Cognitive Styles in the Use of Spatial Direction Terms

WILLEM J. M. LEVELT

Let us, by way of introduction, consider two spatial descriptions obtained in an experiment to be described more fully below. The two descriptions are of the same spatial pattern, namely the one presented in Figure 1, but were given by two different subjects. One subject was a male student, while the other was a female housekeeper. Subsequently, they will be referred to as 'he' and 'she'.

The subjects had been instructed to describe the pattern in such a way that a listener familiar with the type of patterns involved would be able to redraw the pattern accurately from a tape recording made of their speech. The instructions moreover asked the subjects to start the description at the node marked by an arrow.
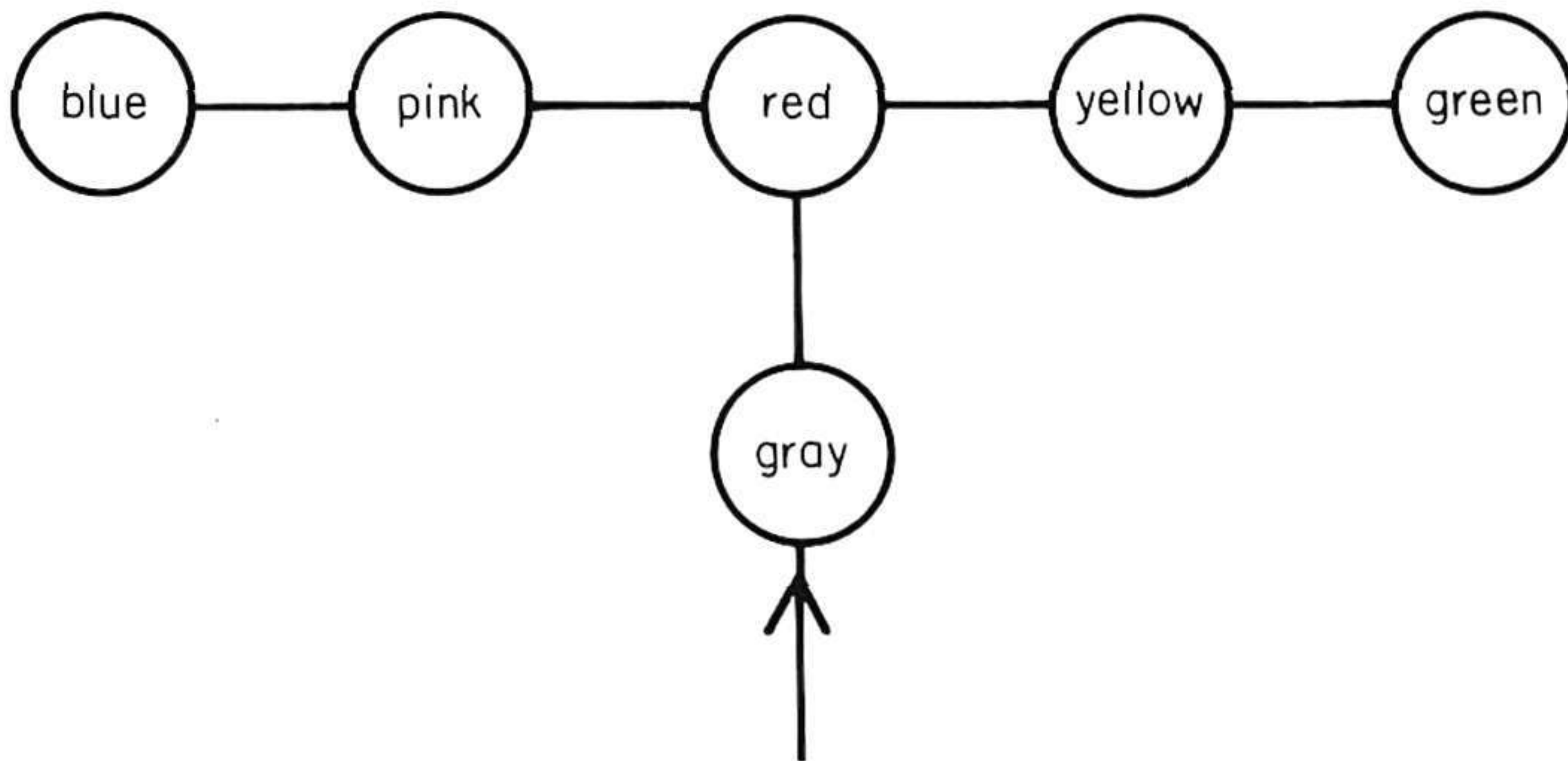

Figure 1   Network of coloured nodes and black arcs, presented to subjects to describe. The arrow indicates where the description should begin

His description:
0. In het middel beginnen, een grijs knooppunt
   In the middle to begin, a grey nodal point

251

1. Vandaaruit naar boven, een rood knooppunt
   From there upwards, a red nodal point
2. Dan naar links toe, een roze knooppunt vanuit rood
   Then to the left, a pink nodal point from red
3. Dan vanuit roze weer naar links toe een blauw knooppunt
   Then from pink again to the left a blue nodal point
4. Dan weer terug naar rood
   Then back again to red
5. Dan van rood naar rechts toe een geel knooppunt
   Then from red to the right a yellow nodal point
6. En vanuit geel weer naar rechts toe een groen knooppunt
   And from yellow again to the right a green nodal point

Her description:
0. Ik start bij kruispunt grijs
   I start at crossing point grey
1. Ga rechtdoor naar rood
   Go straight on to red
2. Ga linksaf naar roze
   Go left to pink
3. Ga rechtdoor naar blauw
   Go straight on to blue
4. Draai rond ga terug naar roze
   Turn around go back to pink
5. Ga terug, eh rechtdoor naar rood
   Go back, uh straight on to red
6. Rechtdoor naar geel
   Straight on to yellow
7. Rechtdoor naar groen
   Straight on to green

Both descriptions are *tours* of some sort. Each tour starts at the grey node indicated by the arrow (line 0 in the descriptions), and ends at the green one, meanwhile traversing all the nodes in a more or less connected way. The tours, moreover, consist of elementary *moves* (lines 1–7 in the descriptions) consisting of an optional source phrase (e.g. 'from there'; 'from pink'), a directional phrase ('to the left', 'back again', 'straight on', etc.), and a goal phrase ('a blue nodal point', 'to red', etc.). But within this rather fixed frame, the two descriptions exhibit some striking differences. The maker of the tour is unspecified in his description, but 'I' in hers (although this is deleted in all moves subsequent to the first one, so that the moves also sound like instructions for the addressee). He usually gives the source phrase at each move, but she doesn't. Her description is also more elliptical in that, except for line 0,

the nodes are referred to by their colour only (e.g. 'blue'), whereas he often uses a full noun phrase ('a blue nodal point'). In the one case where they both use the colour term adjectivally, namely in line 0, there is still a marked difference: he uses the indefinite article, and normal Dutch word order ('een grijs knooppunt'), whereas she omits the article and uses inverse order ('kruispunt grijs'), as if to accentuate the given/new structure.

