persons with ID using pictures taken with a digital camera have a lot of photographs. These could be rather similar to each other, since they often depict something familiar to the person and there are a limited number of familiar persons and environments. The photographs can be relatively newly taken or older, which makes this interesting to investigate in both a short-term and a long-term memory perspective. Thus, this study of picture recognition is relevant to picture-based communication with photographs, and is ecologically motivated from the perspective of persons with ID.

Type of Person

Persons have faces, and face recognition is special compared to other types of picture recognition (Elgar & Campbell, 2001). One part of the research on picture recognition is concerned with face recognition, of both unfamiliar faces (for a review

see Hancock, Bruce, & Burton, 2000) and familiar faces. One of the most cited models of face recognition was proposed by Bruce and Young (1986). This model predicts that familiar persons are easier to recognize than unfamiliar persons.

However, different studies of person familiarity and face recognition have used different operationalizations of the concept of familiarity. In some studies, number of exposures was the method of familiarization of previously unfamiliar test items to the participant (e.g., Dalton, 1993; Dubois et al., 1999; Thomson, Robertson & Vogt 1982). Other studies used celebrities as familiar persons (e.g., Proctor & Pick, 1999; Davies & Milne, 1982). Studies using pictures of persons who are personally related to the participant are rare. Baddeley and Woodhead (1982) argued that the method using equal number of exposures of unfamiliar persons is best since the degree of familiarity is equal for all face pictures. From an ecological point of view, this type of familiarity is not relevant for persons with ID in their use of photographs because their photographs often show persons with a personal relation to the person with ID, for example, their friends or themselves. Nevertheless, independently of the type of familiarity manipulation, the results of several studies showed that familiar persons were more easily recognized than unfamiliar ones, (e.g., Davies & Milne, 1982; Thomson, Robertson & Vogt, 1982).

The most familiar face for the participant is the participant's own face, which he or she usually sees in the mirror or in photographs, whereas other familiar faces are of persons that the participants know personally. This leads to two predictions; First, if the degree of person familiarity has an effect, which we predict, pictures of the participant him- or herself will be easier to recognize than pictures of other familiar persons. Secondly, we predict that when a lure picture consisting of a mirrored version of the encoded picture is present at retrieval, fewer errors will occur in

choosing the mirrored lure picture for target pictures of oneself, compared to other familiar persons.

Type of Environment

Many distinctions have been made regarding what context means in the process of picture recognition, and many have been influenced by the now 30-year-old encoding specificity principle (Tulving & Thomson, 1973). Glenberg (1979) made a distinction between specific cues and general cues at different levels of context. Baddeley and Woodhead (1982) distinguished between context independent of the target and interactive context. However, it is difficult to reach agreement on a set of criteria to decide whether a context is independent of the face to be recognized (Tiberghien, 1986).

Dalton (1993) made a similar distinction: local context comprises elements encoded uniquely to one or a few stimulus items, as opposed to global context, which is associated with many stimulus items such as a state of being under the influence of a drug or the environment in the test situation (for reviews see Dalton, 1993; Montoute & Tiberghien, 2001; Tiberghien, 1986). The present study is concerned with local context in Dalton's (1993) sense. Studies which have included a shift between encoding and retrieval of local context – such as clothing (e.g., Sporer, 1993; Thomson, Robertson & Vogt, 1982), background (e.g., Markham, Ellis, & Ellis, 1991; Thomson, Robertson, & Vogt, 1982), facial expression (e.g., Guillaume & Tiberghien, 2001; Markham, Ellis & Ellis, 1991) or semantic labels like occupation (Dalton, 1993) – all demonstrated a decrease in recognition accuracy, compared to not shifting.

Person and Environment

Davies and Milne (1982) manipulated background change and pose change between study and test in a face recognition test with pictures of both unfamiliar persons and familiar persons (celebrities). The results on the difference between unfamiliar and familiar persons when neither (unfamiliar) background nor pose is changed between study and test are not presented. However, using the numbers given in their study we have calculated this result, and there is a tendency that familiar persons are easier to recognize than unfamiliar ones, $t(38) = 1.70$, $p < .10$. Since pictures of unfamiliar environments (backgrounds) were used, the prediction for the present study would be that, in unfamiliar environments, oneself and familiar persons are more easily recognized than unfamiliar persons. Thomson, Robertson & Vogt (1982) found in a similar study similar results, but a striking ceiling effect (100% hits for familiar persons and 98% for unfamiliar) prevented valid conclusions.

Regarding person recognition in a familiar environment, two alternative predictions can be made. First, that familiarity is the important factor, meaning that familiarity of both person and environment optimizes performance. Alternatively, a figure-ground effect may constitute the basis for the prediction: a familiar person in an unfamiliar environment is the easiest condition. These alternatives will later be referred to as the familiarity hypothesis and the figure-ground hypothesis.

