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DEVELOPMENTAL DIFFERENCES IN THE ABILITY TO GIVE ROUTE DIRECTIONS FROM A MAP

MARK BLADES AND LOUISE MEDLICOTT

Department of Psychology, University of Sheffield, Sheffield S10 2TN, U.K.

Abstract

The ability to give accurate route directions is an important way of expressing environmental information, but the development of this ability has received little attention, therefore an experiment was designed to assess how children and adults gave route directions from a map. In an extension of a previous, small scale, experiment (Brewster & Blades, 1989 *Journal of Environmental Education and Information*, **8**, 141–156). Four groups of children (aged 6, 8, 10, and 12 years) and one group of adults described two routes from maps and the route descriptions were assessed for both their accuracy and content. The six and eight year olds were unable to give correct route directions, but a few of the ten year olds and many of the 12 year old children were able to provide directions for most of the route, and all the adults gave accurate route descriptions from the maps. Analyses were carried out on the content of the descriptions, the effect of the presence of landmarks at turns on the route, and the effects of direction of travel when approaching turns. The main finding was a major developmental contrast in the style and content of the descriptions: the younger children relied predominantly on landmarks and vague indications of direction; the older children and adults included information about the type of road junction at the turn and about the road sequence (e.g. 'first left', 'second right'). The implications of the results for further research are discussed.

Introduction

An individual's environmental cognition may be expressed in different ways. Researchers have used several methods to externalize individuals' knowledge of the environment—for example, subjects have been asked to give verbal or written descriptions, draw sketch maps, estimate directions, judge distances and recognize photographs (Golledge, 1987; Heft & Wohlwill, 1987; Spencer *et al.*, 1989). But outside the laboratory the most common situation which involves the externalization of a cognitive representation is when one person asks another for information about how to find the way through the environment.

Successful wayfinding in an unfamiliar area may depend on information which is part of the environment (e.g. sign posts) or on information which is additional to the environment (e.g. maps)—see Blades (1989). But most frequently it depends on asking for directions from other people who are assumed to be more familiar with the environment (Petchenik, 1985; Mark & McGranaghan, 1988). Several surveys and experiments have shown that adults often rely on verbal or written directions (e.g. Gordon & Wood, 1970; Lunn, 1978) and that adults can use directions very effectively (e.g. Streeter *et al.*, 1985; Kovach *et al.*, 1988; Kirasic & Mathes, 1990). Adults are also very proficient at giving accurate directions (Hill, 1987).

Although there have been several studies of how adults give directions most of these studies have concentrated on direction giving as a form of communication (Psathas & Henslin, 1967; Psathas & Kozloff, 1976; Klein, 1982; Wunderlich & Reinelt, 1982; Psathas, 1987). These studies have described the pattern or sequence of communication which takes place when people ask for directions with the emphasis on the structure of the interaction, rather than on the content or accuracy of the route description itself, and there are only a couple of studies which have considered the content of adults' route

descriptions (e.g. Vanetti & Allen, 1988; Ward *et al.*, 1986). For example, in the study by Ward *et al.* (1986) college students were asked to describe a route between two places on an invented map, and they did so mainly by reference to landmarks and the use of the terms left and right, but their descriptions were only assessed by scoring the number of times that landmarks, 'relational terms' (left and right), cardinal directions and distance estimates were mentioned, and Ward *et al.* did not provide any more detailed analysis.

Children's route directions have been studied in more detail than adults—children's descriptions were first investigated by Piaget who asked children to describe a route from memory (Piaget *et al.*, 1960). He argued that children pass through several stages of ability—in Stage I children's knowledge of a route is very limited and does not extend beyond a general sense of direction. Piaget suggested that children in Stage II base their route descriptions, not on the environment as such, but on their memory of movement and travel through the environment, and he quoted one child (aged six years) who gave a description without referring to any features or landmarks along the route:

I go straight along, I turn there, I go straight along again, I turn there, I keep going straight and I turn once more (Piaget *et al.*, 1960, p. 11).

This type of description led Piaget to suggest that children's earliest appreciation of routes is a 'sensorimotor' understanding, and that it is only after this understanding is achieved that children can 'attach' landmarks and other information to their memory for the route. It is not until Stage III that children are able to describe routes more coherently, though not always completely accurately, with references to landmarks and directions.