In the following we will not deal with all these differences or many others that could be detected. Instead, we will limit ourselves to a discussion of some differences in the use of directional expressions, such as 'left', 'right', and 'straight on', and in the way such expressions are strung together. Our aim is to show that such individual differences are not more or less random fluctuations in idiolect, but are due to systematic variations in the ways people operate on internal representations of space.

In order to focus on the phenomena we have in mind, compare the following differences between the two descriptions:

(i) In his move 1 the directional term is 'upwards' ('naar boven'); the corresponding term in her move 1 is 'straight on' ('rechtdoor').

(ii) Moving from pink to blue is described by him as 'again to the left' ('weer naar links') in move 3, whereas for the same move she uses 'straight on' ('rechtdoor').

(iii) His move 4 brings him back to the red crossing point in one leap, unspecified as to direction ('back again'), whereas she uses two specified moves to accomplish this: her move 4 which describes the turning around and return to pink (this node is not mentioned again by him at all); and her move 5 for reaching the red crossing node, which starts out with 'go back', but then is corrected to the more specific 'straight on'.

(iv) In order to move from red to yellow he uses as directional phrase 'to the right' ('naar rechts toe') in his move 5, whereas she accomplishes this in her move 6 with 'straight on' ('rechtdoor').

(v) Finally, the concluding move to green is specified by him (move 6) as 'again to the right' ('weer naar rechts toe'), whereas she indicates it (move 7) as 'straight on' ('rechtdoor').

One might want to ascribe the differences (i) and (iii) to superficial variation in wording: 'upwards' and 'straight on' in (i) are synonymous in the context of use; each subject could have used the other term without much consequence for the listener. Similarly for (iii), the combination of 'go back' and 'straight on' in her description may just be a bit more specific than his 'back again', but still they would be largely synonymous in the given context. However, such an explanation cannot hold for differences (ii), (iv), and (v), where either 'right' or 'left' in his description corresponds to 'straight on' in her description. These expressions are neither synonymous nor differ in

degree of specificity, and one should worry for the subjects who have to draw the pattern on the basis of these descriptions.

There are two different, but related factors which can account for the observed discrepancies. The first factor I will call 'linearization type', and the second factor I will denote by 'orientation type'. These are to be considered as cognitive style factors in dealing with space. Let us consider them in turn.

1   LINEARIZATION TYPES

In order to describe a spatial pattern like that in Figure 1, one needs to map a non-linear spatial configuration onto a linear sequence of verbal expressions, or statements. This should be done in such a way that a listener can draw the pattern given the description and acquaintance with the class of actual patterns. In this particular setting, therefore, the description should, together with the foreknowledge of the listener, uniquely specify the pattern. Let us call this task requirement 'completeness'.

The speaker may approach this requirement of completeness in several ways. One way to form a complete linearization would be to give a global structural description, and then provide the details of increasingly smaller parts. That is, one could start out by saying 'This pattern is T-shaped', and then continue by mentioning the nodes on the vertical bar, and from left to right those on the horizontal bar. Of the 53 adult subjects who participated in our experiment, and described the pattern shown in Figure 1, only one started out like this ('On this figure I see a vertical and a horizontal line. On the vertical line the first one is a grey dot', etc.). In all other cases the linearization strategy was to make a *tour*, as in the two examples given above. The dominance of tour-like linearizations in spatial descriptions has been observed in earlier studies as well: in Linde & Labov's (1975) seminal paper on apartment descriptions, in Klein's (1979, also this volume), Wunderlich & Reinelt's (this volume), and Munro's (1977) studies of route directions, and in Ullmer-Ehrich's (1979 and this volume) study of room descriptions. Although there are marked differences between these studies with respect to the character of such tours (in room descriptions, for instance, only a 'gaze tour' is made, contrary to the other cases), the tour strategy for dealing with linearization of spatial structures seems to be a fairly general one.

What is less apparent, however, is that there are systematic individual differences in the *way* tours are constructed. In an earlier paper (Levelt, 1981) I have shown that the 53 subjects from the present experiment quite neatly divide into two main linearization types, the so-called 'jumpers' and 'movers'. The essential difference between them lies in the way they deal with backtracking to choice points. Jumpers deal with choice points in the pattern in the following way: they first select one branch and describe it entirely;

they then *leap* back to the choice point in order to describe the (or an-) other branch. Movers do not leap back, but *move* step by step back, along the branch already described, until they again reach the choice point. The male subject above is a jumper (see move 4), whereas the female subject is a mover (see moves 4 and 5). These types are quite consistent. The subjects in the present experiment not only described Figure 1, but 53 different patterns in total. Of these patterns, 45 involved choice points, and it almost always turned out that if a subject was a jumper in the description of one pattern, he was a jumper for all the others too, and also once a mover, always a mover. Of our 53 subjects, only four jumped in some patterns and moved in others, but even these had a strong preference for either moving or jumping. Among the 49 'pure' types, there were just about twice as many jumpers (33) as movers (16).

