

## Recognizing Specialized Terminology Presented Through Different Modes

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**ABSTRACT.** In the present study, the authors examined how previous experience and modes of presenting information affect the recognition of terms in new, specialized terminologies. The specialized terminology used was related to orienteering. Orienteering concepts representing features found in the woods may be communicated verbally (as definitions or words) or symbolically. There were 225 participants (101 reported no orienteering experience and 122 reported varying amounts of orienteering experience; 2 did not respond to that question) who tried to identify which of 5 entities was an orienteering definition, word, or symbol. Those with orienteering experience found that recognizing the specialized terminology was significantly easier than for those without experience. Recognizing symbols was significantly more difficult than recognizing definitions or words, particularly for non-orienteers. Performance of the orienteers was similar for the three modes. Within the orienteering group, the number of years of experience and usual course difficulty attempted were significant predictors of overall test success. Applications to training of both low-level specialized terminology (e.g., used in algebra), and higher level terminology (e.g., used in computer science) are discussed.

**Key words:** modes of presenting information, orienteering, specialized terminology

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PEOPLE USE DIFFERENT SPECIALIZED TERMINOLOGIES in different organizations and at different times. For example, in psychological organizations people might talk about *stages of development* or *post-traumatic stress disorder*. In the computer world, people might talk about *RAM*, or *using Flash*. How do people come to recognize that a term is from a particular set of specialized terminology? What kinds of experiences might be helpful in the process of acquiring a new terminology? Finally, are there ways of presenting information that make concepts more recognizable and therefore easier to learn? Knowing the

answers to these questions might help people come up with better ways of teaching specialized terminologies.

Psychologists have studied the development of language for many years, but most of these studies examined the learning of a first language in infants and very young children (Brown, 1988). The task to be studied here is also not equivalent to the learning of a second language, which may often be completely different from someone's first language. The people of interest here already know how to speak at least one language but are faced with recognizing a specialized terminology that, although related to the language that they use in daily life, is only used by certain people in certain contexts.

To study this topic, using a specialized terminology with which most people are unfamiliar should make it easier to differentiate between individuals who know that terminology and those who do not. We chose to study the terminology related to orienteering. *Orienteering* is a sport in which an individual has to find certain places in the woods using a map and a compass. An orienteering racer must go to all the locations that are marked on the map, in the order marked. In orienteering, many of the items that have to be found are topographic features that have unique names, like "reentrant" or "spur"; some orienteering terms are also more commonly known (such as trail or cliff). Most people probably do not know what at least some of the more specialized terms mean.

The use of such specialized terms in orienteering is supplemented by the use of corresponding symbols. These symbols appear in some form on maps but also appear on what are called clue sheets. A clue sheet is a listing of the features that an orienteer is supposed to find sequentially in the woods. Beginning orienteers generally have clues that are written as phrases or single words. As orienteers become more advanced, the clues are first given using both words and symbols; then later they are given in symbolic form only. These characteristics of the orienteering terminology make it a natural way to study (a) how well people who are being exposed to a new terminology recognize initially unfamiliar concepts as being from that terminology, (b) the role of experience in that recognition, and (c) the effect of presenting the concepts using different modes of presentation. Specifically, when the concepts are presented in verbal modes will there be more transfer than when concepts are presented in symbolic modes?

One major variable that will affect how easily someone recognizes certain words is how much previous exposure they have to those words. We examined the effect of the amount of previous exposure on recognizing specialized terminologies in three different ways: First, we compared a sample of people with no

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*We wish to acknowledge the contribution of Patrice M. Miller to the preparation of this manuscript.*

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orienteering experience (non-orienteers) with a sample of people with varying degrees of orienteering experience (orienteers). Because non-orienteers and orienteers were expected to have different degrees of familiarity with orienteering features and the nature of orienteering, we expected the orienteers to recognize more words. Murakoshi (1994) showed that experienced orienteers more accurately reported information about map features, such as their size. Postigo and Pozo (1998) also found novices and experts dealt with maps differently.