Given Piaget's discussion of the development of route knowledge it would be expected that children's earliest description of routes will generally be made up of indications of directions. However, Siegel and White (1975) proposed a slightly different sequence for the development of environmental knowledge. They based their description on Piaget's, but argued that the first stage of environmental awareness was a knowledge of landmarks, and that only after landmarks were known could they be linked to form a route. Therefore, Siegel and White's theory (in contrast to Piaget's) implies that children's first route descriptions will emphasize individual features or landmarks along the route (for a more detailed and critique of both theories, see Blades, 1991).

Children's earliest route descriptions have re-

ceived little empirical attention though a study by Spencer and Darvizeh (1983) asked preschool children in Iran and in Britain to describe familiar routes. Spencer and Darvizeh found that some children gave descriptions based on movement and directions (corresponding to Piaget's results) other children provided a list of landmarks (as would be expected from Siegel and White's theory). In other words, the evidence from Spencer and Darvizeh's study does not distinguish between the relevant theories, but it does demonstrate that young children have some idea of what it means to give directions, even though their descriptions were far from complete and were often ambiguous.

Other studies have focused mainly on older children, but the results from different experiments do not give a completely coherent description of the development of children's ability. For example, Flavell *et al.* (1985) found that seven year olds were unable to detect ambiguous directions when using those directions to follow a route on a map, and this might imply that children of this age do not always have a complete understanding of what constitutes a satisfactory route description. Similarly, in a series of experiments designed to study developmental differences in the ability to communicate information Lloyd (1990, 1991, in press) found that seven year olds were often unable to describe a route from a map. In contrast, Waller (1985, 1986a) and Waller and Harris (1986) showed that slightly older children were competent at giving directions along a short route. Waller asked children to give directions between places in their school or playground and found that eight year olds were not only able to describe the routes, but also altered and simplified their description appropriately when they were talking to younger children.

Studies which have also included older children have shown that after about ten years of age children are able to give adequate directions, but they may not do so in exactly the same way as adults. For example, Lloyd (1991) analysed the strategies which children and adults used when describing a route from a simplified map—adults used a 'directional strategy' (i.e. included references to left, right, and straight on at junctions), but ten year olds relied on describing the landmarks at junctions (and given the simplified map used in Lloyd's study, this was sufficient to identify the correct route). In other words, directions given by older children may differ in content from those given by adults, and to some extent such differences may be due to the children's lack of competence with the component aspects of direction giving—for

example, children may not be very accurate or confident at using relational terms like left and right (Boone & Prestcott, 1968; Waller, 1986*b*).

However, most studies with children have only included two different age groups which limits what can be said about any developmental progression in the ability to describe routes and therefore, to find out more about developmental differences we carried out a small scale study with groups of ten six, seven and eight-year-old children and ten adults (Brewster & Blades, 1989). The subjects were shown an invented map which included typical map features and clearly labelled landmarks, as well as a scale and the cardinal directions. A route which included eight choice points was drawn on the map and subjects were asked to give a verbal description of the route. All the adults did this successfully, but none of the children gave accurate directions, though four of the eight year olds, and two of the seven year olds correctly described at least half of the turns along the route (the six year olds hardly ever described a turn correctly).

The children's accuracy was affected by the nature of the choice point—turns associated with a landmark were easier to describe than turns without a landmark, and turns approached moving 'up' the map were better described than ones where the direction of travel was 'across' or 'down' the map. There was an age related increase in the amount of information included in the directions—the adults provided almost twice as much information as the oldest group of children, and this in itself contributed to the adults' accuracy, because any minor errors or slight ambiguities in their descriptions would easily have been understood by a listener in the context of all the information which was provided. There was also a striking difference in the type of route information given by the adults and the children. Nearly all the adults included descriptions of the road junctions on the map (as crossroads, T-junctions, etc.) but the children never referred to the type of junction. By describing the type of junction the adults were able to use these as landmarks along the route. More importantly, all the adults frequently described the sequence of roads ('first right', 'second right', etc.) which was an effective way of specifying a subsequent turn on the route, and overcame the difficulty of identifying a turn which was not directly associated with an obvious landmark. None of the children ever referred to the road sequence.