From the findings in that study we have reason to believe that jumpers and movers differ in the way they cope with their own memory requirements in producing a description. Both jumpers and movers keep a record of the nodes and branches they have already mentioned. But it seems that, over and above this, jumpers mark for themselves the choice node(s) they will have to return to after finishing the description of one branch. This is not a wholly trivial matter, since the branch being described may contain a choice point of its own. An example is given in Figure 2. If a jumper starts moving through
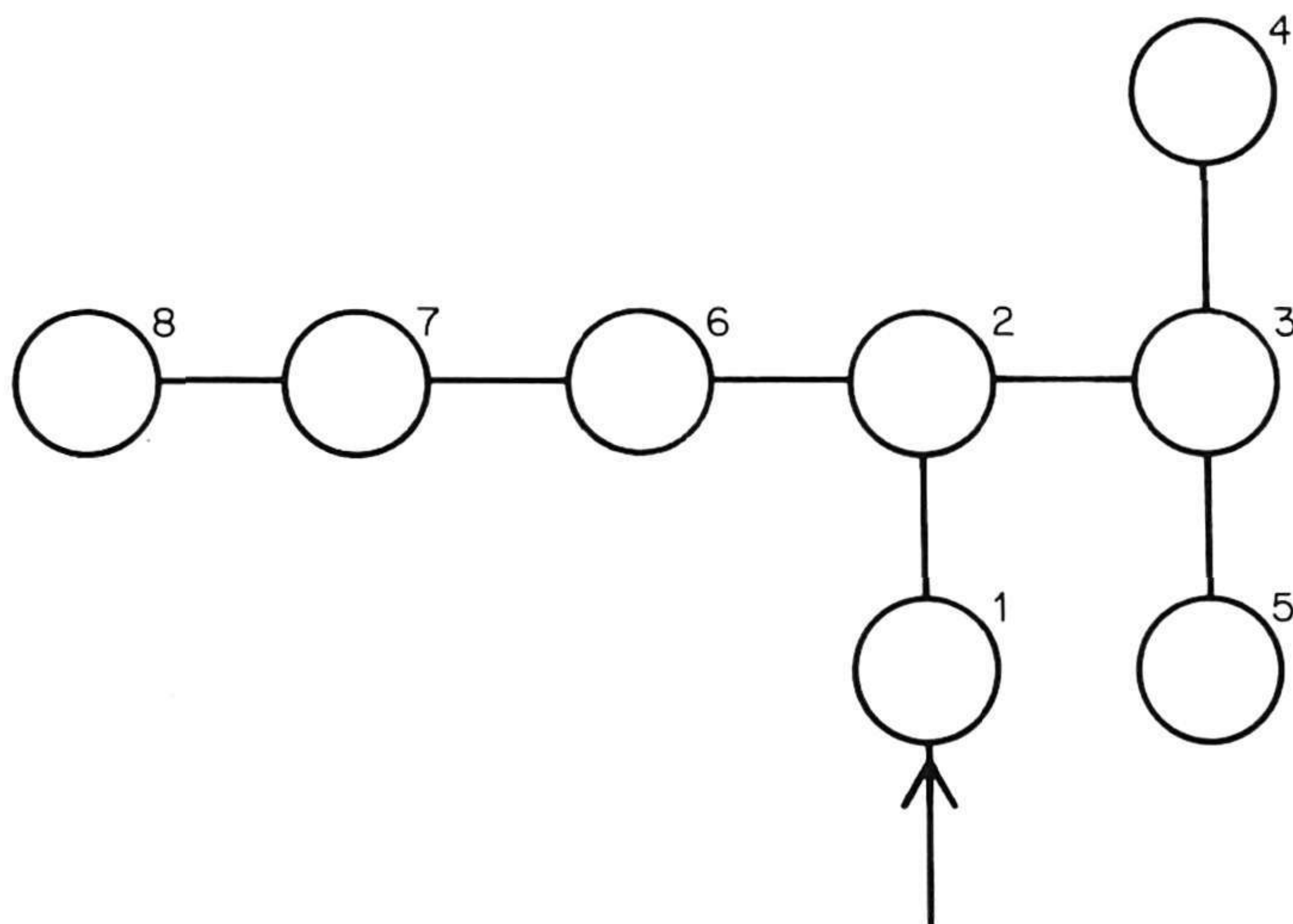

Figure 2 Network of coloured nodes and black arcs with an 'embedded' choice node. (Numbers are presented only for ease of reference in the text)

Figure 2 in the succession $1 \to 2 \to 3 \to 4$, he has not only the first choice node 2 to return to (for finishing $2 \to 6 \to 7 \to 8$), but also the later choice point 3. This return is necessary in order to describe the alternative branch that leads from node 3 to node 5. If a jumper marks for himself the nodes to which he has to return, he must also impose some order on them. After reaching node 4 in Figure 2, which of the two return addresses will get priority? If it is the first choice node encountered (2), the jumper will describe branch $6 \to 7 \to 8$ first, but if it is the last choice node (i.e. node 3), then priority will be given to description of the branch to 5. If no specific order is imposed there will be within- and between-subject differences in order of return. What we predicted and found in the earlier study was that jumpers return to choice nodes in reverse order. In Figure 2, for instance, they return to node 3 for completing the description of $3 \to 5$ before returning to 2 for the description of branch $2 \to 6 \to 7 \to 8$. The prediction was based on an Augmented Transition Network (ATN) model which contains a push-down store for choice node addresses, and thus has the required first-in-last-out characteristic. For a large variety of complex patterns, jumpers almost without exception adhered to this reverse order of return to unfinished choice nodes. This is in agreement with what Linde & Labov (1975) found in their study of apartment descriptions. Still, the situations were quite different: in their study, subjects described from memory, whereas in our study they described a perceptually available pattern.

Movers, we supposed, can make their descriptions without explicit book-keeping of unfinished choice nodes. They can produce a complete linear-ization by working from their record of nodes and branches described. The return move at the end of each branch guarantees that the unfinished choice point will be found again, and even that this will be the *last* unfinished choice node. The mover who runs through Figure 2 in the order $1 \to 2 \to 3 \to 4$ *must* return to node 3 before returning to 2. The mover describes the pattern 'without lifting the pencil', so to speak. Clearly, such a description is less efficient than a jumper's description, since the nodes along the return path are mentioned twice. On the other hand, it may be an easier description for the listener to follow, and in any case involves less book-keeping for the speaker *since no recording of return addresses is required.* The earlier paper gives an ATN model describing this mover-behaviour. It contains no special push-down stack for choice nodes, but keeps only a record of completed nodes and branches. What the mover does, according to this model, is return at the end of a branch, and check his records for each node on his return path. Any arc that has not yet been described will be entered. It seems to be somewhat expensive to check each node and arc described before, but in a perceptual situation this involves very little effort: the visually present nodes and arcs are, one after another, retrieval cues for the records; there is no special

memory load involved. It should be noticed that this would be quite different if a subject has to work from memory as in the apartment descriptions. A mover would then have to retrieve each node's records by means of a retrieval cue which is itself a trace in memory, namely the earlier node or arc. This, of course, is harder than perceptually guided retrieval. It is not surprising that there are no movers in the Linde and Labov study, where subjects have to describe from memory. Almost all subjects there are jumpers.