Second, we examined the effect of whether someone was a child or an adult. Adults, because of their greater exposure to language in general, were expected to do better than children. Third, the effect of differing amounts of experience among people recruited only at orienteering meets was examined. The more orienteering one has done, the more familiar one becomes with the definitions, words, and symbols involved; so more experienced orienteers were expected to do better.

What factors might affect how easily an individual recognizes information that is presented verbally versus symbolically? Note that being able to recognize orienteering symbols in isolation is not exactly the same as map reading (as seen in Liben, 1999; Liben & Downs, 1992; Postigo & Pozo, 1996, 1998; Tversky, 2000; Zacks & Tversky, 1999) but may be related to it. In general, the symbolic clues are iconic representations of the features they represent. So, the symbol for a trail is a straight, dashed line, and on a map it is generally represented as a dashed line (but one that may not be straight). The symbol for a wall is a line with dots along it, and on a map that is the same. The symbol for the top of a hill (called a knoll) is a symmetrical oval; in a map, the top of a hill may be represented as an oval-like shape that is only sometimes symmetrical. Because the symbols may not be exactly the same as the features on the map, recognizing these symbols may only sometimes generalize directly to map reading. In addition, when the symbols are on the map they are placed in a context with a large number of other symbols and the difficulty of what the reader of the map is trying to do is correspondingly greater.

There have been very few studies of the ease of recognition of information presented verbally versus symbolically, especially those examining stimuli that belong to a specialized terminology. However, there are studies of the effect of mode of presentation on memory and other cognitive processes. For example, Paivio (Paivio & Begg, 1974; Paivio & Csapo, 1973; Paivio & Ernest, 1971) suggested that memory and search times for pictorial information were superior to memory and search times for verbal information. Santa (1977) found that verbal and visual information were stored differently.

An area of study that might be more relevant to this research is the study of the acquisition of characters in the Japanese or Chinese languages. In studies that have compared remembering Chinese characters (or logographs) with remembering English words, the logographs have tended to be remembered more easily, but only by Chinese speakers who are already familiar with them (Liu, 1995).

To examine these two related issues (experience and mode of presentation), we asked participants to identify which of five entities in a multiple-choice type format was most likely an orienteering definition, word, or symbol. We predicted that, to the extent that there is transfer from everyday verbal language to orienteering terminology, even novices could be expected to get some of the verbal items correct, as there would be a certain amount of transfer from one's everyday vocabulary to the specialized vocabulary (e.g., everybody knows what a trail is). Definitions should also be easier because they contain more information than do words. People in general, however, should be much less familiar with the orienteering symbols. Finally, because many studies have found gender differences in spatial abilities (e.g., Malinowski, 2001), in this study we also examined whether there are gender differences in the ease of recognition of symbols.

## Method

### Participants

There were 225 participants, 122 who were orienteers (76 males, 44 females, and 2 unidentified) and 101 who were non-orienteers (51 males, 47 females, and 3 unidentified). A breakdown of orienteers versus non-orienteers who were younger and older than 18 years is shown in Table 1.

We recruited the participating orienteers at a weekend camping recreational orienteering event (attended by boy scouts and local families as well as individuals) and at a national competitive event (mostly experienced orienteers). Their experience in orienteering ranged from none (6 individuals who were novices) to 60 years (1 individual was 76 years old). The mean number of years of orienteering experience was 9.04 ( $SD = 8.75$ ), with a median number of 7.00 years experience.

**TABLE 1. Number of Male and Female Orienteers and Non-orienteers Aged Older and Younger Than 18 Years**

Participant	Orienteers	Non-orienteers
Younger than 18		
Males	31	18
Females	18	3
Older than 18		
Males	45	33
Females	26	44

The non-orienteeing participants were college students of traditional and nontraditional ages from several psychology courses at a college north of Boston, college students of traditional ages we recruited during summer vacation from a suburban Boston location, and students from the Cambridge public schools. Whereas the orienteeing sample alone would have been sufficient to examine differences in experience, the idea behind adding the additional sample of non-orienteeers was to show the difference between people who had absolutely no orienteeing experience and those who had at least some experience.

