Adaptivity and Anticipation in Expert-Laypeople Communication

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Abstract

Communication between experts and laypeople has become an almost ubiquitous phenomenon. However, this dimension has been neglected in psychological research on expertise where the expert usually is modeled as an isolated problem solver. The present paper argues that in particular the expert's specialized knowledge often proves to be an obstacle to effective interpersonal communication with laypersons. The theoretical discussion of the notion of community membership (Clark and Marshall 1992) shows that it is a necessary but complex demand for experts to take a layperson's perspective in order to establish common ground. In an empirical study with two types of computer experts it was investigated in how far experts are able to anticipate what laypersons know about their domain. A second study analyzed how different aspects of knowledge are differently considered by expert architects when adapting to a lay audience.

There are numerous situations in everyday life in which one must rely on specialized knowledge provided by experts. Hence, expert-layperson communication has become an almost ubiquitous phenomenon. However, sometimes specialized knowledge becomes an obstacle to effective communication with laypeople. It is more than just a cliché to say that there is a certain type of 'blind expert'. Despite his or her skilled professional performance this type of expert strikingly fails as soon as he/she is asked to explain how he/she managed to solve one's problem. Traditional research on expertise has yielded important insights into the cognitive basis of expert performance in complex domains (Boshuizen and van de Wiel 1998, Bromme 1992, Chi, Glaser, and Farr 1988, Ericsson and Smith 1991, Evans and Patel 1992, Hoffman 1992). A rich and differentiated knowledge base, including multiple representations of problems and a categorical perception 'soaked' with experience, enables a rapid conceptualization of problems and the activation of routine problem solving strategies. In this research tradition, high performance experts are typically compared with novices and intermediates while the knowledge base under study is confined to the problem domain, i.e. a certain field of expertise. Hence, the knowledge base required for communication and cooperation is not studied, instead the expert is rather construed as a 'lonely' problem solver.

When 'expert' is understood as 'professional' (cf. Bromme and Tillema 1995, for commonalities and differences of both concepts) and when their interaction with laypersons (or with experts from other domains) is examined, the question arises which additional knowledge and skills are necessary to cope with the task demand of cooperation and communication and how this additional knowledge is related to the domain-knowledge. We have set up a research program to investigate such questions. We are especially interested in communication between experts and laypeople and in communication within interdisciplinary work-settings (http://wwwpsy.uni-muenster.de/inst3/AEbromme). At present, we focus in particular on the analysis of experts' ability to anticipate a layperson's perspective for communicative purposes. We propose that the study of such anticipations is an important step to learn more about the nature of the 'additional' expert knowledge needed for successful communication with laypersons.

This focus on studying experts' assumptions about laypersons' perspectives is inspired by – among others – H.H. Clark's collaboration model of communication (Clark and Wilkes-Gibbs 1986, Clark 1996). For example, consider the following utterance of a computer expert on a service hotline: "You should really clear your browser cache, uh – do you know what I mean?". This request requires the layperson to click on a certain button in his/her browser preferences menu. As follows from Clark's theory, the utterance also contains a grounding act inasmuch as the question at the end invites the layperson to provide positive or negative evidence about his understanding of the discourse referent. The expert's attempt to initiate grounding thus presupposes an evaluation process of the common ground already established including the anticipation that the concept of 'browser cache' may not yet be part of it. Consequently, in order to establish what is common knowledge, a speaker should be able to reasonably assess what the addressee already knows.

It will be discussed in the following how large and systematic knowledge differences and their impact on the grounding process could be understood within Clark's and his collaborators' theoretical framework. The aim of this paper is twofold: On the one hand, Clark's and his coworkers' account will be examined with regard to its significance for a better understanding of communication between experts and laypeople. On the other hand, it will be argued that the focus on knowledge differences between the interlocutors is fruitful for a general understanding of anticipation and adaptation in communication, especially for the theoretical notion of 'community membership' (Clark and Marshall 1992). After an introductory discussion of the community membership heuristic, selected

results of two of our studies will be reported, exemplifying our main argument.

