



## Spatially Oriented and Person Oriented Thinking—Implications for User Interface Design

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Identifying aspects of individual cognitive variation of relevance for the design of instructional multimedia is argued to be an important research task. A study is presented in which two candidates, person oriented thinking and spatially oriented thinking, were explored. Two different user interfaces to an application, one with a person related format and the other with a spatial format, were used, and participants were asked to choose between the two versions and to motivate their choice. Two main tendencies appeared. Interface preferences tended to correlate with style of thought as well as with gender.

**Keywords:** instructional multimedia; user interface preferences; person oriented thinking; spatially oriented thinking; gender.

### Introduction

In educational psychology one finds several theories and models that describe aspects of individual cognitive variation. There are theories of cognitive styles (e.g., Witkin *et al.*, 1977; Pask and Scott, 1972; Riding, 1997), theories of learning styles (e.g., Kolb, 1976, 1984; Entwistle, 1979, 1988; Dunn *et al.*, 1989) and theories of multiple intelligences and cognitive profiles (Gardner, 1983, 1991, 1999). Furthermore it is proposed in different contexts that education ought to accommodate to cognitive variation among students (see e.g., Pask and Scott, 1972; Witkin *et al.*, 1977; Gardner, 1991; Sternberg, 1994; Davis, 2000, as well as many curricula).

Instructional multimedia offers some new possibilities to present a material in several alternative ways. For instance, it can provide alternative entry points to a subject and thus accommodate some of the cognitive variation in a student group. At the same time it is of course not possible to accommodate to *all* known aspects of cognitive variation. It is a *research task* to identify instances of cognitive variation that would be important and fruitful to seek to adapt instructional multimedia to.

### The Project

In the study, presented in this paper, the following two instances of cognitive variation were explored with respect to the design of pedagogical applications:

- Variation in *spatially oriented thinking*, i.e., in abilities and motivation to handle spatial knowledge structures and representations.
- Variation in *person oriented thinking*, i.e., in abilities and motivation to handle knowledge structures and representations that relate to interpersonal and intrapersonal phenomena.<sup>1</sup>

It should be pointed out that there is no conflicting relation between the two types of thinking: Both may be equally well—or equally little—developed in one individual.

There were two main reasons for choosing these two instances of cognitive variation for study. Firstly, both these kinds of cognition are, in a sense, central in human thinking. A human being is a spatial as well as a social creature, equipped with abilities to handle social and spatial information and with some motivation to explore and deal with spatial and social environments. This makes frameworks in the form of social environments and spatial environments, respectively, suitable as *formats* for presenting various knowledge materials. (An example of a social or person related framework could be “a circle of friends, a working team, a class, etc. with their relations and interactions” or “the members of a family with their different personalities and their lives in some aspects”. An example of a spatial framework could be “an outer space environment” or “a particular village with its spatial structure”).

Secondly, the *variation* in both these kinds of thinking<sup>2</sup> in a human population has been relatively well documented.<sup>3</sup> It should be noted that some of the documented variation is gender related. There are more females than males amongst the individuals that score high on some of the aspects of person oriented thinking, and there are more males than females amongst the individuals that score high on some aspects of spatially oriented thinking.<sup>4</sup> That there is a relatively large body of studies that show variation in the two aspects is important since the aim of the present project is to explore the possible *relevance* of aspects of cognitive variation for the design of instructional multimedia—not to explore aspects of cognitive variation as such.<sup>5</sup>

### **Purpose and Objectives of the Study**

In the present study two different user interfaces to one and the same application were presented to the participants. The two user interfaces employ, respectively, a *spatial* and a *person related* format for organizing the information and presenting the functions of the application. The purpose of the pilot study was to explore the following issues:

1. Would a variation in preferences show up—or would all or a large majority prefer *one* of the user interfaces?
2. If a variation in preferences showed up, was this due to the two different presentational formats? In other words, were the spatialization and the personalization of information, respectively, important factors behind preferences?