### *Materials*

We used three sets of paper-and-pencil test items in which the same information was presented in three different modes: as definitions, as words, or as symbols. Each test consisted of five multiple-choice questions each with five items. In each question one of these five items was an actual orienteeing item and four were not.

Five orienteeing items of varying difficulty were chosen to serve as the "items to be recognized":

1. a small valley (reentrant)
2. a small hill (knoll)
3. a small low spot between two hills that looks like a saddle (a saddle point)
4. a sharp drop in elevation, usually rocky (cliff), and
5. a path leading through the woods (trail).

We chose 20 non-orienteeing terms to fill the other choices in the multiple-choice format. The non-orienteeing terms included such items as

1. a large omnivorous mammal with a shaggy coat, usually brown or black (bear)
2. dwelling for a small reptilian animal (snake hole)
3. a tree that is of abnormal size, specifically large (large tree)
4. a formerly living creature that is deceased (dead animal)
5. a natural collection of leaves clustered in one area (leaf pile)
6. a variety of plant that, when humans come in contact with it, they experience rashes and itching (poison ivy)
7. a portion of a trunk or branch that is not connected to a living tree (log)
8. a type of underbrush that has sharp thorns (brambles)
9. a plant that has fronds, no seeds or flowers, and reproduces by means of spores (fern).

Once we chose the terms, we made up the three types of tests. The first type (Test 1 or Mode 1) consisted of definitions of the chosen orienteeing and non-orienteeing terms. The second type (Test 2 or Mode 2) consisted of the one or

two word labels of the chosen orienteering and non-orienteering terms. The third type (Test 3 or Mode 3) consisted of the symbol for the chosen orienteering or non-orienteering term. Since non-orienteering terms did not have pre-assigned symbols, we drew iconic representations of them.

We chose the location of the actual orienteering item randomly for all three test types, and the same non-orienteering items did not always co-occur with a particular orienteering item. Finally, the order in which we presented each group of five was different; that is, in Test 1 (the definition test) the definition for the orienteering term *trail* and its four associated other definitions was first. In Test 2 (the word test), the orienteering term *reentrant* and its associated non-orienteering terms came first. In Test 3 (the symbol test), we presented the orienteering symbol for *knoll* and its associated non-orienteering symbols first.

The Appendix shows a sample definition test question and a sample word test question; Figure 1 shows a sample symbol test question. We compiled the three tests into a single packet. In each packet, the tests occurred in a different order. Some packets had Test 1 first; some had Test 2 first; and some had Test 3 first. We distributed approximately equal numbers of each type of ordering.

In each group of symbols below, circle the one symbol that you think really shows a feature that one would look for in orienteering. Please give your best guess.



FIGURE 1. Items from the symbol test.

### *Procedure*

For the non-orienteers, we distributed the materials to the students either at the beginning or the end of class, and they filled out the questionnaires while sitting at their usual desks. We told the students that they were free to participate or not; there was no extra credit or other inducement given. We gave those who chose to participate a brief summary of what orienteering is: "In orienteering, individuals use a map and a compass to locate different places and features in the woods." We told students, "You will be asked to read the material that is presented in different ways and to answer questions about it." Students were also told to return the materials without filling them out if they already knew something about orienteering.

In each test, students were asked to "circle the one description/word/symbol that you think really names/describes/shows" a true orienteering description, word, or symbol. Students completed the packets in about 5 min.

We approached participants who were recruited at orienteering events (orienteers) individually and asked them to participate in a short survey about orienteering. We approached them either before they went orienteering or after they had returned from their course. Most people filled out the questionnaire while the investigator waited; some took it to a nearby table to fill out and then returned it. Orienteers were not asked to return the survey if they had orienteering experience, and they were not given an introduction to orienteering.