How Much Do Speakers (e.g. Experts) Need to Know about Communities They Do Not Belong to (e.g. Laypeople)?

There is evidence for several biases experts typically exhibit in communication with laypersons (Isaacs and Clark 1987). Many patients personally experienced the situation that a doctor takes a short look at the X-ray photograph and starts to explain his/her diagnosis, presupposing that his/her addressee spontaneously perceives what he/she is perceiving while in fact the patient sees nothing but some darks spots on a screen. Moreover, one finds several forms of violation of the quantity priniciple, for example if the expert provides less information than is necessary for the layperson to understand what is meant or on the other hand, if more information is provided by the expert than the layperson can process. Erickson and Shultz (1982) used the notion of 'talking down' to characterize situations in which an expert paraphrases the same content several times without noticing that his/her addressee has already well understood the point. In some cases, such miscommunication may be deliberately promoted in order to demonstrate the exclusiveness of (expensive) expertise. In other cases it may arise from the expert's general unwillingness to communicate with non-experts at all, or from situational factors like time pressure. However, these explanations alone cannot account for the systematic nature of such communication problems. Clark's collaboration model offers an illustrative blueprint for the understanding of such communication problems (see also Alpay, Dieng, and Giboin 1999, Bromme and Nückles 1999, Bromme forthcoming). According to Clark (1992, 1996), any verbal encounter represents an act of cooperation. All contributions are formulated and understood on the basis of background assumptions about the situation in question, the object of conversation and its goal: "Two people's common ground is, in effect, the sum of their mutual, common, or joint knowledge, beliefs, and suppositions" (Clark 1996, p. 93). Mutual understanding is the product of the interlocutors' joint effort to coordinate their individual perspectives and this process of coordination requires anticipation of the partners' perspective. This implies assumptions about the interlocutor's situation, his/her knowledge about and conceptualization of the discourse topic, his/her attitudes etc. One important heuristic for the development of such assumptions is based on the community membership of the interlocutor. Clark and Marshall (1992) present several examples of how information about the addressee's nationality, his/her preferred sports and also his/her profession inform a speaker's utterances. Two persons, being comembers of the same community, can assume that they have a certain amount of mutual knowledge. If Ann, a psychiatrist, meets Bob and learns he is a psychiatrist, too, she can assume that Bob knows what she refers to, should she mention Freud's theory of neurosis. Clark and Marshall (1992, p. 36) write about Ann, their fictitious speaker: "But Ann belongs simultaneously to many communities and sub-communities, each of which has its own distinct areas of knowledge". Hence it is often not easy to determine community membership and in many cases the certainty of assumptions about who belongs to which community may be quite weak. Clark and Marshall (1992) give interesting examples of how information about one's own community membership is provided when people meet each other for the first time.

Such a situation of persons meeting each other for the first time is also modeled in Isaacs' and Clark's (1987) study on grounding between individuals who entered a conversation with very different levels of knowledge about its topic, New York City landmarks. The experiment was run as a referential communication task. Pairs of subjects were confronted with an identical series of postcards showing images of New York. Both subjects could hear one another but were visually separated by a screen and could therefore only see their own sequence of postcards. One of the subjects functioned as 'director' whose task was to instruct the other subject, the 'matcher', on how the postcards had to be placed to establish the sequence the director had received from the experimenter. The two subjects did not know one another beforehand, thus they did not know whether their partner in the experiment was familiar with New York or not, i.e. whether he/she was an 'expert' or a 'layperson'.

It was shown that the director, after only a few turns, was able to intuitively ascertain the matcher's expertise (e.g. by interpreting the matcher's inquiries) and that the two were quickly developing a new common terminology which captured the verbalizations' referential meaning. This terminology was idiosyncratic and specific to situation. The study is informative for further empirical investigations of expert-layperson discourse and of discourse among specialists of different disciplines. For example, it sheds light on the emergence of new specialist concepts during interdisciplinary cooperation (Bromme forthcoming). Nevertheless, many contexts where experts meet laypeople differ from the above sketched situation in two critical ways: (1) The topic of their conversation does not allow grounding acts by reference to concrete objects, (2) Though the persons involved know each other's status as expert and layperson from the very beginning, what can be assumed as mutual knowledge remains uncertain for them. (Logically this uncertainty is not different from the uncertainty about community membership described by Clark and Marshall (1992), however psychologically there is a difference.)