If these hypothetical differences in cognitive style between jumpers and movers are essentially true, one might predict that jumpers would try to linearize a pattern in such a way as to minimize their memory load, or more precisely the stack of return addresses they have to keep in mind. In describing the pattern in Figure 2, for instance, jumpers should show a preference for going to the left first at choice point 2. In that case, they have to store only one choice point while describing 6 → 7 → 8. Jumping back to 2, this can now be removed from their memory stack. Arriving at 3 on the following move, this choice point will now be stored, so that again a memory load of just one element results. If, however, a jumper goes to the *right* first on reaching point 2, he must store that choice point, and later, on top of that, choice point 3. That would result in a memory load of two elements. So, jumpers should prefer to go left first at choice point 2, in order to minimize memory load.

Movers, on the other hand, might try to minimize the amount of backtracking they have to do. If they go right first at choice point 2 they will have to make three return moves, namely 4 → 3, 5 → 3, and 3 → 2. But if they go left first they must make four return moves: 8 → 7, 7 → 6, 6 → 2 and 4 → 3 (or 5 → 3 dependent on the direction they take first at 3). It is thus more efficient for them to turn right first at 2; this is just the opposite of what the jumpers are predicted to do. The experiment gave clear support for these different strategies. Of our 33 jumpers 26 went left first in Figure 2, and only seven went right first. Of the 16 movers, however, only four went left first, the others started going right at choice node 2. Similar results were obtained for other patterns.

So much for linearization types. The distinction between jumpers and movers explains one difference between the two descriptions we started out with. Under (iii) we mentioned his coming back from blue to the red crossing point in one unspecific move ('then back again to red'), whereas she used two more specified moves to accomplish this ('Turn around go back to pink' and 'Go back, uh straight on to red'). This difference is not due to a global tendency on her part to be a bit more specific in her description (in fact, she isn't, leaving out almost all of the source phrases), but to a well-defined difference in linearization strategy. As we will see in Section 3, difference (iv) is probably also due to linearization type. That analysis, however, requires some insight in the other style factor, orientation type.

2   ORIENTATION TYPES

The discussion of orientation types can be best introduced by a quotation from Miller & Johnson-Laird (1976, p. 396):

'We will call the linguistic system for talking about space relative to a speaker's egocentric origin and coordinate axes the deictic system. We will contrast the deictic system with the intrinsic system, where spatial terms are interpreted relative to coordinate axes derived from intrinsic parts of the referent itself. Another way to phrase this distinction is to say that in the deictic system spatial terms are interpreted relative to intrinsic parts of ego, whereas in the intrinsic system they are interpreted relative to intrinsic parts of something else.'

This distinction is directly applicable to the present case. The subject in our experiment was always provided with a customary physical position with respect to a pattern. The patterns of Figures 1 and 2 were placed on a table before the subject in the position they would be if the present seated reader put the book down flat in front of him, oriented for easy reading. Now, consider Figure 1, and let us assume that the last move that was made by the subject was from red to pink. There are, basically, two ways of describing the location of blue. If the deictic system is used, the subject will relate blue to pink by (tacit) reference to coordinates of ego, and select an expression such as 'left from pink is blue'. If the intrinsic system is used, reference will be taken from intrinsic parts of the pattern, here presumably the last path moved along in the tour (i.e. the path from red to pink). So, now the expression will be something like 'straight on from pink is blue'. Thus, it turns out that the same pathway can be denoted by 'left' or 'straight' depending on the coordinate system used. Ideally, the speaker should inform the listener which of the two systems he has in mind. Miller & Johnson-Laird suggest that there might be a convention that the intrinsic system is used, unless the deictic system is explicitly introduced ('from my point of view'), or unless the intrinsic system *cannot* be used (if the relatum has no intrinsic orientation). This ideal situation is not approached in the present experiment: we find that in roughly two-thirds of the cases where deictic and intrinsic use can be distinguished, the deictic system is used, and it is almost never the case that this use is explicitly mentioned to the listener.[1] Still, the listener's position is not hopeless. There is a combination of two factors which may help the listener find out which of the systems is in fact used.

The first factor is the use of specific directional terms. If the speaker in the setting of the present experiment uses terms such as 'above', 'up', 'under', 'below', etc., i.e. terms related to a vertical dimension, the listener can safely conclude that the speaker is operating in the deictic system. This is not at all a trivial matter, and we will discuss it at length after some supporting data have been presented. If the orientation system can be discovered, the listener must,

moreover, be justified in assuming that it is used *consistently*. If the speaker switches perspective at every move *within* a pattern, the listener will be lost. But it would also be helpful to the listener if he could make the reasonable assumption that in the present task, where the speaker gives a sequence of pattern descriptions, consistency also exists *across* patterns. If the assumption is correct, one could speak of orientation types. Some subjects would be of the *pattern-oriented* type, consistently using the intrinsic system; others would be of the *ego-oriented* type, consistently using the deictic system.

There is evidence that these types exist. Let us first give some indication of within-pattern consistency. There are three moves in the description of the pattern in Figure 1, where an ego-oriented use of terms can differ from a pattern-oriented one. Firstly, going from pink to blue would be 'left' (or some synonym 'left side', 'to the left', etc.) for ego-oriented types and 'straight' (or some synonym) for the pattern-oriented types. Secondly, the move from yellow to green would, similarly, be 'right' for the ego-oriented types, and again 'straight' for the pattern-oriented ones. Finally, the use of 'up' or some synonym would indicate deictic use, as mentioned earlier and to be discussed shortly; this may distinguish the ego-oriented type in describing the very first move, from grey to red.