### **Results**

In the first analysis we examined how many people had 0, 1, 2, 3, 4, or 5 questions correct on each type of test. We scored an answer correct if the participant identified the actual orienteering definition, word, or symbol. Table 2 shows the mean number correct for non-orienteers and orienteers (men and women separately) on all three tests. As Table 2 and a repeated-measures analysis of variance (ANOVA) show (see Table 3), non-orienteers scored significantly and consistently lower than orienteers on all three tests,  $F(1, 203) = 121.80$ ,  $p < .0005$ ,  $\eta^2 = .45$ ; mode of presentation was the within-factor variable, orienteering status and gender were between-factors variables, and age was entered as a covariate. As the effect size shows, orienteering experience made a large difference. For example, on the symbols questions, non-orienteering women had a mean of .93 compared with 3.83 for orienteering women. On the definition questions, the non-orienteering men had a mean of 2.53 compared with 3.483 for orienteering men.

Because there were a number of possible differences in education and profession in the adult sample, we performed a second repeated-measures ANOVA (with mode of presentation as the within-factor variable and orienteering status as the between-factors variable) for the participants who were

**TABLE 2. Mean Number Correct (and Standard Deviations) for Male and Female Non-orienteers and Orienteers on Test 1 (Words), Test 2 (Definitions), and Test 3 (Symbols)**

Test	Non-orienteeing		Orienteering		Overall	
	Male ( <i>n</i> = 49)	Female ( <i>n</i> = 45)	Male ( <i>n</i> = 72)	Female ( <i>n</i> = 42)	Male ( <i>n</i> = 114)	Female ( <i>n</i> = 94)
Definitions						
<i>M</i>	2.53	2.18	3.83	4.33	3.31	3.22
<i>SD</i>	1.56	1.45	1.36	.98	1.58	1.65
Words						
<i>M</i>	2.08	1.64	3.81	4.31	3.11	2.93
<i>SD</i>	1.46	1.37	1.63	1.02	1.77	1.80
Symbols						
<i>M</i>	1.31	.93	3.44	3.83	2.58	2.33
<i>SD</i>	1.29	.94	1.75	1.45	1.90	1.89

*Note.* Ten individuals left either the definitions, word, or symbols test blank, resulting in data for only 208 of the participants.

aged 18 and younger, where such differences were likely to be somewhat less. This analysis showed that the younger orienteers still did significantly better than the younger non-orienteers,  $F(1, 65) = 9.26, p < .003, \eta^2 = .126$ , a small effect size.

Note that the division here between older and younger than 18 is based solely on the fact that, on average, starting around age 18, young adults in this culture attend college and increasingly begin to specialize in terms of education and career-related activities. In orienteering, the relevant split between adults and "juniors" seems to be at age 21, not 18. A second ANOVA, calculated on those 21 years and younger in this sample, showed that orienteers 21 years and younger did significantly better than non-orienteers in the same age bracket,  $F(1, 106) = 41.42, p < .0005, \eta^2 = .28$ , a moderate effect size.

In the same repeated measures ANOVA (Table 3), we found that different modes of presentation of information also made a significant difference in how well people correctly identified an item as an orienteering item,  $F(2, 406) = 7.39, p < .001, \eta^2 = .035$ , a very small effect size. As the third column of Table 2 shows, the participants as a whole did best on the definitions questions and worst on the symbols questions. There was no significant main effect of gender; however, there was a significant effect of age,  $F(1, 203) = 38.71, p < .0005, \eta^2 = .16$ , a small effect size; the mean score of those older than 18 was 3.14 ( $SD = 1.55$ ), whereas for those younger than 18 the mean score was 2.20 ( $SD = 1.25$ ).



**TABLE 3. Analysis of Variance: Test Type (Within Factor), Gender, Orienteering Status (Between Factors), and Age as Covariate**

Source	SS	df	MS	F	$\eta^2$	p
Test	12.99	2	6.496	7.39	.035	.001
Test $\times$ Gender	.11	2	.055	.06	—	ns
Test $\times$ Orienteer	14.86	2	7.43	8.45	.040	.0005
Test $\times$ Age	.46	2	.228	.26	—	ns
T $\times$ G $\times$ O	.25	2	.123	.14	—	ns
Gender	.897	1	.897	.25	—	ns
Orienteer	505.70	1	505.70	141.80	.41	.0005
Age	138.05	1	138.05	38.71	.16	.0005
Gender $\times$ Orienteer	37.32	1	37.32	10.46	.049	.001
Error	723.93	203	3.57			