Intellectual Disability

We have not found any previous study of both person and environment factors in picture recognition for persons with ID. Nevertheless, the level of ID is predicted to influence the results in such a way that less severity means better picture recognition. There is no theoretical rationale for making predictions regarding interactions with the other variables.

Long-Term Picture Recognition

Dobson and Rust (1994) presented pictures of unfamiliar persons and objects for persons with ID and controls matched on chronological and mental age, respectively. Persons with ID needed as many trials as the mentally age-matched controls to learn to recognize all pictures, but the chronologically age-matched controls needed significantly fewer trials. However, there was no difference between the three groups regarding recognition of the pictures of the unfamiliar faces one week, one month, and two months after encoding. It seems that once the picture is encoded there will be no difference in the forgetting rate due to intellectual disability. Therefore, in the present study, in a retest after a week, no difference due to degree of ID is predicted for the pictures previously chosen correctly in the short-term picture recognition task. However, for pictures not correctly chosen in the short-term picture recognition task, persons with severe ID are expected to show lower performance than persons with less severe ID.

Research Questions and Predictions

The two research questions for this study are:

How will the three factors 1) familiarity of the person in the picture, 2) familiarity of the environment in the picture, and 3) the degree of intellectual disability, influence the accuracy in short-term picture recognition? How will the degree of intellectual disability influence the accuracy in long-term picture recognition?

The predictions regarding the research questions are summarized here: In short-term picture recognition, an effect of degree of familiarity of person in picture is predicted. Unfamiliar persons are predicted to be more difficult to recognize than familiar persons, who are more difficult to recognize than oneself. For the person-by-environment interaction, there are two alternative predictions: the familiarity

hypothesis predicts that more familiarity yields better performance; and the figure-ground hypothesis predicts that a combination of a familiar and an unfamiliar part gives the best performance. It is also predicted that fewer errors will occur when choosing a mirrored lure picture for target pictures of oneself, compared to other familiar persons. The level of ID is only predicted to influence the results generally such that less severity means better picture recognition.

In the long-term picture recognition test phase, no difference due to degree of ID is predicted for the pictures previously chosen correctly in the short-term picture recognition task. However, for pictures not correctly chosen in that task, persons with severe ID are expected to show lower performance than persons with less severe ID.

Method

Participants

In Sweden, all children and youths between the ages of 7 to 16 years with ID attend either compulsory school for pupils with intellectual disabilities (CSID) or training school (TS). Persons in CSID have mild to moderate ID whereas TS is for pupils with severe intellectual disabilities which prevent them from benefiting from the education given in CSID (The Swedish National Agency for Education, 2005).

All the 58 pupils, who attended either CSID or TS in a school in southern Sweden, were asked to participate. A letter was sent to them and their parents. Nine pupils did not want to participate and one chose to withdraw half-way through the study. Neither the experimenter nor the pupil's personal assistant could explain the instructions in an understandable manner for two pupils, and finally, one pupil did not complete all tests in the study due to problems with test administration. All in all, 45 pupils were included in the study. Four persons did not participate in the long-term

picture recognition task due the administration of the test, but were included in the other tasks of the study (see below).

The distribution of the background variables sex, age, and IQ, assessed with coloured progressive matrices (Raven, Court, & Raven, 1995), divided on the CSID and the TS group can bee seen in Table 1. IQ was assessed at a later testing where only 24 participants (11 in the CSID and 13 in the TS group) were testable, mainly due to migration or to not getting a written consent from the parents. However, there were no significant difference in results between the group that participated in the IQ test and the group that did not. Neither were there any interactions with any other variable in this study. Also, a division into two groups based on IQ resulted in the same significant effects and result pattern as the present division based on school belongingness. All participants had normal, or corrected to normal, hearing and vision.

Table 1: The background variables sex, age, and IQ divided on the two groups of pupils either belonging to the compulsory school for persons with learning disability or the training school

	Sex		Age		IQ	
	Boys	*Girls*	*M*	*SD*	*M*	*SD*
Compulsory school	11	12	12.9	2.0	51.9	10.0
Training school	13	9	13.1	2.4	43.5	7.3

Tasks

The study consisted of three types of tasks: two screening tasks, one short-term recognition task, and one long-term recognition task.

The first screening task was to recognize oneself among six test pictures. This was included to be sure that the participant actually could recognize him- or herself. The second screening task was a picture-matching task: one target picture was to be matched with one of three pictures. There were three purposes with this task: first, to control that the participant managed to match two identical pictures; second, to check that the participant understood the instruction; and third, to learn the procedure, since a similar procedure was used later in the short-term picture recognition task (STPRT). The STPRT was the primary task in this study. In the long-term picture recognition task (LTPRT) the participants should judge whether a presented picture had been presented in the STPRT.