Such a difference in the style and content of the children's and adults' directions was unexpected, and it was difficult to explain because in the Brewster and Blades (1989) experiment only a few young children were being compared to mature adults. The difference in style might reflect an age related progression to more sophisticated direction giving, or it might simply have been the case that the older subjects had adopted a different way to describe routes as adults (without any developmental progression being indicated). To investigate this the present experiment was designed to extend the findings from Brewster and Blades, by including a larger number of subjects across a wider age range.

In designing the experiment three other points were also considered. Firstly, it was predicted that children would give directions at turns associated with landmarks more accurately than directions at turns without landmarks (from Siegel & White's 1975, theory). Secondly, we expected that the direction of travel would influence accuracy, and choice points approached travelling northwards on the map would be easier to describe accurately than choice points approached from other directions. This is a common finding from previous studies (e.g. Brewster & Blades, 1989) and in formal spatial tests (e.g. Money, 1965). Thirdly, gender differences in spatial ability have often been reported (for a review see Linn & Petersen, 1985)—for example, Ward *et al.* (1986) found that male students gave more accurate directions than female students, and other studies with adults have also indicated that males are better map readers (Chang & Antes, 1987). Therefore, the results from the present experiment were also examined for gender differences in ability.

Subjects

Ninety subjects took part in the experiment. There were 18 adults with the mean age of 22 years (range 21–30 years) and 72 children were randomly selected from two schools. The children were divided into four age groups of 18 children, with mean ages of six years one month (range 5–9 to 6–9); eight years two months (range 7–6 to 8–9); ten years (range 9–4 to 10–10) and 12 years (range 11–6 to 12–11). There were approximately equal numbers of male and female subjects in each age group. None of the subjects had received any training about giving directions in school.

Materials

Two maps were especially drawn for the experiment. A diagram of Map A is shown in Figure 1. The map was drawn in colour on a piece of white card
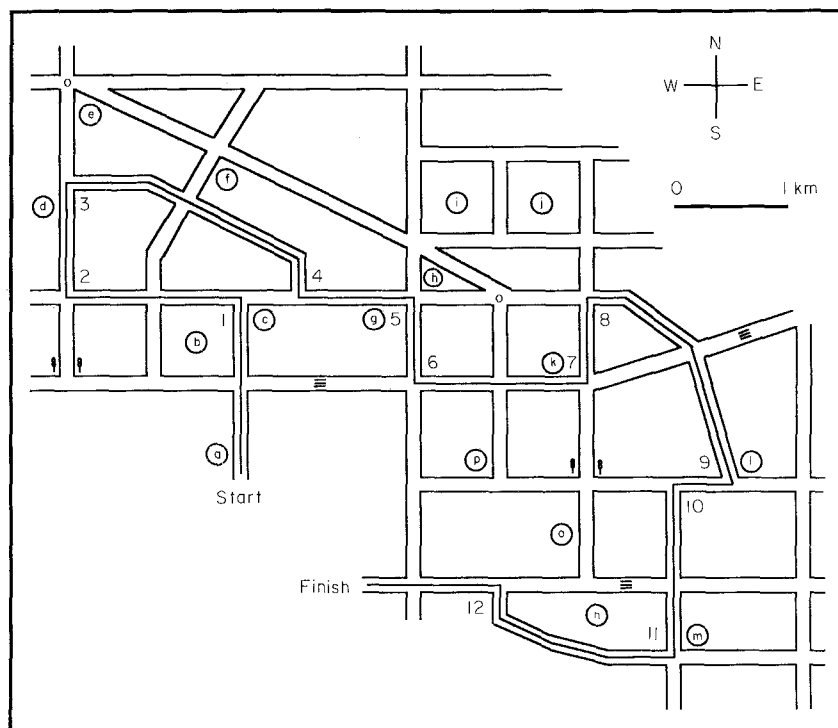
FIGURE 1.   Diagram of Map A showing route which was described. Turns on the route are numbered for reference (but the numbers did not appear on the original map). Landmarks, which were included as labelled drawings on the map, were: a, garage; b, house; c, school; d, sweet shop; e, bank; f, telephone box; g, pond; h, library; i, shop; j, post office; k, swimming baths; l, church; m, big house; n, playground; o, cafe; p, doctor's house.