The finding that orienteering experience and mode of presentation both affected performance was slightly altered, however, by the finding that there was also a significant interaction of mode of presentation with orienteering experience,  $F(2, 406) = 8.455$ ,  $p < .0005$ ,  $\eta^2 = .04$ , a very small effect size. Mode of presentation made a much bigger difference for non-orientees than for orientees, as seen by the fact that orientees scored at almost the same level for all three tests, whereas non-orientees did much worse on the symbols test, somewhat better on words, and best on definitions (see Table 2). We tested this result by calculating contrasts for both the main effect of orienteering and the interaction of orienteering status by mode of presentation. There was a significant linear effect of type of test for the sample as a whole,  $F(1, 203) = 12.15$ ,  $p < .001$ ,  $\eta^2 = .056$ , and there was a significant linear effect for the interaction of orienteering status by mode of presentation,  $F(1, 203) = 13.9$ ,  $p < .0005$ ,  $\eta^2 = .064$ , a small effect size.

We had hypothesized that men would do slightly better than women. Although there was no overall gender difference, there was a significant interaction of gender and orienteering experience,  $F(1, 203) = 10.464$ ,  $p < .001$ ,  $\eta^2 = .049$ , a very small effect size. Female orientees had higher average correct scores ( $M = 4.07$ ) than male orientees ( $M = 3.64$ ), whereas female non-orientees had lower average correct scores ( $M = 1.73$ ) than did male non-orientees ( $M = 2.29$ ).

To further explore the role that experience might play in participants' performance on this test, we used a Rasch (1980) analysis, which transforms the raw data into a unidimensional, linear, equal-interval scale, to create scaled scores. The advantage of a Rasch analysis is that the resulting score for each participant will be a joint function of the difficulty of the individual items and the prowess

of the participants in identifying which items belonged to orienteering. The Rasch measurement model uses the logistic function to transform data obtained from dichotomous or polychotomous responses to a set of statements on an interval scale with equality of intervals. Because Rasch analysis allows for the equal interval scaling as to the difficulty of the items themselves, we used it here to further examine both the effects of mode of presentation and of two measures of experience.

Figure 2 shows the Rasch scaling of the 15 items: 5 definition items, 5 word items, and 5 symbolic items, in terms of their relative difficulty. Items toward the top of the figure are less difficult. Note that the items show a relatively small range of difficulty, equal to about 3 logits. Four of the symbol sets were more difficult than the mean difficulty, with the most difficult set being Symbols 4 (the orienteering symbol was *cliff*). The first of the word sets, (the orienteering word was *reentrant*), was slightly more difficult than Symbols 4. Three of the definition sets and three of the word sets were easier than the mean; only one of the symbol sets (*knoll*) was slightly easier than the mean.

As suggested earlier, a Rasch score can also be created for each individual; this score reflects how they performed in relation to other individuals, given the difficulty of the task. The more negative a Rasch score was, the better the individual's performance on the test. It would be interesting to know whether the type or amount of orienteering experience, or other factors, would be influential. To answer this question, the individual Rasch scores for orienteers only were predicted in a regression analysis that examined the effects of the level of difficulty of the orienteering course that an individual usually ran<sup>1</sup> and the individual's number of years of orienteering experience.

Because these variables could also combine to affect how well a participant did, we added the interaction of level of difficulty and number of years of orienteering to the regression equation. All three of the variables significantly predicted an orienteer's score, but the main effects and the interaction had opposite effects. Recall that more negative Rasch scores mean a better overall performance. The difficulty of the participant's normal course contributed to a participant's overall Rasch score,  $\beta = -.745$ ,  $t(98) = -5.108$ ,  $p < .0005$ ; that is, the more difficult a course someone generally runs, the better their performance. The number of years of orienteering experience also contributed,  $\beta = -1.547$ ,  $t(98) = -5.311$ ,  $p < .0005$ ; in other words, the number of years of ori-

<sup>1</sup> Note that orienteering courses vary greatly in difficulty; the lowest level is called *White*. A White course involves finding locations that are quite obvious and can be reached easily using trails (it is also much shorter in length). The most difficult course, called *Blue*, involves running long distances, rarely using trails, but also involves finding features that are extremely difficult to find, most often because of their lack of proximity to anything else that is easily recognizable (so one may have to find one reentrant among 5 or 6 nearby ones).