Test Pictures

The test pictures used in this experiment were created by combining two photographs of different types; an indoor environment as the background and a person (cropped from the rest of the photograph from chest upward) as the foreground, using Adobe Photoshop 5.5. All pictures were shown in color at size 7 × 7 cm on a Hewlett Packard Omnibook 6000.

In the STPRT, a total of 72 encoding pictures were used. The pictures were produced by orthogonally combining 12 photographs from the three person-on-picture conditions and the two environment-on-picture conditions ($12 \times 3 \times 2 = 72$).

A familiar person in picture was operationalized as a class mate, and the familiar environment was operationalized as the participants' school environment. Note that no test picture had any previous episodic memory associated with it, due to combining a person in picture and an environment in picture from different photographs. This precautionary measure was especially important for the self-conditions.

Four types of lures were used in the STPRT: (1) correct person in false unfamiliar environment, (2) false unfamiliar person in correct environment, (3) false unfamiliar person in false unfamiliar environment, and (4) mirrored correct picture. The 216 retrieval lures were created by parts of the encoding pictures and other photographs of previously unseen, unfamiliar persons and environments. For both the encoding pictures and the lures, 50% of the new unfamiliar persons were girls and 50% were boys, all approximately the same age as the participants.

The encoding and lure pictures in the picture-matching task were made in the same way. In the recognize-yourself task, one photograph of the participant was used.

In the LTPRT, 11 of the encoding pictures from the STPRT showing unfamiliar persons in unfamiliar environments were used plus 11 new unfamiliar persons in new unfamiliar environment pictures. The reason for only choosing this condition was to eliminate the effects of seeing the test picture's person or environment in a photograph during the week since the STPRT. Only 11 of 12 test pictures in this condition were used due to technical problems.

Procedure

To avoid effects of exhaustion or lack of motivation, the tests were completed in three separate sessions. The tests at the first two sessions consisted of the same parts, and they were completed within three days. In the third session, one week after the second session, the LTPRT was completed.

The participant was picked up in his or her classroom by the experimenter and accompanied to another room in the school. Before the test started, the participants were asked if they could handle a mouse. Thirty-one participants said yes and, consequently, used the mouse throughout the test. Participants who said no, pointed at the screen and the experimenter clicked the mouse where the participant pointed. Of

the 14 participants who did not use the mouse, 10 belonged to the TS group. No significant effect regarding ability to use the mouse could be found in the recognition results.

Each task started with that the experimenter gave a briefing of what to do. After he had demonstrated the task, the participant was asked if she or he understood what to do. If not, the instructions were explained again and, if the participant had a personal assistant, the latter was asked to assist in the explanation. If the instruction still was not understood, the person was excluded from the study.

Completion of the recognize-yourself task, which all participants managed, was followed by the picture-matching task. The matching procedure started with showing a picture at the top of the screen. The participant clicked the picture when she or he was ready. Three potential matching pictures were then shown at the bottom of the screen. The pictures were the correct picture plus two out of the four possible lures. All participants had the same sequence of lures, and this sequence was balanced for picture position, the order in which the pictures were shown, and the number of presentations of each lure.

A relatively common criterion for determining the capacity to recognize graphic symbols (Keogh & Reichle, 1985; Mirenda & Locke, 1989; Reichle & Keogh, 1985) is 80% or more matches between object and picture, which is also in line with more recent studies (e.g. Furniss, Lancioni, Rocha, Cuncha, Seedhouse, Morato, & O'Reilly, 2001; Sigafoos, O'Reilly, Seely-York, & Edrinsinha, 2004). Hence, being able to match five consecutive pairs of pictures was set as the criterion for matching ability. If the participant reached the criterion, she or he went on to the STPRT; otherwise she or he had to complete all 18 pictures before continuing. Eleven participants needed all 18 pictures during at least one session to complete the task.

Therefore, the picture-matching task was not used as a screening task, and all 45 persons were included in the analysis of the STPRT.

In the STPRT, the procedure was the same as in the picture-matching task with a few exceptions: When the picture used at encoding was clicked on, the picture disappeared, and a harp sound was heard 3.0 seconds before the three retrieval pictures were shown at the bottom of the screen. The sound was included to help maintain the focus of attention to the computer as pretests with three persons without sound showed that this was a problem. With the sound, the participants focused much better on the computer. The sound was chosen to carry minimal semantic information. All pictures in the test had to be completed.

In the LTPRT, participants were shown one test picture at a time and were asked whether they had seen the picture before. They answered by clicking a green button on the screen labeled "Yes" (in Swedish) or a red button labeled "No", and then the next test picture was shown immediately.

Design

The design of the STPRT was a 2 × 3 × 2 split plot factorial design. The first factor refers to the between-participant variable group (CSID or TS). The second factor refers to the within-participant variable of person in picture (self, familiar or unfamiliar). The third factor refers to the within-participant variable of environment in picture (familiar or unfamiliar).