(measuring 53 × 81 cm). It was intended to be similar to a conventional road map, though the landmarks were made especially salient and street names were not used because this would have disadvantaged the youngest children whose reading skills were limited. The map included a scale and a compass rose with the cardinal directions marked. A red line, drawn along the roads on the map indicated the route to be described.

Sixteen different landmarks were included on the map (these are represented symbolically in Figure 1, but on the map itself each landmark was drawn as a small picture and labelled). The landmarks were selected so that they would easily be recognized by all the subjects (e.g. a school, a garage, a church and a playground). Six of the landmarks were placed at turns along the route. The map also included traffic lights, pedestrian crossings and roundabouts, but none of these features were directly associated with the route.

The route included 12 turns—these are numbered for reference in Figure 1, but no numbers appeared on the actual map. The route was designed so that half of the turns were at a landmark (turns 1,3,5,7,9,11) and the other half did not have a

related landmark (2,4,6,8,10,12). Half the turns were at the first junction after a previous turn (3,5,6,8,10,12) and half were at the second junction after a previous turn (1,2,4,7,9,11).

The route was also designed to take into account the direction of travel, so that four turns were approached while travelling north (1,3,8,12); four were approached travelling south (4,6,9,11); and four were approached from the east or west—which will be referred to as 'across' the map (2,5,7,10). In addition, half the turns were right turns and half were left turns; and half the junctions were at crossroads and half were at T-junctions.

As far as possible all these factors were balanced. It was expected that the direction of travel would influence the accuracy of describing route turns, but one the main hypotheses was concerned with the presence (or absence) of landmarks at turns, and therefore to avoid confounding travel direction and landmarks these two factors were strictly counterbalanced. In other words, of the six turns with a landmark two were approached travelling north, two were approached travelling south and two were approached 'across' the map; and the same was the case for the six turns without a landmark.

The second map, Map B, was a mirror image of Map A. This map retained all the features of Map A with the exception that right turns became left turns and vice versa. All other factors were the same as Map A and this provided the opportunity to test the subjects twice with the same route, but on different maps.

Procedure

All subjects were tested individually with both maps. Half the males and females in each age group saw Map A first and the other half saw Map B first. The map was placed on a table in front of the subject (who was not allowed to rotate it).

The roads, compass rose and scale were pointed out and the landmarks were named (and all the subjects were able to recognize all the landmarks). Then it was explained that the red line on the map represented a specific route along the roads. Subjects were asked to pretend that they were describing the route over a telephone to someone who needed to walk the route but did not have a copy of the map. It was emphasized that the route directions should be clear so that anyone using them would not get lost. A toy telephone was provided for the younger children to help them pretend that they were talking to someone at a distance.

After the subjects had completed one map they were then given the alternative map and the procedure was repeated. No help was given, except (for the younger children) occasional prompts to encourage them to complete the task. All responses were recorded on tape and then transcribed.

Scoring

The subjects' route descriptions were scored for accuracy. There are several ways in which a correct turn can be described without ambiguity, for example:

(a) By a combination of landmark and direction. For example 'turn right at the church' or 'turn north after the swimming baths'. Such combinations were the most frequently used turn descriptions and usually the direction was specified in terms of left or right, although two adults, six 12 year olds; three ten year olds; and one eight year old made at least one reference to a cardinal direction in combination with a landmark. Adults also used descriptions of road junctions as effective landmarks in combination with a direction, for example: 'turn right at the T-junction'.

(b) By a combination of landmark and distance. For example 'after the garage you go 1 kilometre and then turn left'. This combination was only used infrequently—two adults; three 12 year olds; and four ten year olds each made at least one use of this combination in their descriptions.

(c) By referring to the sequence of roads. For example, 'the first right, next left and then second left'. All the adults and six of the 12 year olds made at least one reference to the sequence of roads, but it was rare for younger children to do so (see below).

Given the design of the map in this experiment, the above combinations, if applied correctly, are the minimum necessary to specify a turn unambiguously. The route descriptions were scored according to two criteria of accuracy. The first 'strict' criterion assessed whether the description given by the subject would have been sufficient for a person following the directions to make a correct turn at each of the choice points along the route. In other words, a perfectly correct route description on either map would have scored a total of 12.