It may be argued that this situation is a clear example of non-community co-membership, i.e. the persons involved will start with the assumption of distinct areas of knowledge. The burden of establishing common ground would then totally rest on the actual process of communication. Nevertheless in most social contexts where experts and laypeople are involved, the communities (with respect to the topic of interaction) are clearly distinct, but the knowledge typical for each community (i.e. for experts and for

laypeople) is often overlapping. When Ann, the fictitious psychiatrist in the Clark and Marshall (1992) example, meets a patient for the first time, the heuristic of non-co-membership will not work. She can not be sure that her client does not know what she is talking about if she mentions 'Freud's theory of neurosis' just because the patient does not belong to the community of psychiatry experts. Quite in reverse it would be wise for Ann to assume that those laypeople who come into her office may have already heard about Freud. In our example Ann may know this because she and her patient share the community membership of well educated adult Americans and within this sub-community Freud is quite popular. But Ann cannot be sure. If both partners are members of the same community, lexical entrainment (Brennan 1991) mutually conveys information that they refer to the same objects. But in expert-laypeople communication the use of the same words does not necessarily indicate that there is a mutual understanding about what these words refer to (Schober 1998). This does not only occur in communication between experts and laypeople, but here it happens more regularly and to a greater extent. Expert knowledge mostly comes along in specialist concepts, i.e. more or less well defined abstract notions, implying a multitude of background assumptions. But many specialist concepts have evolved out of everyday language. Many of them refer to topics which are not only part of the experts' (academic) training but are also subject of everyday thinking and therefore are popular among laypeople. This is – for example – obvious in medicine, law and psychology where such lay concepts have been studied empirically (see for example Furnham 1988). Thus, it is quite common that laypeople use lexical items which are also (or exclusively!) specialist concepts, but it remains unclear to which degree the underlying concepts of experts and laypeople actually overlap.

In the communication between experts and laypeople, the variety of perspectives among interlocutors usually does not only encompass tremendous differences in factual knowledge, but also different conceptualizations and different epistemological styles, which are typical for a professional on the expert's side and typical for everyday thinking on the layperson's side (Fleck 1979, Bromme and Tillema 1995, Schön 1983). Nevertheless a layperson would not search the expert's advice if her/his conceptualisation of a problem would not at least share certain elements with the expert's one.

Hence, accumulation of common ground seems to be more difficult for the interlocutors compared with situations in which no specialist knowledge is involved. As a result of this, misunderstandings between experts and laypersons are more likely since the communicative demands are much higher than in everyday interactions. From this perspective, communication problems like the above mentioned violations of the quantity principle can be explained as a failure of establishing common ground. Miscommunication such as 'talking down' thus occurs when experts hold false assumptions about the knowledge the layperson brings into a given situation.

Of course, none of the above mentioned difficulties exclusively occur in conversational contexts which include large and systematic knowledge differences. It is additionally important to note the many strategies of establishing common ground ad hoc, which would work also among partners who are not community co-members (Brennan and Clark 1996, Garrod and Anderson 1987). Nevertheless, relying on a priori assumptions about the knowledge of one's interlocutor (cf. Fussell and Krauss 1992) is important especially in the expert's case. Experts are no teachers, and in most contexts they have little time and do not intend to systematically dissolve the qualitative and quantitative difference between their professional perspective and laypeople's ideas about the topic in question. On the other hand, clients, customers, and patients are supposed to make 'informed choices'. For example, the final decision about an operation has to be made by the patient and not by the doctor. In this case there is a mutual dependency as experts also need information from their clients. As there is usually not enough time to establish mutual understanding from scratch, the expert's a priori ideas about the knowledge of the lay-community are of critical importance.