The second issue was assessed in two ways:

- a) Participants were asked to give reasons for their choices, and the answers were analyzed in order to find which aspects of the user interface designs that, according to the motivations given, contributed to the choices.
  - b) Relations between choice of user interface and style of thought—according to the categories “more spatially oriented than person oriented”, “more person oriented than spatially oriented” or “equally person oriented as spatially oriented”—were analyzed. The style of thought was estimated by means of an interview and some tests. In particular, the prediction that participants with predominantly spatially oriented thinking would tend to chose the user interface employing a spatial format, and that the participants with predominantly person oriented thinking would tend to prefer the user interface employing a person related format, was examined.
3. Given that at least some aspects of spatial and person oriented thinking are known to correlate with gender—and that the user interfaces employ spatial and person related formats respectively—also correlation between user interface preferences and biological sex was checked for.

The overall aim was to find possible tendencies to follow up with larger scale studies. It should be noted that only variation in *preferences* as to the different user interfaces was explored in this study. In order to look further for pedagogical implications of cognitive variation and user interface design, a coming study will focus on whether different user interfaces have an effect on how easily participants retain new information conveyed.

## Method

Twenty four adults, 12 women and 12 men, aged between 23 and 59, all visitors at a public library, participated in the study as volunteers.<sup>6</sup> The test sessions were carried out at the public library. No reward was offered.

The material consisted of two different user interface prototypes to one and the same application. One of them—The Book Park—employs a spatial format for organizing and presenting the information, the other—The Book People—employs a person related format (Figure 1).

The user interfaces were designed to be as equivalent as possible in the following respects:

- Complexity. The two interfaces are equally rich in the level and amount of detail. This was to prevent that one of the user interfaces would be preferred as being more complex and richer and therefore more interesting. Or, inversely, that one of the user interfaces would be preferred as being simpler and cleaner.
- Style of visualization. One and the same graphic designer—himself not more spatially than person oriented, nor vice versa—produced the pictures, layout, etc. for both user interfaces, deliberately using a similar style. This was to prevent choices due to style preferences.
- Degree of imaginativeness or realism. This was to prevent preferences relating to this property.