But it was considered that the strict criteria might underestimate the younger subjects' ability to give directions, because some of the children may have appreciated the need to identify a turn by (for example) combining a landmark and a direction, but made a mistake by giving an inappropriate landmark or describing the direction incorrectly. The latter sometimes happened when children transposed left and right when the direction of travel was down the map. To compensate for errors which might have been due to a confusion of terms rather than an inability to give directions *per se*, a second 'lax' criterion was also used to assess the descriptions: if subjects (for example) referred to a landmark and a direction to indicate a turn, but gave *either* a wrong direction *or* an inappropriate landmark they were scored as correct. If however, both direction and landmark were given inappropriately the subject received no credit. The mean scores for each age group by each criterion are given in Table 1.

TABLE 1
Mean scores for each age group for strict and lax criteria (for definition of criteria, see text). Maximum possible score was 24

	Age group (years)				
	6	8	10	12	Adult
Strict criterion	0·00	0·89	7·00	17·35	23·17
Lax criterion	0·28	3·38	7·92	19·68	23·52

In fact, both scoring criteria gave similar results in all the statistical analyses, and therefore only the results from the strict criteria will be reported here. Nonetheless, the similarity between the strict and the lax analyses indicates that the differences between age groups and conditions given below do reflect developmental differences in the ability to understand what is required to give a satisfactory route description. The reported differences are not simply the consequence of younger subjects being less consistent in the use of terms such as left and right, or less precise in selecting landmarks.

Other measures of performance (e.g. the amount of information given in the subjects' descriptions and the number of landmarks or road junctions mentioned) are described in the following section. As explained above there are different ways to describe a route and two individuals might be equally accurate at giving directions, but do so in different ways and therefore the results section also includes a discussion of the different descriptive styles used by the subjects.

Results

Preliminary analyses showed that there was no difference in performance on Map A and Map B; no effect for direction of turn (left or right) and no effect for the type of junction (crossroads or T-junction). Nor was there an effect for the order of presentation—in other words, there was no practice effect and all the age groups performed equally well with the first map and the second map which they were given. Therefore, the subjects' scores for both Maps A and B were combined (i.e. if subjects described every turn on both maps correctly they would have scored a maximum of 24).

Two analyses were carried out. The first focused on the relationship between the presence of a landmark at a turn and the direction of travel in a 5 (age) $\times$ 2 (male/female) $\times$ 2 (landmark/no landmark) $\times$ 3 (travel direction: north, south, across) analysis of variance.

There was an effect for age, F = 99·50; df 4,80; $p <$ 0·001. A Tukey HSD *post hoc* comparison ($p <$ 0·01) showed that the adults had a better mean score than the 12 year olds who were better than the ten year olds who were better than the eight year olds and six year olds. There was no difference between the performance of the latter two age groups (for the mean scores of each age group see 'strict' data in Table 1). Therefore, with the exception of the two youngest groups there was a progressive age-

related improvement in the ability to give effective directions from the maps.

There was an effect for landmark, F = 7·09; df 1,80; $p <$ 0·01). The subjects were more accurate when there was a landmark associated with a turn (mean score 5·02) than when there was no landmark (4·66). There was also an effect for direction, F = 22·24; df 2,160; $p <$ 0·001. Tukey comparisons ($p <$ 0·01) showed that when travel direction was northwards turns were better described (mean score 3·70) than when the travel direction was across the map (3·18) or when travel was southwards (2·80). Also, accuracy was better ($p <$ 0·05) when direction of travel was across the map than when it was southwards. In other words, subjects found it easier to describe turns correctly when moving 'up' the map than when moving across it, and they were poorest when describing turns as they moved 'down' the map. There was no effect for gender, F = 0·07; df 1,80; $p >$ 0·05.

A significant interaction was found for age $\times$ direction, F = 4·76; df 8,120; $p <$ 0·001. This interaction was because the effect of direction of travel ('up' better than 'across' better than 'down') was generated by the performance of the three intermediate age groups who each showed this trend. But neither the adults (with almost perfect scores for all three travel directions) nor the six year olds (with uniformly poor scores for all three directions) reflected any effect for the direction of travel. A significant interaction was also found for landmark $\times$ direction, F = 6·55, df 2,160; $p <$ 0·01. This was the result of performance being more accurate when a landmark was associated with a turn and travel direction was north or across the map. But when travel direction was southwards the presence or absence of a landmark made little difference to the accuracy of the turn description.