Hence, in our research we focus on the expert's assumptions about the layperson's perspective which includes also the anticipation of what the layperson already knows and what he/she does not know. It will be argued in the following that such assumptions should be examined with careful consideration of the domain-specific aspects of the knowledge structures under study.

Do Experts Tend to Over- or Underestimate Laypersons' Knowledge?

How accurate are people's intuitions about what others know? In an often cited study, Nickerson, Baddeley and Freeman (1987) had college students estimate the likelihood that other students would know the answers to a sample of general knowledge questions. Nickerson et al. found that the subjects' estimates of what others knew were quite accurate, but at the same time biased towards the estimator's own knowledge. More importantly, however, the authors also determined the accuracy of subjects' estimates by comparing them with the actual percentages of correct answers in a norm sample. The main result of this analysis was that subjects were found to overestimate the commonality of answers they themselves knew, whereas there was no such tendency to overestimate for items the subjects did not know. In the social perception literature, this bias of one's anticipations towards one's own knowledge is called the 'false consensus effect' (Ross, Greene and House 1977, Marks and Miller 1987, Dawes 1989). According to Nickerson et al., such overestimation bias seems to be reasonable at least inasmuch as general knowledge is concerned. "If much of what each of us knows is common knowledge, then one's own knowledge surely provides a reasonable basis for predicting what other people know." (Nickerson et al. 1987, p. 246). Reframed in terms of Clark and Marshall (1992), one can say that the anticipation should

mainly be based on the assumption of community co-membership.

In the third part of their paper Nickerson et al. focus on the question which kind of influence expert knowledge might exert on the estimations. Unfortunately, because of methodological problems with their sample of 'experts', this interesting question remained unanswered for the time being. The question is interesting because in the case of experts' anticipations of laypersons' knowledge the assumption of community co-membership becomes problematic. And it is by no means clear how experts deal with this aspect or if they simply tend to ignore it. In the latter case the expert should behave simply like a 'very knowledgeable' person considering the knowledge in question as part of the general knowledge, the result being an even stronger tendency to overestimate the layperson's knowledge among experts than among the general population. On the other hand, if the expert is aware of the fact that the knowledge item in question is part of some specialist knowledge, which is markedly different from general knowledge, he/she must replace the heuristic of community co-membership by something else.

One alternative could be some sort of inverse community co-membership heuristic. The expert could take the difference between herself and the general population as a starting point for her anticipation. Such concentration on the exclusivity of her own expert knowledge should result in a tendency to rather underestimate the actual distribution of knowledge among laypeople. Inasmuch as the accumulation of the specialist knowledge in question is regarded as the single most important feature of the own expert status, such a tendency to underestimate seems quite plausible. Another possible basis for anticipations could be the reliance on actual communicative experiences with laypeople. If the expert has a rich history of such experiences he/she might be able to develop a mental model of the 'community' of laypeople (as distinct to her own expert community), which is more or less validly cross-indexed with her own specialist knowledge in the way sketched by Clark and Marshall (1992, p. 58). The validity of this model should strongly depend on the actual professional tasks the expert has to perform. While for some experts communication with laypeople is an integral part of their job performance, others (like for example researchers in a laboratory) might hardly ever come in (professional) contact with non-experts at all.

Which Computer Concepts May Laypersons Know? Some Results of a Study with Two Types of Computer Experts

To investigate these questions empirically, we conducted a study with two different groups of computer experts (Bromme, Nückles, Rambow, and Pisula, in prep.) The basic design of the study was quite similar to that of Nickerson et al. (1987). A questionnaire was developed which contained 33 specialist concepts related to the subject matter of Internet computing and 10 general knowledge concepts. The general knowledge concepts and a subsample of the specialist concepts were matched with regard to their difficulty, whereby difficulty was computed as the percentage of subjects in a norm sample (N = 188) being able to produce a correct answer. The norm sample consisted of students evenly distributed among the faculties at the University of Muenster. The students in the norm sample not only had to give short definitions of the item in question but also estimated the distribution of knowledge among their peers. These data constitute the basis for comparisons with the two expert groups. 10 subjects from the norm sample were eliminated because they were too knowledgeable so that the lay sample consisted of N = 178 subjects.