Results

The main dependent variables in the STPRT were hits (scored as 1 if correct picture was chosen) and d'. d' is a signal detection theory measure that captures the ability to discriminate between old and new items in relation to their common standard deviation (Snodgrass & Corwin, 1988). Simply put, d' is adjusted for

guessing. To analyze the results further, two other dependent variables were used: time at picture encoding and reaction time at retrieval. All dependent variables were analyzed with analysis of variance (ANOVA). All a priori mean comparisons were made with *t* tests, and a posteriori mean comparisons were made with Tukey's HSD test. Age effects were analyzed with a separate ANOVA, with the total number of hits as the dependent measure, and age as between-groups variable. In the LTPRT, the dependent variable was *d′*. The alpha level was set at .05 for all statistical tests used throughout the study. The data for the STPRT had a reliability of 0.94, as measured by Cronbach's alpha.

The ANOVA on recognition hits (see Table 2 for means and standard deviations) for the STPRT revealed significant main effects for person in picture, $F(2, 86) = 3.71$, $p < .05$, partial $\eta^2 = .08$ (Huynh-Feldt corrected), environment in picture, $F(1, 43) = 4.07$, $p < .05$, partial $\eta^2 = .09$ and group, $F(1, 43) = 12.41$, $p < .01$, partial $\eta^2 = .22$. All interactions were nonsignificant. A priori *t* tests showed that unfamiliar persons were significantly more difficult to recognize than familiar persons, $t(90) = 3.46$, $p < .01$ and self, $t(90) = 3.21$, $p < .01$.

Table 2: Mean performance in percent and standard deviation for the three independent variables combined: person in picture, environment in picture, and group

	Person					
	Self		Familiar		Unfamiliar	
Environment	*M*	*SD*	*M*	*SD*	*M*	*SD*
Compulsory school for persons with learning disability						
Familiar	82.6	17.2	80.1	18.6	83.0	19.7
Unfamiliar	77.5	19.4	80.1	14.4	76.1	17.5
Training school						
Familiar	68.6	17.0	65.5	19.6	59.8	17.0
Unfamiliar	63.3	15.6	67.4	18.7	58.3	21.5

The *d'* ANOVA showed a significant main effect for person in picture, $F(2, 86) = 11.45$, $p < .001$, partial $\eta^2 = .21$ (Huynh-Feldt corrected) and group $F(1, 43) = 12.16$, $p < .01$, partial $\eta^2 = .22$, and an interaction effect for person by environment $F(2, 86) = 6.72$, $p < .01$, partial $\eta^2 = .14$ (Huynh-Feldt corrected) (see Figure 1). A priori *t* tests of our predictions regarding the person showed that they were partially confirmed; unfamiliar persons were significantly more difficult to recognize than familiar persons, $t(90) = 5.86$, $p < .001$ and self, $t(90) = 5.90$, $p < .001$. However, oneself was not more easily recognized than other familiar persons. All the simple effects in the interaction were significant, except two: for unfamiliar persons there was no difference regarding environment, and for familiar environments there was no difference between familiar and unfamiliar persons. This means that neither the familiarity hypothesis nor the figure-ground hypothesis for the person-by-environment interaction was confirmed. The results for all conditions were significantly higher than zero, $t(44) = 5.48$, $p < .00001$ for the condition with the lowest performance, meaning that performances were better than guessing.

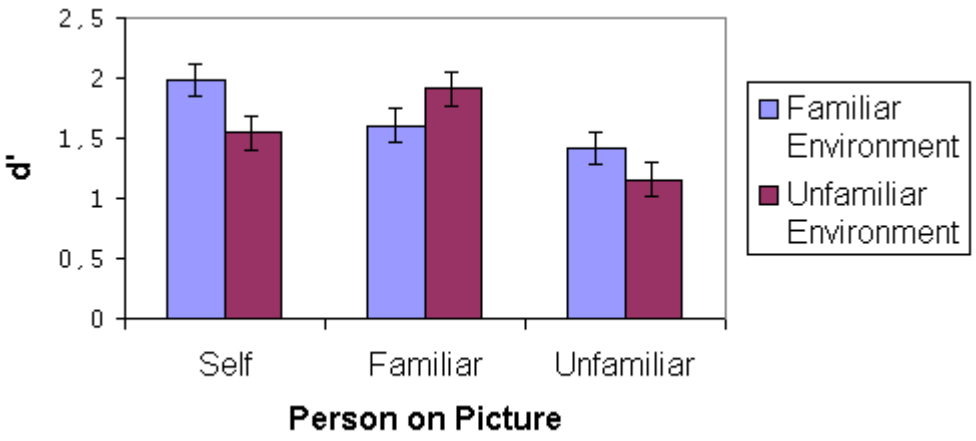

Figure 1. Person by environment interaction in the ANOVA on d' with standard error marked on the bars.