The second analysis considered the effect of the sequence of roads. Each subject's mean score for first turn with a landmark; first turn without a landmark; second turn with a landmark; and second turn without a landmark were entered in a 5 (age) $\times$ 2 (male/female) $\times$ 2 (landmark/no landmark) $\times$ 2 (first turn/second turn) analysis of variance.

The significant main effects for age and landmark were described above. The other main finding was an effect for turn, F = 12·39; df 1,80; $p <$ 0·001. The subjects were better at describing a turn when it was the first turn after a previous turn (mean score 5·07) than when it was the second turn after a previous turn (4·68). There was also a significant interaction for age $\times$ turn, F = 12·39; df 4,80; $p <$ 0·001.

TABLE 2

Mean number of items of information and mean number of landmarks included in the route descriptions by each age group. Table also shows the number of landmarks as a proportion of the number of items of information

	Age group (years)				
	6	8	10	12	Adult
Items of information	6·9	18·9	27·6	51·5	69·3
Landmarks	3·9	5·4	6·4	11·8	14·3
Landmarks as proportion of information	0·57	0·29	0·23	0·22	0·20

This came about because all the age groups had similar scores for both types of turn, except for the ten and 12 year olds who were more successful at describing a first turn than a second turn.

As a simple measure of the amount of information provided by the route descriptions a total was made of all the items of information mentioned by each subject (for both maps). An item of information was taken as any reference to a landmark, a feature on the map, a distance, or an indication of direction. These were totalled (without taking into account how accurate or appropriate the information might be) and the means for each age group were calculated. The means indicated a clear age related increase in the total amount of information provided by the subjects—see Table 2.

More specifically, the total number of landmarks referred to by each subject was also calculated and the means for each age group are included in Table 2. This table also gives the number of landmarks as a proportion of all the items of information and shows that the proportion declined with age. For example, names of landmarks represented 57% and 29% of the information provided by the six year olds and eight year olds respectively, but only 20% of the adults' descriptions were references to landmarks.

An assessment was made of the total number of references to landmarks (for both maps and all age groups combined). The six landmarks at turns were referred to most frequently (with a mean of 43·5 references; range 28–54) and the only other landmarks to be mentioned as frequently were a garage (at the beginning of the route) which received 41 references, and a playground (at the end of the route) with 48 references. Four landmarks which were on the route, but not at turns, were sometimes mentioned (with a mean of 15 references; range 4–28). Landmarks which were not associated with the route were almost never included in the subjects' descriptions; one received four references; one

received three; one received two; and two received one reference each.

All 18 adults included descriptions of road junctions, usually by stating whether a choice point was a crossroad or a T-junction and they made a mean of 9·7 references (range 2–23) to the type of junction. Eight of the 12 year olds also described the road junctions with a mean of 10·4 (range 3–17) references. But only two of the ten year olds described the junctions (one made seven references and one made three references), and none of the younger children attempted to give information about the type of junction.

An important difference between the adults and most of the children was the adults' use of the sequence of roads (i.e. describing a turn as 'first left'; 'second right', etc.). Without exception all the adults included references to the road sequence— the 18 adults made a mean number of 7·1 (range 2–14) such references. Six of the 12 year olds also mentioned the road sequence (mean number of references, 5·1 and range 2–8). But only one ten year old included the road sequence in his description and referred to it at eight points along the routes; none of the younger children mentioned the road sequence.

The six year olds had difficulty in carrying out the task and a few children were able to do no more than point out one or two unconnected features on the map, and none of the six year olds were able to give a completely accurate description of any of the turns along the routes. Two six year olds mentioned cardinal directions, and one child used the directional term 'right' on a single occasion, but in general, the children relied on vague indicators such as 'over there', 'forward', 'that way' which reflected movement on the map, rather than the directions for actual travel, for example:

You go up and across; up; across; down; across; up; round; across and down; up and round

Six of the children gave descriptions like the above which were just a list of directions and made no reference to the features on the map. Alternatively four of the six year olds simply provided a list of landmarks with little or no indication of direction at all.