Let us first compare the subjects' behaviours in the first two cases. We categorized each term used in these two moves as pattern-oriented ('straight on', or its synonyms), or ego-oriented ('left', 'right', or synonyms). This could not always be done, for instance when a subject merely said 'and then' or 'and'. For the fully categorizable cases, Table 1 gives the contingency distribution. It appears that there is only one inconsistent subject. This subject combines 'straight on' ('rechtdoor') with 'keep going left' ('links blijven gaan'), an expression which allows for both a durational and a repetitive interpretation, so that this inconsistency is at best a weak one. If we remove this subject from further consideration, 34 subjects can be categorized as explicitly ego- or pattern-oriented, 22 being ego-oriented, and 12 pattern-oriented. Let us see how these 34 behave at the first move, from grey to red. Will there be more 'ups' and 'aboves' among the ego-oriented subjects? This can be seen in contingency Table 2. The table shows a highly significant interaction: with only two exceptions, the ego-oriented subjects use a vertical-dimension term

Table 1   Ego- and pattern-oriented responses for two moves in Figure 1 (from pink to blue, and from yellow to green)

Move from yellow to green	Move from pink to blue	
	Ego-oriented	Pattern-oriented
Ego-oriented	22	0
Pattern-oriented	1	12

Table 2   Use of vertical dimension terms at first move (grey to red) in Figure 1 ('up', etc.) by ego- and pattern-oriented subjects

Subjects	Vertical-dimension term used	Other term used
Ego-oriented	20	2
Pattern-oriented	1	11

to describe the first move from grey to red, whereas only one of the pattern-oriented subjects does.

From all this it can be concluded that three of the differences which we observed at the beginning of this paper between our male and female subjects' descriptions are linked intimately together. Distinction (i) concerned the first move where he said 'up', and she 'straight on'; distinction (ii) concerned move 3 from pink to blue, where he used 'again to the left', and she 'straight on'; and distinction (v) involved the last move, from yellow to green, where he used 'again to the right', and she 'straight on'. All three differences can be explained by orientation type: he being ego-oriented (deictic), and she being pattern-oriented (intrinsic).

Still to be explained is why vertical-dimension terms are consistently used in deictic orientation, and not in intrinsic orientation. There are various possible accounts of this. One could argue that in deictic orientation the subject mentally rotates the page into vertical position (somewhat like holding a newspaper). This explanation would only shift the problem to the question as to why this mental rotation does not take place in intrinsic orientation. Another account could be that in deictic orientation the direction 'away from ego' coincides with what is normally called 'top of page': the top/bottom of page terminology would then be metaphorically extended to the use of 'up' and 'down'; since the orientation of page to ego is irrelevant in the intrinsic system, the vertical metaphors will only appear in the case of deictic orientation. This account is not convincing either, or at least it is not very elegant: why would somebody who prefers to operate in ego-centric (deictic) orientation resort to a metaphor which is intrinsic; the top of a page is an intrinsic property of the page, defined by the conventional shape and way of printing. Moreover, there was no print on our patterns, and the sheets were exactly square.

We prefer a more literal account of the use of vertical-dimension terms in deictic orientation. In the tour strategy the ego-centric orientation is mediated by movement of gaze. The subject's tour is a gaze tour, and the directions of the gaze shifts correspond exactly to the directional terms used: in deictic orientation it is not only the case that 'left' and 'right' agree respectively with leftward and rightward shifts of gaze, but that 'up' and 'down' indeed conform

to upward and downward gaze movements. In intrinsic orientation, the relations to 'watching ego' are irrelevant, and direction of gaze is irrelevant for the selection of directional terms. What matters there is the change or continuation of direction in the plane, whatever the gaze and orientation of the speaker—no vertical dimension is involved. This account would predict that for deictic subjects vertical dimension terms will diminish or disappear if the horizontal plane of the pattern is lifted to (almost) eye level: this will almost completely eliminate vertical eye movements.

Let us now consider whether these deictic versus intrinsic characteristics carry over to the descriptions of other patterns. Are orientation types consistent *across* patterns? Here we will report some evidence in support of such consistency. Remember that we defined the orientation type of our 34 'clear cases' by the terms they used for the two extreme moves in Figure 1: 'left' and 'right' defined the ego-oriented subject, 'straight on' the pattern-oriented subject. We have claimed above that such differences in use of terms are not *superficial variations in idiolect*, but are due to underlying *cognitive style* factors. An idiolect explanation would be that some people just prefer using terms like 'left' and 'right', whereas others have a tendency to say 'straight' wherever they can. In order to exclude the possibility of such an explanation, we have analysed the description of two other patterns where a consistent ego-oriented subject should *not* use 'left' and 'right', and a consistent pattern-oriented subject should *not* use 'straight on', but in fact 'left' and 'right'. These patterns are given in Figures 3 and 4. They are mirror images of one another, and essentially present the same problem. Let us, therefore,
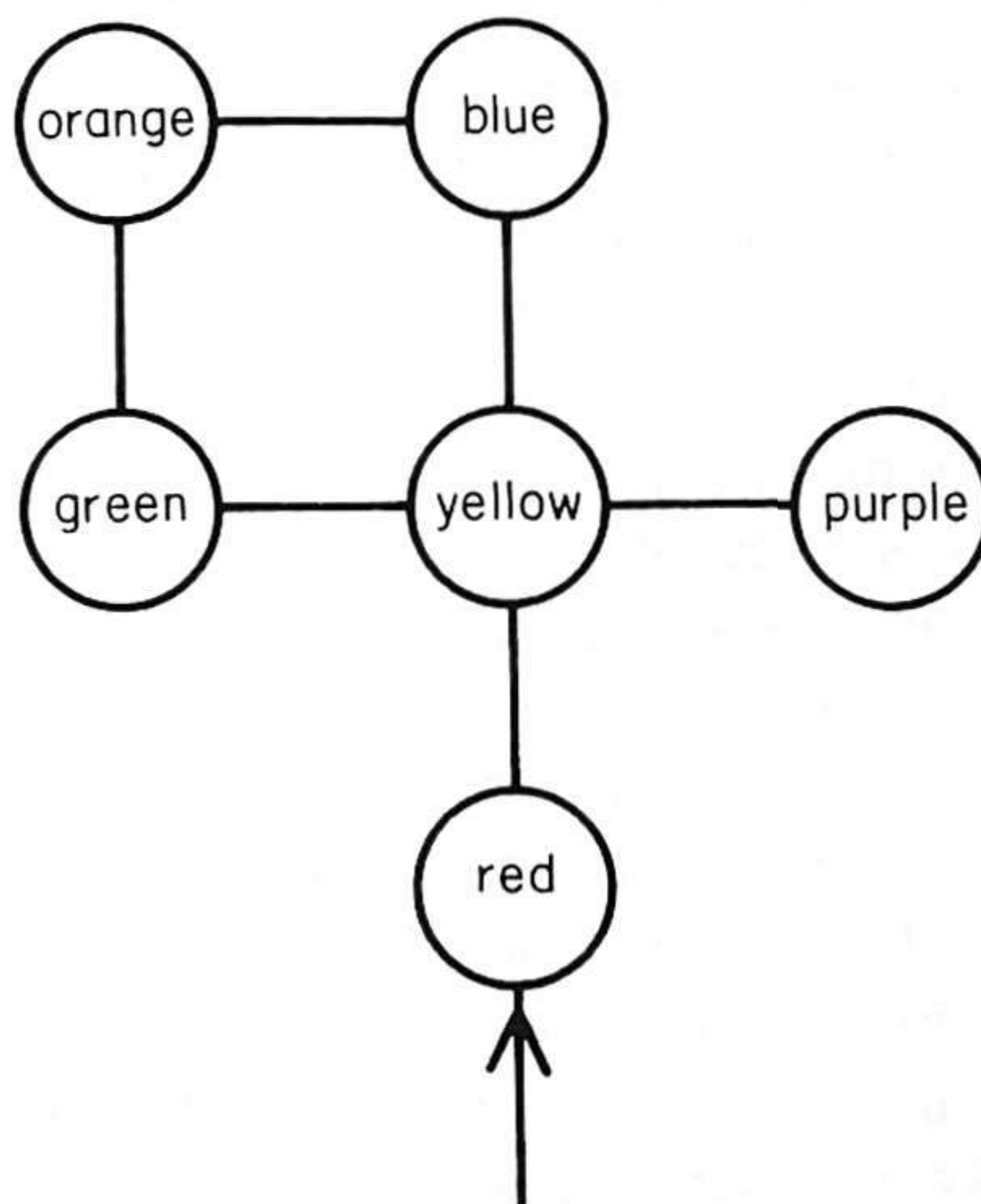