The ANOVA on encoding time revealed significant differences only for person, $F(2, 86) = 8.90$, $p < .001$, partial $\eta^2 = .17$ (Huynh-Feldt corrected), where the self-pictures were looked at during a longer time than the pictures of familiar, $t(90) = 3.94$, $p < .05$, and unfamiliar persons, $t(90) = 4.65$, $p < .05$, and for the person by environment interaction, $F(2, 86) = 3.21$, $p < .05$, partial $\eta^2 = .07$ (Huynh-Feldt corrected). The interaction pattern was similar to the one in the d' ANOVA (i.e., short encoding time equaled high recognition rate), with the difference that both self-conditions were looked at much longer than the other conditions. The ANOVA on reaction time revealed no significant results.

The most chosen lure was the mirrored correct picture (57.8%), followed by the correct person in another environment (29.6%). The mean performances of chosen lure types are shown in Table 3. The result indicates that the person was more important than the environment in retrieval, since the correct person in another environment was more often chosen than another person in the correct environment. One prediction was that there would be fewer errors in choosing a mirrored lure picture for pictures of oneself compared to other familiar persons. For self as stimulus, the mirrored picture was chosen 1.99 times out of 12, and for familiar persons 1.94 times. The difference was nonsignificant, and also in the wrong direction; the prediction was therefore not supported.

Table 3: Mean performance (out of 72 pictures), standard deviation, and distribution in percent of chosen lure types

Lure type	*M*	*SD*	Percent
Mirrored correct picture	11.64	5.70	57.8
Correct person in another environment	5.96	4.69	29.6
False person in correct environment	1.31	2.43	6.50
False person in false environment	1.22	3.04	6.08

An a posteriori analysis gave no significant differences for sex. Neither could a significant age effect be found. The nonsignificant pattern showed that there was much fluctuation in the results both between individuals and between ages 11−16, which was in line with some, but not all, of the literature (Chung, 1995).

Table 4 presents *d′* from the LTPRT based on correct or false response in the STPRT and group. The CSID group performed better than the TS group both for the pictures that were previously chosen correctly in the STPRT and for the pictures not chosen previously. This was not in line with our predictions, since a difference only for the pictures not chosen previously was expected.

Table 4: d' from the long-term picture recognition task (LTPRT) based on correct or false responses in the short-term picture recognition task (STPRT), and group

	Group		
Response in STPRT	TS	CSID	Total
Correct	1.12	2.36	1.71
False	1.13	2.25	1.58
Total	1.12	2.33	1.66

To conclude, the predictions confirmed were: (a) unfamiliar persons were significantly more difficult to recognize than familiar persons and oneself; (b) the CSID group performed generally better than the TS group; (c) there was a difference in performance between groups differing in ID in the LTPRT, for the pictures not chosen previously in the STPRT. The other predictions were not confirmed.

Discussion

Person by Environment Interaction

As the person by environment interaction is significant, the main effects for person and environment are not discussed further. Neither the familiarity hypothesis nor the figure-ground hypothesis gains full support from the data, thus another explanation is needed. Klee *et al*. (as cited in Memon & Bruce, 1985–86) concluded that it is not the change of context per se that produces a decrement in the recognition of unfamiliar faces, but the absence of a significant association between encoding and test context. Our explanation for the person by environment interaction adopts a similar semantic argument, but we argue in terms of a present, absent, or implausible association between person and environment conditions. Also, the similarity of the person by environment interactions in the ANOVAs on *d'* and encoding time, where shorter encoding time equals better recognition, indicates that different conditions are processed in different ways.

The overall interpretation of the interaction is as follows: when a familiar person in a familiar environment is to be remembered, and an association between the particular person and the particular environment is present, a "lazy", fast semantic recognition strategy is presumably used for encoding, that is, remembering "John in the dining room". When the association between the person and environment conditions is absent, that is, a familiar person in an unfamiliar environment, a more laborious episodic memory strategy, with details from the encoded picture, is presumably used.

However, for the pictures with a familiar person in an unfamiliar environment, there is no chance that the participant could know all environments that the familiar person has been in; but this should be known for him- or herself. Thus, the difference between present and implausible associations of person and environment is especially

large in self-conditions. Since all our pictures is manipulated not to have previous episodic memories attached to them, there will be a difference between what is implausible to remember and what actually is remembered – for example, when seeing a picture of oneself in an unfamiliar environment and thinking "what am I doing in Timbuktu, I have never been there". This causes the relatively low performance for self in unfamiliar environments. These presumed implicit strategies, in combination, explain the results of the interaction. It is worth noticing that performance for all conditions was better than guessing, which means that the above reasoning always should be applied together with a nonsemantic explanation for the base-line performance.