Go past house; past sweet shop; past pond; past swimming baths; past church...past playground and you're there

The eight year olds were only a little more accurate than the six year olds, though some of the eight year olds gave accurate directions at individual turns. Eight of the eight year olds mentioned

cardinal directions, usually correctly (though of course the cardinal directions were marked on the maps). Nine children included 'left' and 'right', but on only 39% of the occasions when these terms were used were they given correctly. Like the younger age group, one of the eight year olds just listed landmarks without giving any directions, and ten of the eight year olds gave imprecise indications of direction without including any landmarks:

Right; you go up; then turn left; then you go back up; then turn right; then go right again; then go down; then right....

Though a few children did include both directions and landmarks in more detailed descriptions, and with some recognition that it was appropriate to link landmarks and directions together:

First you start at a garage and you go past a house and a school and then turn east and turn a corner and you go past a sweet shop; then you turn a corner again and you go past a bank; then go past a telephone box; then you turn a corner again....

The ten year olds, who were significantly better than both the younger age groups, showed an improvement in giving directions. But only five of the children described more than half of the 24 turns correctly and therefore even the more successful children in this age group only provided partial route descriptions. Five children mentioned cardinal directions (usually correctly) and ten used left and right (but with only 46% accuracy):

You start at the garage; you go past the house; turn left; then you go north; then you turn right...and get to a pond; then you turn south; then you turn left and you come to the swimming baths; you turn again left; then you turn right; go down a hill to the church; then turn left; then south; you come to a playground and then you've finished.

Unlike the younger age groups, four of the ten year olds introduced distance estimates into their descriptions:

You start at a garage and then go up about 1 kilometre; then turn a corner....

The 12 year olds were generally good at giving directions. Sixteen of the children gave accurate directions at more than half the 24 turns, and eight of these children were correct at 20 or more turns. In other words, many of the 12 year olds were able to give nearly complete descriptions of the route. Both cardinal directions and left/right indicators were used with few errors and three children mentioned distances correctly:

You start by the garage; then you go about one and a half kilometres north and you will get to the school; then go left...for another kilometre until you get to a cross-

roads; then go right and you should pass a sweet shop and then you carry on about a kilometre and you turn right...

As discussed above, six children in this age group also included the road sequence:

...walk along, don't turn until you get to the church; then turn right; then turn first left; walk along and turn second right and walk past the playground....

The adults nearly always gave completely accurate directions, and the few errors were due to confusions of left and right (usually when travelling down the map). Despite their much longer and more detailed route descriptions, only four adults included distance estimates (one subject gave three distances, one gave two and two gave one each) and two adults gave cardinal directions (one gave six references to north or south, and one made a single reference to north). Adults were more likely than children to describe the type of junction at the choice points and quite often used the junction description as a landmark by specifying the type of junction and the turn required without giving any additional information:

...go past the church to a T-junction; turn right at this junction; turn left at the next T-junction; go over another set of crossroads and then turn right at the next crossroads; follow the road round; turn left at the T-junction; then come to the finish.

The adults provided very detailed directions and therefore many of their turn descriptions included several items of information, some of which were redundant because the route turn could have been unambiguously specified with much less information.

Discussion

The results from the experiment demonstrated a clear age related improvement in the accuracy of direction giving. The results showed that the younger children, (the six and eight year olds) had difficulty giving directions from the map. None of the six year olds were able to describe any of the turns accurately, and although some of the eight year old children were able to describe individual turns, they were unable to provide anything approaching a coherent route description.

The finding that six year olds performed poorly corresponds with the results from Brewster and Blades (1989) and confirms that children of this age have difficulty giving directions. In terms of the developmental theories put forward by Piaget et al. (1960) or Siegel and White (1975), children at the

age of six years may not have reached the stage when they have a properly formed the concept of a 'route', and if young children's environmental knowledge is limited to a memory for sensorimotor movements through the environment (Piaget) or unconnected landmarks (Siegel and White) then it is not likely that they will be able to verbalise a coherent route. On the other hand there is now much evidence that the descriptions of young children's environmental cognition put forward by Piaget or by Siegel and White have underestimated children's ability (see Blades, 1991), and studies (e.g. Spencer & Darvizeh, 1983) have demonstrated that young children can give at least partial descriptions of a familiar route from memory. The eight year olds also performed poorly in the present experiment, and this contrasts with Waller's (1985) finding that children of a similar age could give directions along an actual route. There are at least two possible reasons for this discrepancy—firstly, the actual routes used by Waller were less complex and easier to describe (in the sense that the choice points on the route were indicated by obvious landmarks). Or secondly, young children may be better at describing actual routes than routes shown on a map. The latter reason, could be part of the explanation for the generally poor performance of the six and eight year olds in the present experiment, and further research could consider differences in young children's descriptions when describing an actual route and a map of the same route.