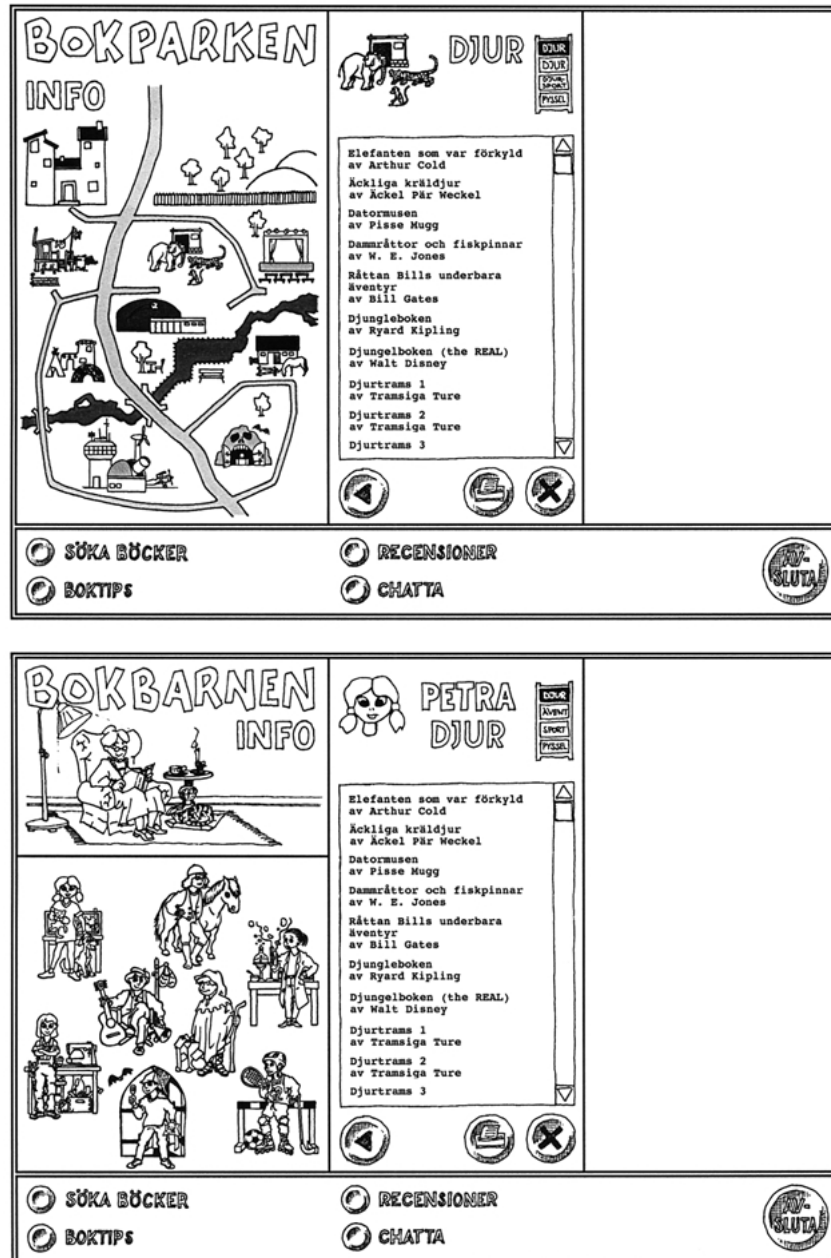


Figure 1. Two alternative user interfaces to a program—the *Book Park* and the *Book People* versions.

- Gender neutrality. Stereotypically feminine or masculine elements, in either form or content, are avoided. This was of particular importance since one of the issues that the study addresses is whether user interface preferences correlate with gender.

Pretests were carried out with respect to the listed properties.

The participants were told they were going to test two versions of a program concerning books and that they would be asked which one they themselves would rather use. They were also told that they would be asked some questions about their interests and their background.

They were first shown the start screen of one of the user interfaces—version A—and briefly thereafter the start screen of the other interface—version B. They were then given a brief description and demonstration of version A followed by an equivalent brief description and demonstration of version B. The order of presentation was balanced: Version A was shown and presented first for 6 men and 6 women, and version B was presented first for 6 women and 6 men.

After the participants had stated which user interface they preferred, they were asked to give reasons for their choice. They were encouraged to think and reason as much as they liked.

An interview followed as well as some tests aiming at giving an indication of the participant's spatial interests and abilities (for example, whether they enjoy constructing and building things, whether they find it easy to form an overview of a building or an area that they visit for the first time; whether they are good at spatial rotation tests, etc.) and of their person related interests and abilities (for example, whether they enjoy reading biographies and stories in diary form, whether they, in general, find it easy to understand how other people think and reason, whether they appreciate a personalized version of a piece of advertisement presented to them or not.) The interview questions and tests, as a whole, were developed specifically for the study.<sup>7</sup>

Using the results gained from the interview and the tests,<sup>8</sup> the participants were classified either as “to a higher extent person oriented than spatially oriented in their thinking”, “to a higher extent spatially oriented than person oriented in their thinking” or “to similar extents person oriented and spatially oriented in their thinking”.<sup>9</sup> Finally they were asked for age, kind of computer experience and education/profession.

The whole session typically lasted 1.5 hours (between 40 and 110 minutes, with an average of 95 minutes).

## Results

The pilot study was of an explorative character, involving a limited number of participants. The number is *too* limited if one is looking for statistical significance in the results taken in isolation. The alternative approach, adopted in this project, was to also consider relations between parts of the study as well as relations to results from other studies. Doing so, the following tendencies, to be explored further, appeared.

First of all, it was not the case that all or even a majority preferred *one* of the user interfaces, but ten participants chose the Book People and twelve participants chose the

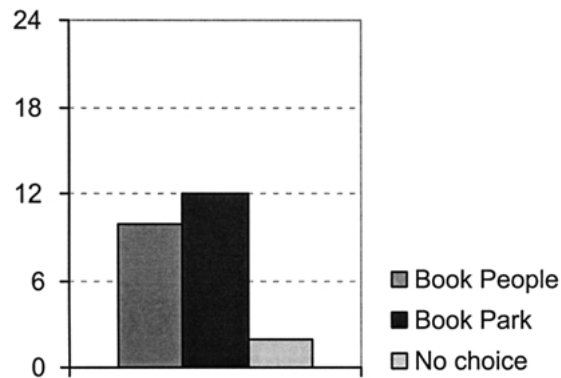


Figure 2. User interface preferences.