Figure 3   Pattern with a loop. The
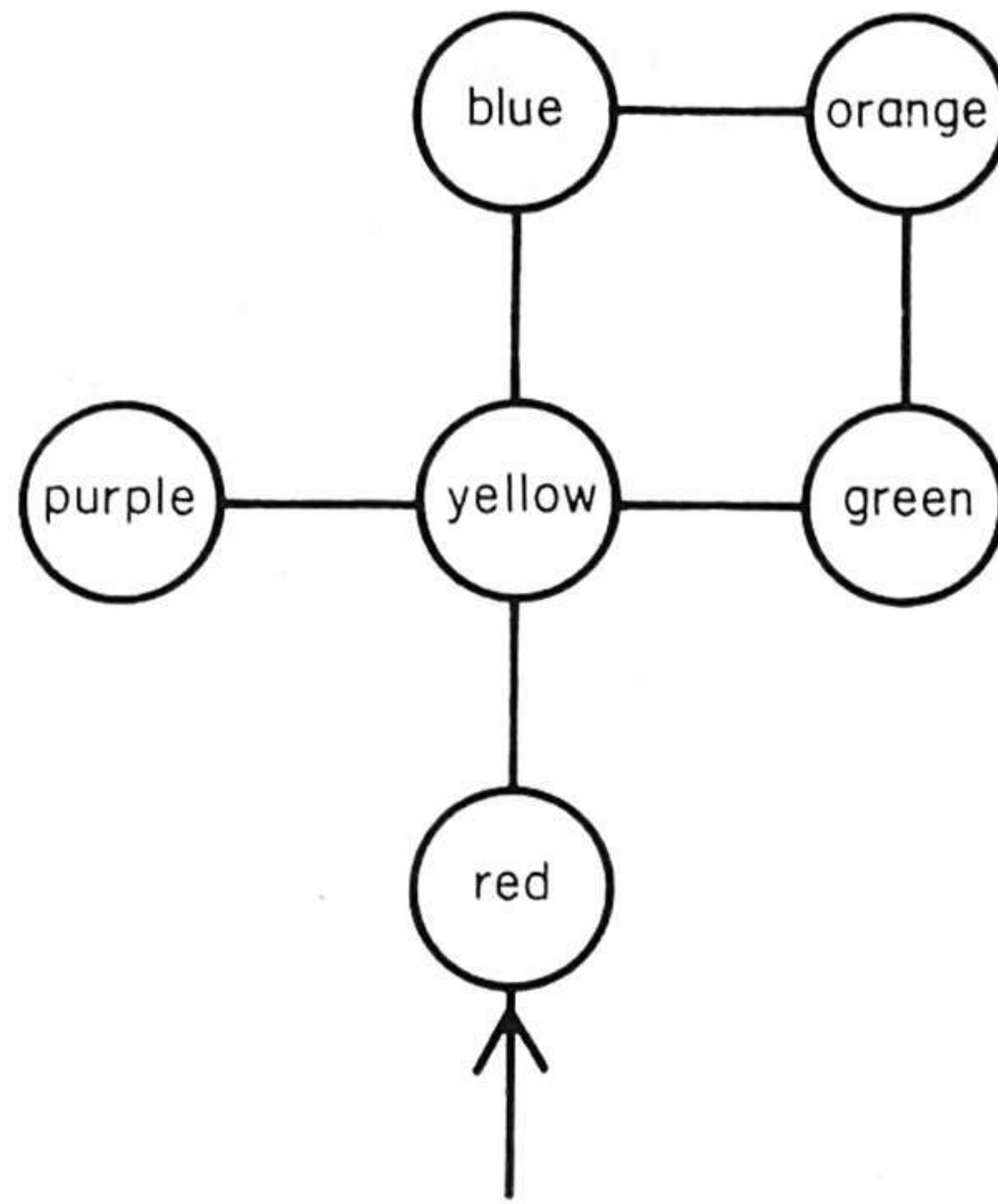description begins at the arrow

Figure 4   A mirror image of the net-
work shown in Figure 3

discuss the case of Figure 3, the other one being the same, *mutatis mutandis*.
The pattern contains a loop, and usually subjects describe a loop by working
all the way around it. In this case they either go from yellow to blue to orange
to green, and back to yellow, or the other way around. Let us assume a
subject starts making the loop via blue. Irrespective of being ego- or pattern-
oriented, the next move direction, to orange, will be described by a term like
'left'. But now consider the following move from orange to green. This *cannot*
be called 'left' if the subject is ego-oriented, since in that framework it is
'towards ego', and a vertical dimension term, like 'down', is the most approp-
riate one. If the subject is pattern-oriented, however, he *cannot* use 'straight'
here, but must instead use 'left'. So it should be possible to distinguish the
same orientation types for this pattern by the use of other terms than in
Figure 1. That is what has been done. Notice that the distinction cannot
always be made: if the subject linearizes the loop by going the other way
round, moving first from yellow to green, it should be the move from blue to
yellow that would distinguish ego-oriented and pattern-oriented direction
terms. But often subjects use the unmarked 'back to yellow' in that case. So, it
is not always possible to distinguish the two types. Tables 3 and 4 present the
distribution of our 34 'clear cases', for Figures 3 and 4 respectively.