The two expert groups were selected following the criterion that their main difference would be the intensity of professional contact with laypeople. The first group consisted of 26 graduate students in Computer Science. To accentuate the most relevant point, these subjects will be referred to as 'theory experts' in the following, even though that is a bit of an oversimplification. The other group, in the following called the 'practical experts', was a rather heterogeneous sample of 25 Internet advisers and consultants, part of which were students providing Internet services for other students on a regular basis, while others were working in commercial Internet consultancies. It was secured that each expert knew at least 90% of the specialist concepts, otherwise he/she was excluded from analysis. Additional criteria for inclusion in one of the expert groups were years of practice, daily time spent with the computer, type of experience, and similar variables.

(It should be kept in mind that in spite of all necessary care invested in the selection of expert groups it is hardly possible to avoid a relatively high heterogeneity of actual professional background in the sample. The expertise variable is too complex as to find 25 highly qualified subjects with exactly the same task profile and professional history who are willing to participate).

The first analysis concerns the question of whether the two domains of knowledge (Internet knowledge and everyday knowledge) are treated differently in the estimates of the lay sample. Our hypothesis was that the average layperson might hold different assumptions about what is known or rather should be known by someone like herself, depending on the category of knowledge a certain concept is classified into. The computations were carried out on the basis of the matched subsample of items so that the item difficulties were comparable. For all 20 items the mean deviation between estimate and norm value was computed separately for those items associated with a correct answer (known items) and for those associated with an incorrect or lacking answer (unknown items). These 'estimation errors' were then compared between the two groups of concepts in two paired sample t-Tests. In the case of known items, both kinds of concepts are overestimated but the amount of overestimation is considerably higher for the ten everyday concepts than for the ten Internet concepts, M = 10.1, SD = 13.4 vs. M = 2.8, SD = 8.0, $t(9) = 2.5$, $p < .05$. On the contrary, in the case of unknown items the laypeople substan-

tially underestimate the real knowledge among their peers concerning both types of concepts. However, we again find a much stronger effect for the everyday concepts than for the specialist concepts, $M = -20.3$, $SD = 21.3$ vs. $M = -8.3$, $SD = 12.8$, $t(9) = -3.1$, $p < .05$. With respect to the small number of items in the sample these results should certainly not be overrated. But the magnitude of the group differences in both comparisons might be taken as a strong hint at the possibility that it might in fact be important for the estimations whether an item is perceived as being part of some well defined area of expertise or part of some more diffuse array of general knowledge. In the latter case the strong orientation towards one's own knowledge, which is obvious in the data, seems a plausible explanation. In the former case the layperson might tend to loosen the relation between her own knowledge and the estimates because of a feeling that the items in question are not part of a knowledge that is evenly distributed among the general population, but on the contrary is 'owned' by those who are interested. This means that from the perspective of a layperson – with respect to some clearly defined domain like Internet-computing – the community of students might be divided into several (or at least two) separated subgroups, which in turn reduces the usefulness of a simple community co-membership heuristic.

The second analysis addresses the question of differences between the two expert groups. Does the professional background have any influence on the tendencies to show bias in the estimations? The hypothesis is that the 'practical experts', who spend a substantial part of their working time communicating with laypersons, should accumulate relevant experiences, thus allowing them to avoid bias better than the 'theory experts'. The hypothesis was tested in two distinct ways. In a first step individual correlations ($N = 33$ items) between estimates and norm values were computed for all 25 practical experts and all 26 theory experts. (In the following analyses we do not differentiate between known and unknown items because due to the expertise of the subjects there are only very little unknown items, the related estimates were treated as missing values. We also restrict our analyses to the sample of 33 Internet-concepts because there is no reason to expect any differences between the two expert groups with respect to everyday knowledge).