Book Park version (Figure 2). Two participants found that they could not choose but insisted that they “preferred both”. No effect of order of presentation on the participant’s preferences was found.

Eleven out of the twelve that chose the Book Park and six out of the ten who chose the Book People interface, furthermore, made their choice without hesitation and without expressing any uncertainty when reasoning about their choice.<sup>10</sup> Two participants preferring the Book Park and two participants choosing the Book People expressed doubt that there *could* be anyone who preferred the other design.

#### *The role of the presentational formats*

Turning to the prediction that the two different presentational formats, with their ways of structuring and presenting information, would influence the choice of interface, 18 participants out of 22 (not including the two participants who did not make a choice) gave motivations that support the prediction. Below are some examples of such motivations given by participants who chose the Book Park:

“I like the maps. I used to draw maps like these when I was little and have always enjoyed exploring such worlds.”

“When the task is to learn where different things are it is much easier for me to think spatially.”

“The park fits my way of thinking.”

“I immediately thought that it is easier to find information in this version.”

Some examples of such motivations given by participants who chose the Book People are the following:

“Spontaneously I just felt that I prefer that one . . . I don’t know exactly why . . . But I think that the information is more accessible in that one, using people.”

“It’s more personal, about people, individuals. [. . .] more pleasant way to present information.”

“A park with houses . . . I have been in too many games where you walk from room to room, often without a real reason to explore really. A social context is more stimulating to explore, I think.”

“It’s more natural and easy for me to relate to the people. The park is less natural.”

However, also some other design features were indicated in motivations given. Two of the participants who chose the Book People made comments that indicate that the reason for their choice was that they experienced this user interface as more realistic and credible than the Book Park.

“Both are *stories*, but the people *might* exist really. The park is just a framework, it is just added.”

“The people are somehow more direct and more realistic.”

One of the participants who chose the Book People and two of the participants who chose the Book Park made comments that indicate that the reason for their choice was that the chosen user interface, in their opinion, is more united or integrated:

“[The Book People version] is more intimate. The park is larger, spread out.”

“The Park is clearer and more homogenous.”

“I find the presentation [in the Book Park] attractive; it is more collected.”

#### *Interface preferences and style of thought*

Concerning relations between participants’ choice of interface design and their style of thought as assessed by interview and tests, the result was as follows: Out of the 10 participants who chose the Book People, seven were categorized as predominantly person oriented in their thinking; two were categorized as predominantly spatially oriented and one was categorized as neutral in style of thought (i.e., equally person oriented and spatially oriented).

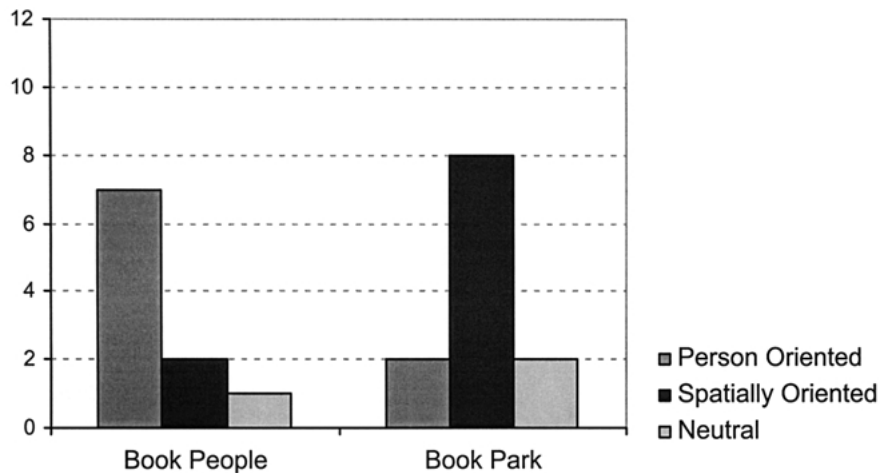


Figure 3. Interface preferences and styles of thought.

Out of the 12 participants who chose the Book Park, two were categorized as predominantly person oriented in their thinking, eight were categorized as predominantly spatially oriented and two were categorized as neutral in style of thought (Figure 3).