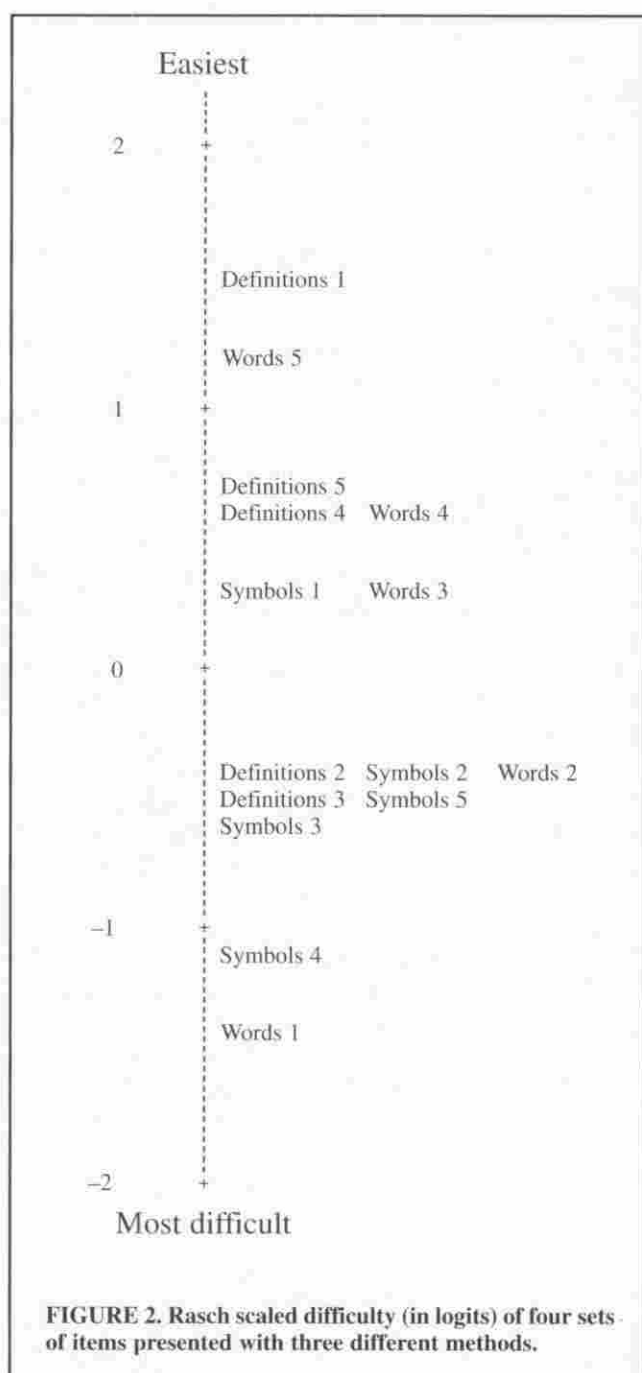


FIGURE 2. Rasch scaled difficulty (in logits) of four sets of items presented with three different methods.

enteering experience contributed almost twice as much to someone's score as the difficulty of one's normal course. In short, individuals who had been orienteering for more years tended to do better than individuals who were just doing higher courses but were perhaps not as experienced. The combination of course difficulty and years of experience (the interaction term) made Rasch scores more positive, which indicated a worse performance,  $\beta = 1.648$ ,  $t(98) = 4.55$ ,  $p < .0005$ . The three variables together in the model accounted for 39.6% of the variance in the data,  $R^2 = .396$ ,  $F(3, 102) = 21.648$ ,  $p < .0005$ .

A second model also included age. This model added .03 to the amount of variance accounted for, with age itself making a smaller but still significant contribution to the participant's score. However, because age and the number of years of orienteering experience were highly collinear, and the variable that was of most interest was not age per se, but experience, irrespective of age, we decided to use the model without age.