The Pearson correlation coefficients were transformed to Fisher's z-values and then compared between the two groups (unpaired t-test). The mean correlation values (retransformed) are $r = .79$ for the practical experts and $r = .73$ for the theory experts respectively; the difference being not quite significant in a two-tailed test, $t(49) = 1.8$, $p < .1$. The effect is rather small but at least it shows the expected direction: If we take the correlation as an indicator of the 'fit' between estimates and true values, then one can say that the estimates of the 'practical experts' are indeed somehow more precise than those of the 'theory experts'.

Up to this point we still do not know what this might indicate in terms of the tendency to systematically over- or underestimate the knowledge among laypeople. To shed further light on this aspect of the data, an individual score of directed differences between estimates and norms was computed for every subject and then averaged within both groups. In separated two-tailed one-sample t-tests, the theory experts reveal a significant tendency to overestimate the knowledge of the norm sample, $M = 4.8$, $SD = 11.4$, $t(25) = 2.14$, $p < .05$, while the estimates of the practical experts do not significantly differ from zero, $M = 1.8$, $SD = 11.6$, $t(24) = .78$, n.s. So again we find a difference in the expected direction, indicating that aspects of the personal history of professional experience might in fact play a role in the anticipation process. The practical experts seem to draw substantially on their memory store of communicative episodes with laypeople while estimating the distribution of their own specialist knowledge among the general population.

If we concede that the practical experts are 'better' at anticipating a lay perspective than the theory experts, the question arises how that relates to the ability of the laypersons themselves. Should the bias to overestimate, exhibited by the theory experts, be considered as rather strong or rather weak compared to the laypersons' bias? The investigation of this research question poses peculiar methodological difficulties. Since the amount of estimation error is usually substantially negatively correlated with the difficulty of an item (the degree of knowledge is overestimated for difficult items and underestimated for easy items) these difficulties must be held constant for every comparison between groups or categories of items in order to be valid. In our first analysis this was secured by prior matching of items. In the expert group comparison it posed no problem because practically all of the experts were familiar with all of the items. But if the experts are compared to the laypersons with respect to the Internet concepts, then for every item the number of laypersons in the sample is different because only the estimates of those who know an item correctly can be reasonably taken into account. That automatically means that the mean estimates for easy items rest on the values of very few subjects and therefore are highly vulnerable to idiosyncratic values. This is all the more a serious danger because the mere fact that some peculiar lay subject knows a difficult specialist concept might well indicate that this subject is rather atypical for the lay population.

To cope with this difficulty we calculated the comparison between experts' and laypersons' estimates on the basis of item values instead of individual subject scores. This creates the possibility to average within different subsets of items and thereby to describe precisely the effect of the aforementioned confoundation between item difficulty and estimation error. Hence, for each of the 33 Internet concepts, the average differences between estimation and norm value were computed separately for each group. After that means for three different item samples were computed and compared: 1. for all 33 Internet items; 2. for all items ($N = 19$) with norm values > .2 (concepts known by more than 20% of all subjects in the norm sample); 3. for all items ($N = 8$) with norm values > .4. The results of

all three analyses are shown in figure 1. It is obvious that on the one hand the ordinal structure of the results remains the same no matter which sample of items is taken into account, while on the other hand the amount and direction of estimation error changes substantially as a result of item

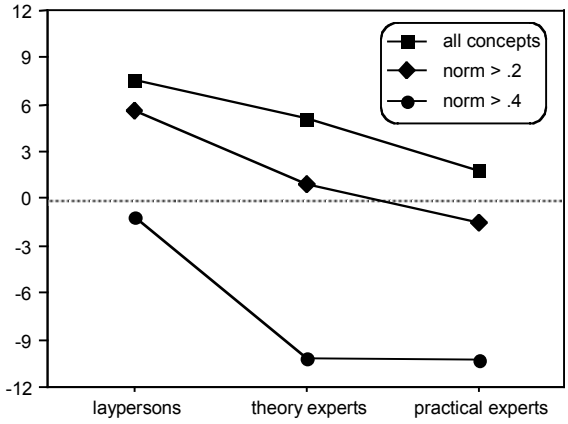

Figure 1. Mean estimation error (in percent) for the three groups, averaged among different subsamples of items.