Reaction Time

Schweich, Schreiber, Rousset, Bruyer & Tiberghien (1991) found longer reaction times for famous persons when the environment in picture was incongruent with the person, compared to congruent and neutral environments, for three tasks: a familiarity decision, a semantic decision, and a naming task. Therefore, the non-result in our study concerning reaction time is surprising. One possible explanation could be the differences in tasks. In our study, the pictures are first encoded, and at the second exposure the reaction time is measured, as opposed to the study by Schweich et al. (1991) where the reaction time is measured at the first (and only) exposure. Therefore, a more appropriate comparison could be between their reaction time and the encoding time in the present study. Doing so, our results for encoding time for pictures of self in known environments (present association between person and environment conditions) and unknown environments (implausible association) are in line with the results of Schweich et al.

Thus, the study of picture recognition in persons with ID does not follow the predictions drawn from the literature. The theoretical contribution is that when theorizing about semantic aspects of environmental context for persons with ID, not only facilitative but also plausibility aspects of the semantic memory must be addressed.

Implications for Photographs in Augmentative and Alternative Communication

One of the motives for this study was to investigate how the person and environment variables influence picture recognition and the implications for the use of photographs in augmentative and alternative communication for persons with intellectual disability. The ability to recognize pictures is most important in the process of choosing the preferred photograph to use among many other photographs. One example of the use of photographs is in documentation activities, that Danielsson and Svensk (2001) showed was a common activity among persons with ID: You are not able to read and want to talk about what Steven did on the excursion last summer and chose a photograph of Steven from another excursion instead of the right one. It is not unusual that the person you want to talk to has more information than you do about the photograph, e.g. if the photograph or the folder that contains the photograph has a name, this designates the context for the person you are talking to. This small difference for you between the photographs can lead to a very different interpretation for the person you talk to.

The results in this study can be interpreted such that the photograph should depict something that is familiar to the user in order to be easy to recognize. Especially familiar persons, including the user him- or herself, are easy to recognize. There seems to be a difference between photographs with absent, present or implausible associations between the person and the environment on the picture. This should have

implications for how the photographs are organized. Pictures where the association between the person and the environment on the picture is present could be in the same folder without creating much recognition problems. Pictures with absent or implausible associations are more important to organize in a way that the user can see and understand which contexts the pictures are taken in. One way of doing this could be to organize this type of picture by situation so that each folder has an "icon" that clearly shows something unique for this situation, and also that the other pictures in the folder give the context to prevent similar pictures from another context being chosen.

These are some implications drawn from the perspective of picture recognition. However, more research is needed to investigate other abilities important for picture communication and also to evaluate whether the implications drawn here are valid in a more complex ecological setting.

Control Group

We had several reasons for not including an extra control group of persons without ID. First, we believe that not finding any interactions with group is a control in itself, since there is the same pattern in the results independently of degree of ID. The best children had such a high accuracy rate that a control group matched for age with participants without ID would have had an accuracy rate higher than 97% (estimated by using the mean of the five best-performing participants in this study). The ceiling effect would make the inclusion of control participants essentially worthless. A control group matched on average performance in the test (estimated age, 4–6 years) has other theoretical and methodological drawbacks. Adults are better at recognizing and matching familiar faces from the internal features than the external (Carey & Diamond, 1977), whereas children (under the age of 10) are more accurate

at recognizing familiar faces from their external features. Recent research has even found the adult pattern with 7-year-olds (Bonner & Burton, 2003). This means that such a potential control group would process the pictures in a qualitatively different way. In addition, there would be a need for a totally new stimulus material, since no children at that age attend the school investigated in this study (or any similar school), so they do not recognize the familiar persons or environments used in the test. Needless to say, with two different sets of material it is impossible to tell whether observed differences depend on the material or differences between the groups. Besides that, our motivation for this study was to focus on persons with ID and their abilities for using picture-based communication.

Reliability

The data of the STPRT has high reliability, 0.94 as measured by Cronbach's alpha. In the present study several measures are also been used to statistically control for confounding factors like IQ, mouse skill, sex and age. One way to enhance experimental control could be to use a procedural reliability estimates (Billingsley, Munson & White, 1980), where an independent judge estimates how well the procedure is followed. We believe, however, that if another unknown person is present at the test, this could instead make the test situation a bit more stressful and unnatural for the participant. Consequently, the results could have been influenced by this, so in the trade-off between reliability and validity, a procedural reliability check was not deemed necessary in this study

Stimulus Materials

Different studies (Baddeley & Woodhead, 1982; Bruce, 1982; Hay & Young, 1982) present a criticism of using identical pictures at encoding and retrieval, namely that picture recognition per se rather than face recognition is studied. This might be

valid, but in the ecological context of picture-based communication, the relevant task is to recognize an identical picture among several similar ones, after previous encoding. Therefore, the present study uses identical pictures at encoding and retrieval.