Both tables show highly significant consistencies among our subjects. Only
three subjects have changed orientation type in describing Figure 3, and no
more than two out of 34 in describing Figure 4. For completeness it should be
remarked that, on the average, 25 other patterns intervened between the
descriptions of Figure 1 and either of Figures 3 and 4. Figures 3 and 4 were on

Table 3   Distribution of ego- and pattern-oriented descriptions of Figure 3 for ego-
and pattern-oriented subjects*

	Description of Figure 3		
Subjects	Ego-oriented	Pattern-oriented	Indeterminable
Ego-oriented	21	1	0
Pattern-oriented	2	10	0

*Categorized on the basis of their descriptions of Figure 1.

Table 4   Distribution of ego- and pattern-oriented descriptions of Figure 4 for ego-
and pattern-oriented subjects*

	Description of Figure 4		
Subjects	Ego-oriented	Pattern-oriented	Indeterminable
Ego-oriented	21	0	1
Pattern-oriented	2	9	1

*Categorized on the basis of their descriptions of Figure 1.

the average also 25 patterns apart in the series, and all order permutations were possible. We also checked separately whether our 53 subjects were consistent in type between their descriptions of Figures 3 and 4. They were: only one subject out of 47 clear cases was pattern-oriented for Figure 3 and ego-oriented for Figure 4, all others being consistent. Finally, we did one more global analysis over all 53 subjects and 53 patterns. We used an indication for intrinsic orientation which can best be explained from Figure 3. If a subject uses the term 'left' for the direction from green to yellow, this can only be due to intrinsic orientation (or to error); in deictic orientation this direction should be 'right'. Let us, just for shorthand purposes, call this 'contradictory left'. Similarly, one can define 'contradictory right' as for instance 'right' for green to yellow in Figure 4. By means of a computer program we sorted out all cases of contradictory left and contradictory right in our 53 × 53 pattern descriptions. We found that 33 subjects did not show a single case of contradictory left or right. One could argue that these include all ego-oriented subjects, but they may also include some pattern-oriented (intrinsic) subjects since there is not a single pattern where it is *necessary* for an intrinsic subject to use contradictory left or right. (In Figures 3 and 4 such a subject could, for instance, say 'back to yellow', and in so doing evade the use of 'left' or 'right'.) But if orientation types are consistent across patterns, a subject who uses contradictory left or right at least once should be intrinsic as a whole, i.e. all 20 remaining subjects should be of the pattern-oriented type. Counter-evidence against this would be if any of these subjects occurred among the 22

'clear' ego-oriented cases of Table 1. This turned out to be the case for four of the 20 subjects (as compared to 18 for the 33 'non-contradictory' subjects). It shows that absolute consistency does not occur, but even for this very strong test (the subject has 53 patterns in which to be 'contradictory' at least once) the number and seriousness of the deviations is small. The four deviant subjects gave contradictory left or right in three cases on the average. For all 20 subjects who showed such use of left and right the average was eight cases, the range from 2 to 24. A final statistical datum for the consistency of the orientation types is the correlation between the use of contradictory left and use of contradictory right. If we correlate the number of cases 'left' and 'right' over all subjects, we find $r = 0.88$: a subject who tends to use contradictory right also tends to use contradictory left.

From all this, we may conclude that our subjects have a rather consistent style of orientation in describing spatial patterns, both within and across descriptions. Roughly two-thirds of the subjects are ego-oriented in their descriptions, using their own orientation axes as a basis for selecting directional terms. The other one-third consists of subjects who are pattern-oriented; they use the direction of the last move they have made as an orientation for the direction mentioned in the next one.

The obvious question now is whether orientation type has anything to do with linearization type. This will be the topic of the next section.

3 LINEARIZATION TYPE VERSUS ORIENTATION TYPE

The two subjects used as examples turned out to differ in both linearization type and orientation type: he is an ego-oriented jumper and she a pattern-oriented mover. Is it more generally the case that jumpers tend to be ego-oriented and movers pattern-oriented? Let us consider the evidence. Remember that the descriptions of Figure 1 allowed us to find 34 'clear cases' of orientation type. It was also noticed above that 46 out of 47 cases agreed in orientation type between Figures 3 and 4. So, these 46 subjects can also be considered as 'clear cases', though on a different basis. Tables 5 and 6 show how these clear ego- and pattern-oriented subjects distribute over the three linearization types: jumpers, movers, and mixers. Inspection of these tables shows that no significant differences exist in the distribution of ego- and pattern-oriented subjects over linearization types: we have no basis from these data for claiming that linearization and orientation types are related.

Still, it would be surprising if the linearization strategy would affect orientation at no point in the pattern description. The reason is purely procedural. It was noticed in Section 1 that jumpers presumably store unfinished choice points in working memory, in order to ensure correct backtracking. Movers need not do this, as no such storage is required for producing complete descriptions. But what does it mean to 'store a choice point'? Will it be stored

Table 5   Distribution of ego- and pattern-oriented subjects over linearization
types (basis: Figure 1 descriptions, N = 34)

Linearization type	Orientation type	
	Ego-oriented	Pattern-oriented
Jumper	11	8
Mover	8	4
Mixer	3	0

with or without the direction that led into it? The simplest hypothesis is that only pattern-oriented subjects will store the direction, whereas ego-oriented ones will not. A pattern-oriented subject must always relate the subsequent direction *from* a node to the antecedent direction *into* that node, which must be specially registered. But what is the direction into a choice node after a jump? Is it the direction from some far-away node, that happened to be the end of one branch from the choice node? That would not be a very valid system, since that direction can be oblique to different degrees, so that terms like 'left', 'right', and 'straight' cannot be used in a determinate way. It is thus simpler to register the original direction into the choice point, and keep it in working memory for later reference.

Ego-oriented subjects, however, will never need such directional information. They base the choice of their directional terms solely on the direction *from* a node plus their personal orientation. The direction *into* the node is simply irrelevant, and hence needs no storage in their linearization procedure.