sample restrictions. All concepts considered, the laypersons, as well as the theory experts show a significantly stronger bias than the practical experts, $t(32) = 4.14$, $p < .001$ and $t(32) = 4.38$, $p < .0001$, respectively. The difference between theory experts and laypersons narrowly misses significance, $t(32) = 1.7$, $p > .1$. If concepts known by less than 20% of the norm sample are excluded, only the laypersons show systematic overestimations. All three groups differ significantly (laypersons vs. theory experts: $t = 2.3$, $p < .05$; laypersons vs. practical experts: $t = 3.3$, $p < .005$, theory vs. practical experts: $t = 2.2$, $p < .05$; *df* for all tests: 17). In the third case, when only the eight most easy concepts are taken into account, both expert groups show an equally strong bias towards underestimation while the (knowing) laypersons' estimation error centers around zero. Both expert groups' estimation error differs significantly from that of the laypersons, $t(7)= 4.8$, $p < .005$ for practical experts, and $t(7)= 4.2$, $p < .005$ for theory experts.

Qualitative analyses of the data show that the items which invoke the strongest tendency to over- or underestimation are not the same for laypersons and experts. This observation (which here can only be hinted) manifests itself quantitatively in the correlation of item estimation error among groups. While the distribution of error is very similar between the two expert groups, $r = .94$ $N = 33$, the coefficients for laypersons and practical experts, $r = .74$, $N = 33$, as well as laypersons and theory experts, $r = .75$, $N = 33$, are much smaller. This result is interesting because it turns the attention to questions of thematic content. There is obviously some kind of interaction between person variables and thematic aspects of the material. Laypersons' anticipations fail with respect to other items than experts' anticipations. Because our item material was not systematically varied in terms of thematic content, we have no possibility to investigate this issue systematically. But we do think that further examination of the nature of this interaction will be of primary importance for the psychology of expert-layperson communication.

Anticipation and Listener Adaptation: Some Results of a Study on Architects as Experts

This point can be further illustrated when we now turn to another set of studies which focused on the domain of architecture (Bromme and Rambow 1995, Rambow and Bromme 1995, Rambow 1999). Part of this research was quite similar to the Internet study. A questionnaire with 55 items from five thematic fields of architectural knowledge was constructed and applied to a norm sample of 150 students from all faculties. An expert sample of 41 experienced architects was then asked to estimate the distribution of knowledge among laypersons (i. e. students) for each of the items. In every item no significant bias towards overestimation could be detected. The mean estimation error of the items covered a range from –38.5% to 41.9%. Quite similar to the Internet data, a large part of this extreme variance must be attributed to the aforementioned dependency between item difficulty and estimation error. But even though it was not possible to match difficulty exactly among the five thematic fields, the data clearly show that thematic aspects considerably contribute to the variance of estimation error. The clearest difference appeared between items concerning the history of architecture and contemporary architecture. While knowledge of the former among laypeople was rather underestimated by the experts, the knowledge of the latter was grossly overestimated. We assume that the reason for this difference lies mainly in the varying 'visibility' of these issues for the expert. While contemporary architecture is usually very salient to the architect, architectural history might rather be considered as some sort of necessary background knowledge. But actually for most laypeople, information about contemporary architecture is something to ignore while knowledge about architectural history is considered (at least in Germany and at that to a certain degree) as part of general knowledge and as such covered in school.