Finally, the viewpoint of the person in the picture affects the recognition rate. An angled view, the so-called ¾ viewpoint or canonic perspective, gives the highest recognition rate both when changing viewpoint between encoding and test (for a review see Hancock, Bruce, & Burton, 2000) and when not changing viewpoint (O'Toole et al., 1998). In our test, the viewpoint is not controlled for systematically. But the pictures do not have very different viewpoints, so we believe that the effect of different viewpoints is insignificant, since many pictures with slightly different viewpoints is used in every condition.

Conclusions

In sum, this study is providing new knowledge about picture recognition of persons and environments by persons with ID. The most important theoretical contributions from the study are the interpretation of the interaction between person and environment and the use of pictures of the participant him- or herself. The relatively low performance for pictures of the participant in unfamiliar environments is explained by the implausible association between the person and environment conditions, as if to say "what am I doing in Timbuktu, I have never been there" (Danielsson, Rönnberg & Andersson, 2004). We argue that this improves our understanding of what type of photographic pictures to prefer in picture-based communication for persons with ID. If the intended photograph depicts a person and and environment with an existing association between them, it enhances the

possibility of ensuring that the correct picture is chosen, independently of degree of ID.

References

Baddeley, A., & Woodhead, M. (1982). Depth of processing, context and face recognition. *Canadian Journal of Psychology, 36,* 148–164.

Beukelman, D. R., & Mirenda, P. (1998). *Augmentative and alternative communication: Management of severe communication disorders in children and adults* (2nd ed.). Baltimore, MD: Brookes.

Billingsley, F., White, O. R., & Munson, R. (1980). Procedural reliability: A rationale and an example. *Behavioral assessment*, *2*, 229–241.

Bonner, L., & Burton, A. M. (2003). Do children process faces in the same way as adults?. In T. Bajo & J. Lupiáñez (Eds.), *Book of abstracts: XIII conference of the European Society of Cognitive Psychology* (pp. 358–359). Granada, Spain: Universidad de Granada.

Bruce, V. (1982). Changing faces: Visual and non-visual coding processes in face recognition. *British Journal of Psychology, 73,* 105–116.

Bruce, V., & Young, A. (1986). Understanding face recognition. *British Journal of Psychology*, *77*, 305–327.

Carey, S. & Diamond, R. (1977). From piecemeal to configurational representation of faces. *Science*, *195*, 312–313.

Chung, M-S. & Thomson, D. M. (1995). Development of face recognition. *British Journal of Psychology*, *86*, 55–87.

Dalton, P. (1993). The role of stimulus familiarity in context-dependent recognition. *Memory & Cognition*, *21*, 223–234.

Danielsson, H., Rönnberg, J., & Andersson, J. (2004). That's me in Beijing: Person and environment picture recognition for pupils with intellectual disability. *International Journal of Psychology*, *39*, *5–6*(Suppl. S), 114.

Danielsson, H. & Svensk, A. (2001). Digital pictures as cognitive assistance. In Ĉ. Marinĉek, C. Bühler, H. Knops & R. Andrich (Eds.), *Assistive technology research series: Vol. 10. Assistive technology: Added value to the quality of life* (pp. 148–152). Amsterdam: IOS Press.

Davies, G., & Milne, A. (1982). Recognizing faces in and out of context. *Current Psychological Research, 2,* 235–246.

Dobson, E., & Rust, J. O. (1994). Memory for objects and faces by the mentally retarded and nonretarded. *Journal of Psychology, 128,* 315–322.

Dubois, S., Rossion, B., Schiltz, C., Bodart, J. M., Michel, C., Bruyer, R., & Crommelinck, M. (1999). Effect of familiarity on the process of human faces. *NeuroImage, 9,* 278–289.

Elgar, K., & Campbell, R. (2001). Annotation: The cognitive neuroscience of face recognition: Implications for developmental disorders. *Journal of Child Psychology and Psychiatry and Allied Disciplines, 42,* 705–717.

Furniss, F., Lancioni, G., Rocha, N., Cuncha, B., Seedhouse, P., Morato, P., & O'Reilly, M. F. (2001) VICAID: Development and evaluation of a palmtop-based job aid for workers with severe developmental disabilities. *British Journal of Educational Technology*, *32*, 277–287.

Hansen, P., & Bruus-Jensen, L. (2000). *Digitale billede: En nødvendig kommunikationsform* [Digital pictures: A necessary form of communication]. Roskilde, Denmark: Førlaget Udvikling.

Glenberg, A. M. (1979). Component-levels theory of the effects of spacing of repetitions on recall and recognition. *Memory & Cognition*, *7*, 95–112.

Guillaume, F., & Tiberghien, G. (2001). An event-related potential study of contextual modifications in a face recognition task. *Neuroreport, 12,* 1209–1216.