The *motivations* given for the choices of interface show a concordance with the results of the interview and test for assessing style of thought. This increases the likelihood that the motivations given indicate actual factors behind the choices instead of being “just invented” post hoc as a search for a difference between the two alternatives. Correspondingly, it strengthens the hypothesis that there is a substantial, and not just coincidental, relation between style of thought as assessed, on the one hand, and the choices of interface, on the other hand.

#### *Interface preferences and gender*

Checking for relations between gender and choice of interface design the result was the following: Out of the 10 participants that chose the person oriented version, 7 were women and 3 men, and out of the 12 participants that chose the spatially oriented version 8 were men and 4 women (Figure 4).

Taken together with evidence from other studies that show gender related differences in aspects of person oriented and spatially oriented thinking, there is reason to believe that the pattern seen here is not just a random result but worth investigating further.

#### *Possible interaction effects*

Interface preferences thus tended to correlate with *style of thought* as well as with *gender*. Participants with person oriented thinking as well as female participants tended to choose



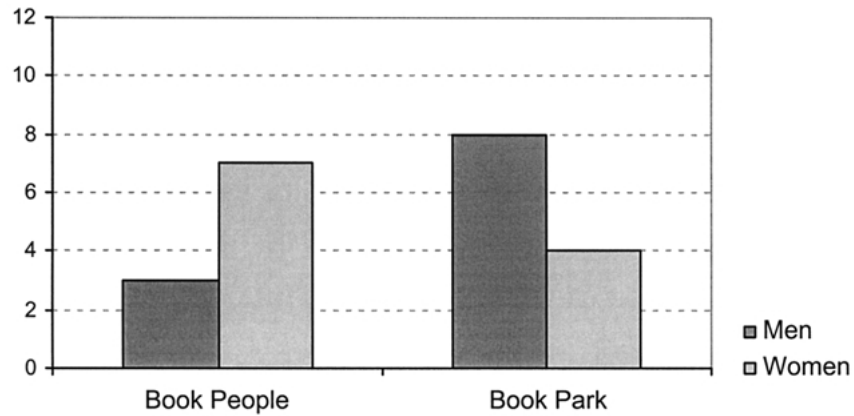


Figure 4. Interface preferences and gender.

the Book People, and participants with spatially oriented thinking as well as male participants tended to choose the Book Park. Given this one might expect a correlation in the material between style of thought and gender. (And indeed, cognitive variation in aspects of spatially oriented thinking as well as in aspects of person oriented thinking has been established as being gender related.) In the material of this study, however, no such correlation can be seen. Five men and four women were categorized as predominantly person oriented in their thinking; six men and four women were categorized as predominantly spatially oriented in their thinking. One man and four women were classified as neutral (Figure 5).

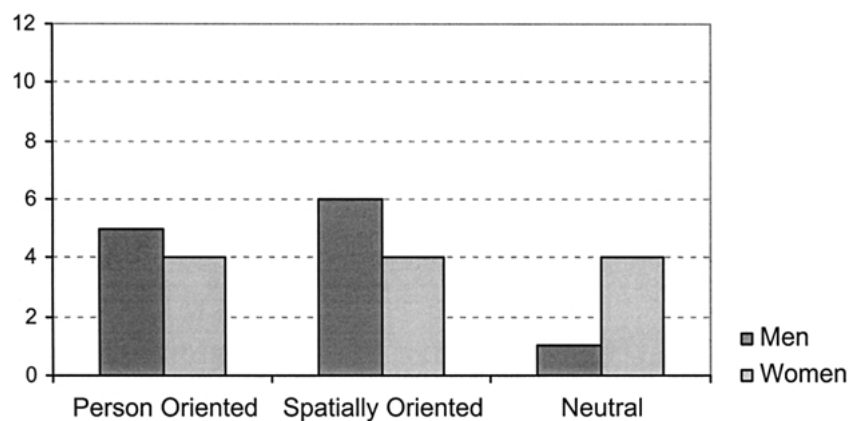


Figure 5. Gender and styles of thought.

Yet it is possible judging by the data that the two variables, style of thought and gender interact. Of the participants categorized as predominantly spatially oriented *all* of the six men, but only two of the four women, chose the *Book Park*. Correspondingly, of the participants categorized as predominantly person oriented *all* of the four women, but only two of the four men, chose the *Book People*. Given the small number of participants, the tendency could be due to random factors, but we find it worthwhile to investigate further in a larger scale study.