If this hypothesis is correct, both ego-oriented and pattern-oriented jumpers will use 'left' or 'right' after jumping back to the red choice point in Figure 1, but for different reasons: the ego-oriented jumpers will label the next move out of red by reference to their own body, the pattern-oriented jumpers will do it by reference to the original move into the red point coming from grey. These two referential devices happen to coincide in this case. What about the movers? If movers don't register choice nodes, they also don't store the direction of the original move into the choice node. Ego-oriented movers

Table 6   Distribution of ego- and pattern-oriented subjects over linearization
types (basis: Figure 3 and 4 descriptions, N = 46)

Linearization type	Orientation type	
	Ego-oriented	Pattern-oriented
Jumper	20	7
Mover	9	6
Mixer	4	0

will simply use their body orientation as the orientation for the next move out of a choice point. They will say 'left' or 'right' when they leave the red choice point of Figure 1 for the second time. Pattern-oriented movers will also have no trace of the earlier move into the choice point, so they will use the last return move as the basis for orientation. They will therefore *not* use terms like 'left' and 'right', but 'straight on' or an unmarked term like 'and then', signalling unchanged continuation of direction. So, in summary: (1) *all* jumpers will use 'left' or 'right' to describe their second move out of the red choice point; (2) *all* ego-oriented movers will do the same; and (3) *none* of the pattern-oriented movers will do so. What we find is that indeed out of our 34 clear cases all of the 11 ego-oriented and eight pattern-oriented jumpers use 'left' or 'right'; all of the eight ego-oriented movers do the same, and none of the four pattern-oriented movers do. (There are further three mixers, all ego-oriented, in the sample; they each use 'left' or 'right', as they should.) These numbers are too small for statistical evaluation, but at least they are in full correspondence with the assumptions. If this result receives further confirmation, one would in general find an interaction between linearization type and orientation type after returns to choice nodes. But this interaction does not signal a correlation between two style factors; it rather is a necessary processing consequence *given* these style factors.

It should have become clear by now that difference (iv) between our example subjects, his saying 'to the right', and her saying 'straight on' after returning to the red choice point, can be explained by such an interaction.

4 SEX AND HANDEDNESS

The use of a male versus a female subject as illustrative cases may have created the impression that females are pattern-oriented movers, and males ego-oriented jumpers. Whether or not this would correspond to any of the pet stereotypes of our culture, the simple fact is that the data show no evidence for this. The 30 female and 23 male subjects of our study distribute about equally over the linearization types, and also over the orientation types.

The situation is somewhat different for handedness, however. After finishing the experiment, and thanks to a suggestion of John Marshall, we were able to recover handedness data for 40 of our 53 subjects. These were categorized as 'pure right-handed' (20 cases) or 'different'; the latter category contained five left-handers, and 15 right-handers who claimed to have left-handers among their own or their parents' siblings.

We found no relation whatsoever between handedness and linearization type, but a noteworthy connection appeared between handedness and orientation type. Tables 7 and 8 show the distribution of the 33 out of 34 clear orientation cases for Figure 1, and the 34 out of 46 clear cases for Figures 3 and 4 for whom we had handedess information.

Table 7   Handedness versus orientation type in Figure 1 descriptions

Handedness	Orientation-type	
	Ego-oriented	Pattern-oriented
Pure right-handers	11	5
Different { Left-handers	2	2
Left-handed siblings	5	8

Table 8   Handedness versus orientation-type in Figure 3 and 4 descriptions

Handedness	Orientation-type	
	Ego-oriented	Pattern-oriented
Pure right-handers	14	4
Different { Left-handers	2	1
Left-handed siblings	6	7

Fischer tests for 'pure right-handed' versus 'different' showed marginal significances: $p = 0.08$ for Table 7, and $p = 0.07$ for Table 8. On the basis of these data we should consider the interesting possibility that pure right-handers take a predominantly deictic perspective, i.e. use their own orientation as a basis for the use of deictical terms, whereas genotypic left-handers (whether phenotypic or not) are less inclined to do so: they easily take an intrinsic perspective, using the pattern's orientation for the selection of their directional terms. This may be an indication of their more general approach to spatial orientations in language use.

In conclusion, then, we have reported strong evidence that systematic individual differences exist in the use of deictical terms, which are not so much due to superficial variations in idiolect, but rather to differences in the ways people operate on spatial information. There is, moreover, some indication that these differences may be in part genetically determined.

NOTE

1. One could argue that what we call intrinsic orientation in the present task is in actuality also deictic: it is ego who makes the tour, and at any moment it is the orientation of ego which determines what is straight, left, and right. If, for Figure 1, ego moves from yellow to red, then grey is left of red. If, however, ego moves from pink to red, then grey is right of red. If both are possible, the direction could hardly be called intrinsic to the pattern. Though we agree that the latter is true, we feel that this is at most a difference in degree with more common examples of intrinsic orientation. If a lampshade is said to be ('intrinsically') to the right side of a chair this is only so

because ego has a preferred orientation with respect to the chair. The ambiguous orientation in the above example of Figure 1 is matched by a 'classical' intrinsic case of a couch. If a flat couch is in the middle of a room, it does have intrinsic orientation, but an ambiguous one: a lampshade is right or left of the couch dependent on how ego 'takes place' on the couch. Intrinsic orientation can be ambiguous in this way because it depends crucially on the *interpretation* of the pattern. Only deictic orientation is always unambiguous because it does not depend on such interpretation.

REFERENCES

Klein, W. (1979). Wegauskünfte. *Zeitschrift für Literaturwissenschaft und Linguistik*, **9**, 9–57.

Levelt, W. J. M. (1981). Linearization in describing spatial networks. In S. Peters & E. Saarinen (eds), *Processes, beliefs, and questions*. Dordrecht: Reidel.

Linde, C., & Labov, W. (1975). Spatial networks as a site for the study of language and thought. *Language*. **51**, 924–939.

Miller, G. A., & Johnson-Laird, P. N. (1976). *Language and perception*. Cambridge, Mass.: Harvard University Press.

Munro, A. (1977). *Speech act understanding*. Unpublished doctoral dissertation, University of California, San Diego.

Ullmer-Ehrich, V. (1979). Wohnraumbeschreibungen. *Zeitschrift für Literaturwissenschaft und Linguistik*, **9**, 58–83.