Hancock, P. J. B., Bruce, V., & Burton, A. M. (2000). Recognition of unfamiliar faces. *Trends in Cognitive Sciences, 4,* 330–337.

Hay, D. C., & Young, A. M. (1982). The human face. In A. W. Ellis (Ed.), *Normality and pathology in cognitive functions* (pp. 173–202). London: Academic Press.

Johnson, R. (1981). *The picture communication symbols.* Solana Beach, CA: Mayer-Johnson Co.

Jönsson, B., Philipson, L., & Svensk, A. (1998). *What Isaac taught us.* Lund, Sweden: Certec, Center for Rehabilitation Engineering Research, Lund University.

Jönsson, B., & Svensk, A. (1995). Isaac: A personal digital assistant for the differently abled. In I. Placencia Porrero & R. Puig de la Bellacasa (Eds.), *The European context for assistive technology: Proceedings of the 2nd TIDE congress* (pp. 356–361). Amsterdam: IOS Press.

Keogh, W. J., & Reichle, J. (1985). Communication intervention for the "difficult-to-teach" severely handicapped. In S. F. Warren & A. Rogers-Warren (Eds.), *Teaching functional language* (pp. 157–194). Austin, TX: Pro-Ed.

Markham, R., Ellis, D., & Ellis, H. (1991). The effect of context change on children's recognition of unfamiliar faces. *British Journal of Developmental Psychology, 9,* 513–520.

Memon, A., & Bruce, V. (1985–86). Context effects in episodic studies of verbal and facial memory: A review. *Current Psychological Research & Reviews,* Winter, 349–369.

Mirenda, P., & Locke, P. (1989). A comparison of symbol transparency in nonspeaking persons with intellectual disabilities. *Journal of Speech and Hearing Disorders, 54,* 131–140.

Montoute, T. & Tiberghien, G. (2001). Unconscious familiarity and local context effects on low-level face processing: A reconstruction hypothesis. *Consciousness and Cognition*, *10*, 503–523.

O'Toole, A. J., Edelman, S., & Bülthoff, H. H. (1998). Stimulus-specific effects in face recognition over changes in viewpoint. *Vision Research, 38*, 2351–2363.

Proctor, R. W., & Pick, D. F. (1999). Deconstructing Marylyn: Robust effects of face contexts on stimulus–response compatibility. *Memory & Cognition, 27,* 986–995.

Raven, J. C., Court, J. H., & Raven, J. (1995). *Raven Manual: Section 2. Coloured Progressive Matrices*. Oxford: Oxford Psychologists Press.

Reichle, J., & Keogh, W. J. (1985). Communication intervention. In S. F. Warren & A. Rogers-Warren (Eds.), *Teaching functional language* (pp. 27–59). Austin, TX: Pro-Ed.

Schweich, M., Schreiber, A.-C., Rousset, S., Bruyer, R., & Tiberghien, G. (1991). Effects of meaning of visual context on semantic processing of famous faces. *Cahiers de Psychologie Cognitive, 11,* 55–71.

Sigafoos, J., O'Reilly, M., Seely-York, S., & Edrisinha, C. (2004). Teaching students with developmental disabilities to locate their AAC device. *Research in Developmental Disabilities*, *25*,371–383.

Snodgrass, J. G., & Corwin, J. (1988). Pragmatics of measuring recognition memory: Applications to dementia and amnesia. *Journal of Experimental Psychology: General, 117,* 34–50.

Sporer, S. L. (1993). Clothing as a contextual cue in facial recognition. *The German Journal of Psychology, 17,* 183–199.

The Swedish National Agency for Education (2005). *Education for pupils and adults with learning disabilities.* Retrieved May 11, 2005, from http://www.skolverket.se/sb/d/374/a/1215.

Tiberghien, G. (1986). Context effects in recognition memory of faces: Some theoretical problems. In H. D. Ellis, M. Jeeves, F. Newcombe & A. W. Young (Eds.), *Aspects of face processing* (pp. 88–104). Dordrecht, Netherlands: Nijhoff in cooperation with NATO Scientific Affairs Division.

Thomson, D. M., Robertson, S. L., & Vogt, R. (1982). Person recognition: The effect of context. *Human Learning, 1,* 137–154.

Tulving, E., & Thomson, D. M. (1973). Encoding specificity and retrieval processes in episodic memory. *Psychological Review, 80,* 352–373.

von Tetzchner, S., & Martinsen, H. (2000). *Introduction to augmentative and alternative communication* (2nd ed.). London: Whurr.

Author note

This research was financed by the Swedish Defence Research Agency. We thank teachers, pupils, and other personnel at the participating school for their collaboration.

Correspondence concerning this article should be addressed to Henrik Danielsson, Department of Behavioural Sciences (IBV), Linköping University, 581 83 Linköping, Sweden, or Henrik.danielsson@liu.se.