### *Summary of results*

The main result of the study is the identification of a major divergence in individuals' judgments on the attractiveness of a spatial context and a social context in an IT-application. It should be pointed out that, with respect to the goal of providing IT-designs that take cognitive variation into account, such a divergence in attitudes can be relevant regardless of whether it is *gender related* or not and regardless of whether it is related to *styles of thought* or not.

In the following section, other research on peoples' attitudes to spatial and social frameworks in IT-applications is discussed.

## **Discussion**

### *Relation to other studies*

Joiner (1998) studied girls' and boys' preferences for four different interfaces to one and the same computer based problem. Three of the four interfaces—"The Princesses", "The Pirates" and "The Honey Bears"—employ a person oriented presentation, whereas the fourth—"Blocks World"—gives an impersonal and abstract presentation of the problem. "Blocks World" is, furthermore, a presentation with a higher degree of spatiality than the other three. The participants were 16 boys and 16 girls, all aged between 10 and 11. One significant variation between the boys group and the girls group was the *weak* preference among the girls for "Blocks World", which is the only of the four user interfaces that presents the problem in an impersonal and abstract way and, furthermore, with a high degree of spatiality. For the other three user interfaces, they had equally strong preferences. The boys, on the other hand, preferred the impersonal, and to a high extent spatial "Blocks World" as much as "The Princesses" and "The Honey Bears". (It should be emphasized that Joiner does not recognize spatial and social frameworks as variables, but is researching the role of gender stereotypes and the relation between preference and performance.)

There is a large body of research on differences in *performance* with spatial user interfaces. In general, however, differences in *attitudes* towards spatial contexts and structures in software have been little studied.

Regarding attitudes to social contexts and formats in software, on the other hand, there is the growing literature on *social navigation*. Several studies within this tradition have investigated user reactions to social frameworks, for instance systems where reviewers provide personal background information about themselves or information systems where various forms of personal traces are being left. (Dieberger, 1999; Svensson, 2000; Dieberger *et al.*, 2000; Höök *et al.*, 2000).

The result of these studies is that one, relatively large, group of participants appreciate the person oriented and social features of the programs. In interviews they state that they find the programs more attractive and inviting—for instance, “more alive and fun to use”—when person oriented. Some participants express a desire that more social and person oriented features should be added to the programs (Dieberger *et al.*, 2000; Höök *et al.*, 2000). But in all studies there is also a group of participants who do not react positively to the person oriented formats. Their verbal utterances and comparatively little activity in terms of the number and variety of interactions testify to this (Svensson, 2000). Also, a correlation between participants’ attitudes towards the person orientation and their willingness to use the system again is found (Höök *et al.*, 2000; Svensson, 2000).<sup>11</sup>

When comparing the use of spatial and social frameworks, respectively, in software and especially educational software, it appears that elaborated, complex spatial frameworks are much more frequent than equally elaborated social frameworks. So called social interfaces sometimes involve nothing more but some animated little figure or “agent” with a colorful surface—with nothing beneath: there is very little information on the person’s or agent’s thoughts, attitudes, personal history, relations to others, development, personality, and the like. Thus, there is no support for meaningful exploration, in the sense that many spatial contexts offer a complexity that invites meaningful exploration.

This situation is not so surprising. Since the introduction of graphical user interfaces (GUIs) and with the development of games, spatial structures and worlds have been a natural format choice. Social frameworks are a latter development—in IT-applications in general, in educational software in particular. Yet, it is a development that, according to the research presented in this paper, is desirable, when the goal is to provide richness and variety in frameworks to reach a majority of users and learners.

### *Limitations*

There are a number of methodological limitations in the study presented that should be acknowledged. Some concern the interview questions and tests employed to estimate the relation between spatially oriented and person oriented thought in the participants. For one thing, there is the limitation of *self estimation*. Several questions requiring self estimation about aspects of social and spatial abilities were posed.<sup>12</sup> It was never asked *directly*, though, whether the person is *good* at something. Instead, in one of the interview sections the participant was asked whether she or he finds it *easy* to do certain things (for instance, to see an environment described in a book in front of her or him, to use a drawing for building something, to imagine what something one is constructing will look like; to interpret and understand the behaviour of other people, even when very different from

one's own behaviour; to understand conflicts between people and find solutions to conflicts). In another interview section the participant was asked to what extent he or she thinks that a number of professions (for instance, architect, taxi driver, author of biographies, therapist, etc.) would be *suitable* for him or her and why.