The two older age groups of children demonstrated a marked improvement in direction giving, though it was only the 12 year olds who were able to give correct directions for all or most of the route. The 12 year olds improvement in direction giving was due to their greater accuracy when using relational terms, and an increased use of road descriptions and road sequences. By describing intersections and naming the road sequence, some of the 12 year old children approximated to the style of the adult subjects. However, it is not clear how children come to adopt this style—it can be assumed that children do not receive specific teaching about how to give directions, and therefore the adoption of an 'adult style' of description may be dependent on imitation or, with greater experience of the environment, a recognition that the combination of certain types of information can provide more economical and less ambiguous route directions. Whether younger children could be taught to give directions in a similar manner remains an open question, but it is worth further investigation because it has important practical implications

for teaching children how to give effective route descriptions.

A further factor in the accuracy of the 12 year olds' and adults' was the amount of information which they included in their directions. On the one hand the information which they gave included much redundant detail which was additional to what was strictly necessary to identify a turn, but on the other hand it had the important effect of overcoming any minor errors or ambiguities in the directions. As Flavell *et al.* (1985) have demonstrated, 12 year olds and adults are sensitive to ambiguous route information, but younger children may not notice a potential ambiguity.

Although the cardinal directions and distance information were included on the map, these were comparatively rarely used by any of the age groups, and this was especially true for the adults who, despite the length and detail of their descriptions, hardly ever mentioned distance or cardinal directions. This suggests that route giving proficiency does not depend on the use of these potential aids, and that if anything, the more 'expert' subjects preferred not to use cardinal directions and distance at all.

As expected, the presence of a landmark at a turn usually resulted in a more accurate description of the turn being given, and the landmarks at turns were referred to much more frequently than any of the other landmarks on the map, even those which were placed along the route. Also as expected, the direction of travel was a major factor in accuracy, and when moving across or 'down' the map the need to work out the correct spatial terms proved more difficult than when travelling 'up' the map. This is a common finding for both children (e.g. Money, 1965; Harris, 1972) and for adults (e.g. Farrell, 1979; Shepard & Hurwitz, 1984) and was an inevitable effect of presenting the route in the form of a map.

There were no gender differences in performance and no evidence that the male subjects performed better than the female subjects. Therefore, the (usually weak) effects favouring males which have been found in previous studies with maps or direction giving (e.g. Ward *et al.*, 1986; Chang & Antes, 1987) were not supported.

In summary, the experiment showed that there are important developmental differences in the way that children and adults give directions. When describing routes, young children provided little information and were generally unable to give a coherent set of directions. They focused on landmarks and vague indications of directions (which often related more to movement on the map than

the movement in the environment), but the land-marks and directions were rarely combined to give a clear indication of the route to be taken at a choice point. However, by the age of about 12 years many of the children provided more accurate and detailed information and were able to adopt a style of direction giving similar to the style favoured by adults. As well as information about landmarks and the use of left and right directions, all the adults made references to the type of junction being approached and often indicated the sequence of roads in relation to a previous turn, so that the recipient of the directions was told whether the next turn was the first or second road ahead. Details about road junctions and sequences were never included by the children before the age of 12 years, and this was the most marked difference in style between the age groups.

The present experiment has provided an outline of how the ability to give directions develops across the age range, and it has also highlighted the marked contrast in the way that subjects before the age of 12 and subjects after the age of 12 years give directions. Not only were the older subjects more accurate, but there were significant differences in the content and the style of their directions compared to the younger subjects. Further research could consider what factors contribute to and influence the ability to give directions and how children about the age of 12 years come to adopt the style of direction giving most frequently used by adults.

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