### Discussion

Experience was an important variable in predicting how well someone would score on this task as shown by all three measures of experience. Orienteers, who had more experience with the definitions, words, and symbols used, did better than non-orienteers did. Adults did better than children did. And finally, orienteers who had more experience did better than did orienteers who had less experience.

As predicted it was also more difficult for participants to judge whether different symbols were orienteering symbols or not, whereas it was easier for them to make these judgments about definitions and words. This was seen both in the mean scores presented for orienteers and non-orienteers and by the scaling of the items by the Rasch analysis. These findings are different from the work on memory for symbols (e.g., Paivio & Begg, 1974; Paivio & Ernest, 1971) but are consistent with the suggestion that symbols may only be easily recognizable for individuals who have already had experience with them (Liu, 1995). In addition, they confirm the findings of Liben and Downs (1992) and Liben (1999) who have reported, on the basis of a variety of studies, that comprehension of map-related symbols and of maps themselves is gradual and seems to lag well behind the development of verbal language-related skills.

The mode of presentation made a particular difference when people had no exposure to the specialized terminology; non-orienteers, for example, had more difficulty with symbols than orienteers. What was surprising, perhaps, was that the non-orienteers did get some items correct, particularly on the definitions and words, with somewhat higher scores on the definitions than on the words. This suggests that there is overlap between everyday (verbal) language and specialized terminology. Among the orienteers, people recognized orienteering items with pretty much the same accuracy across the three methods. With respect to the

symbols, it may have been more difficult for the non-orientees to even recognize what these symbols represented. As a result, differentiating them from other symbols would be hard.

With the definitions and the words, they might be able to figure out that some of them (e.g., *trail*) would probably apply to orienteering, whereas others (e.g., *bear*) might not. If we had used more extensive definitions (rather than single words) it would have been easier still because having more information could have helped participants to make better guesses about which items might be orienteering items. Perhaps because of this kind of common-sense reasoning, one non-orienteer had a perfect score on both word and definition tests.

One potential difficulty in interpreting the difference between the orientees and the non-orientees is the difference in how they were sampled. In our sample, the adult orientees often came from technical fields, whereas adult non-orientees were largely college students, who may have had less technical background. To investigate further the effect of orienteering, however, we did another analysis with just the younger (under 18) orienteering participants. These were all students who were attending orienteering events because they were brought by parents or other adults (such as scout leaders). Even within this group, orientees were significantly better at recognizing the orienteering terminology. Future researchers could examine in more depth the influence of different kinds of backgrounds on the ability to recognize this kind of specialized terminology.

As reported in the second part of the analysis, within the orienteer sample there was a difference between less and more experienced individuals. There was a large improvement in performance based on both the number of years of orienteering experience and the level of difficulty of the orienteering course. Although experience was more important, how difficult the type of orienteering course someone usually ran also contributed significantly to participants' scores. As the orienteering courses become more difficult, two things change. One is that there are more specialized orienteering features that are used in the clue sheets, such as reentrants or knolls. The second is that one increasingly uses only the symbols for features instead of the definitions or words. Even in this specialized terminology area, this parallels what generally happens in society. That is, with education (which is equivalent to experience here) people acquire a larger vocabulary or more sets of specialized terminology.

One can see that symbols could present learning difficulties in a variety of different contexts for many individuals; for example, in school, people begin to first encounter symbols in geography and later in algebra. Many people do not have as much difficulty with geographic symbols as they seem to have with the use and understanding of the algebraic symbols. The orienteering symbols are more abstract than most of the geographic symbols taught in school. Liben and Downs (1992) suggest that one reason why people's symbolic learning

may lag is because of the relative lack of exposure to symbols, especially during childhood. In today's society there are many specialized terminologies that people need to learn if they are to function in some professions, such as programming computers. The findings of this study may be relevant for people learning such new terminologies. Building in the transfer of information explicitly from one's current language, such as putting the symbol that one wishes to learn with a definition or a word describing it, would facilitate such learning.

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