Another limitation is that the interview questions and tests as a whole is tailored for this study. It was pilot tested with a small number of persons, where an independent estimation of whether they were more spatially or more person oriented in their thinking could be obtained, but it would be desirable with a more encompassing pilot testing. To use *only* some well tried out, standardized tests, was, however, not an alternative, since the focus of this research is on variation in "spatial thinking" and "social thinking" in wide senses and not on only *one* or a *few particular* aspects (such as, say, the ability to perform spatial rotations, the ability to remember personal data, the ability to visualize spatial patterns, the ability to interpret body language, etc). Also *motivational* aspects—motivation to deal with spatial and social structures respectively—are included along with *ability* related aspects, and for those motivational aspects there are no standardized tests.

### *Practical implications*

Spatial as well as social frameworks are highly useful in the sense that they are flexible formats that can frame many different kinds of contents. Yet, according to the results of the presented study neither a spatial nor a social framework is optimal as format choice for an educational software, if the ambition is to attract a majority of users or learners. A combination of the two is a better alternative.<sup>13</sup>

There may, of course, also be other kinds of variables, and types of frameworks, to consider in an ambition to offer a suitable richness in frameworks. Research in order to identify such aspects is important.

A general implication of the work presented in this paper is that it is desirable that a designer has some knowledge about cognitive variation and acknowledges that if the goal is a learning product that satisfies many, a certain richness in presentational frameworks may be required. He or she needs to beware of the human bias that what oneself, or the group one belongs to, finds attractive, is generally found to be so.

### **Notes**

1. 'Spatially oriented thinking' is not identical with but can be related to Gardners (1983) 'spatial intelligence', and 'person oriented thinking' is not identical with but can be related to Gardners (1983) 'intrapersonal and interpersonal intelligences'.
2. Specifically, variation in *how well* developed the abilities are and in the *motivation* to use them. (Cf. Gardner, 1991.)
3. For variation in aspects of spatially oriented thinking, see for instance McGee (1979); Holding and Holding (1989); Casey *et al.* (1995); Schiano (1997); Modjeska (1999). For variation in aspects of person oriented thinking, see for instance Gilligan (1982); Turkle (1984; 1988); Tannen (1986; 1990); Mc Vicker Clinchy (1990); Westergren (1996); Schiano (1997); Höök *et al.* (2000); Svensson (2000).

4. Yet, of course, no predictions about specific individuals can be made based upon whether they are female or male. Individual variation outshines the sex related variation.
5. This is not to say that there is any absolute consensus among researchers. For one thing, concepts of spatial thinking as well as concepts of social thinking are vague, and there are several approaches to how they should be defined. Furthermore, *the grounds* for the existing variation is debated. In particular, it is not settled in what proportions environmental factors and genetic factors respectively contribute to the existing variation, and what influence factors such as age, practice, personality etc. have. (See e.g., Sjölander, 1999.)
6. Currently a corresponding study is being carried out with children of age 10–12.
7. Most tests and some interview questions, though, have been used in other studies. The main objective when composing the whole was to cover most of the aspects of spatial and person related thinking that are included in the main theories in the domains.
8. All answers and test results were given scores, and in the end the scores for person oriented and spatially oriented thinking were compared.
9. Note that we were thus only interested in a *relative* measure in the individual.
10. The other participants took longer and reasoned more about which one they preferred.
11. It should be pointed out that the research on social navigation does not specifically focus on pedagogical programs. Yet, the results that are reported here can be generalized, and are relevant for pedagogical programs.
12. Associated with the unreliability of self estimation, there is a known bias in that men tend to overestimate their abilities, whereas women tend to underestimate their abilities. Even though we are interested in a comparison between men and women, this bias does not matter in our study, as we only consider the *relation* between the two kinds of thinking *within individuals*.
13. Also, both frameworks would, of course, need to be well developed and integrated.

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