The tendency to overestimate knowledge about contemporary architecture might be fostered by another aspect: Knowledge of contemporary architecture lacks what we have elsewhere (Rambow 1999) called 'exclusiveness markers'. This term designates the existence of certain formal characteristics which signal that a certain piece of knowledge belongs to some clearly defined domain of expertise. Examples for 'exclusiveness markers' in this sense are technical language, Latin or Greek expressions (as, for example, in medicine), certain forms of abbreviations, complex composites etc. Knowledge of contemporary architecture is, in principle, quite simple (know some names and buildings) and accessible (read about it in the cultural pages of any newspaper), which makes it difficult for experts to anticipate that it is nonetheless part of their own exclusive expert knowledge.

In the architecture study we tried to transcend the Nickerson et al. (1987) approach in several ways. One obvious

limitation to all questionnaire studies of this kind lies in the fact that they draw on a concept of knowledge as a collection of isolated facts, thereby covering only a very superficial layer of expert knowledge. Therefore in the architecture studies we transferred the basic design idea on two different tasks. Our expert architects had to anticipate the layperson's perspective not only in terms of knowledge of isolated concepts, but also in terms of structural knowledge and aesthetic judgment. To determine the anticipation of structural knowledge, we adapted a widely used method from expertise research, namely the multiple sorting procedure. Our subjects sorted an array of 16 building photographs from their own perspective and from an assumed lay perspective according to self-defined criteria. The sorts from the assumed layperson's perspective were then compared to the averaged sorts of a norm sample of 100 laypersons (i.e. students). Quite similar to the procedure in the described questionnaire studies, for every expert subject a measure of similarity between her anticipations of the laypersons' knowledge and the empirical norm was determined. The same applies to the third aspect of architectural expertise that we investigated, aesthetic judgment. Here, too, individual scores of the fit between anticipated and actual layperson's perspective were computed for each architect, in this case on the basis of the subjects' evaluations of building exteriors.

Our two main questions in the architecture studies are the following: 1. Does the validity of the individual expert's model of laypersons' knowledge actually have predictive value for the expert's ability to adapt communication to laypersons' needs? 2. If this is the case, which aspects of laypersons' knowledge are the most important in order to be anticipated validly?

To explore these questions it is crucial to find an operational measure of the ability to adapt to laypersons' needs in communication. We designed a situation in which the expert architect had to produce a monological explanation of a complex building design after making him/herself familiar with the design and an additional array of background information. The explanations have the character of a short presentation towards a virtual lay audience. They were tape-recorded and transcribed for further analysis. The design of this communication task is the result of a compromise between ecological validity and experimental control, which might raise several objections. We opted for a monological situation because in order to control a dialogue well, too many experimental constraints would have been necessary. The experts' monologues were analyzed in two distinct ways. Four independent judges (laypersons) rated all tape-recorded monologues on three global dimensions of comprehensibility (structure, conceptual simplicity, persuasiveness). A thorough quantitative analysis was additionally carried out. It consisted of seven categories of indicators of conscious listener adaptation (e.g. explicit introduction of technical terms, explicit reference to the listener, or metacognitive utterances). By means of multiple regression analyses the predictive value of the individual veridicality scores from the three knowledge anticipation tasks was determined. Interestingly, when the frequency of the specific indicators is introduced as dependent variable, no correlation is found. When, on the other hand, the global comprehensibility ratings are used as dependent variables, substantial influences can be shown. In other words: There is no significant correlation between the assumptions about laypeople and overt steps toward better comprehensibility. We are, however, able to show that those experts who hold valid assumptions about laypersons produce explanations which are rated as better structured and comprehensible. With respect to our second question, we find that the predictive power of the performance in the multiple sorting task is higher than that of either the questionnaire study or the aesthetic judgments, the latter having no significant predictive value at all. We take this result as an indication that in some cases expert knowledge may be too complex to be studied experimentally by means of isolated concepts. For the expert architect to adapt to the communicative needs of a layperson it seems to be much more important that he/she has a valid idea about which central categories structure the layperson's perception of the domain than that he/she knows if the layperson has ever heard of the specific concept X. Nevertheless, the importance of the latter kind of anticipation is not nil, so that further studies in the Nickerson et al. (1987) tradition remain a useful opportunity to study experts' anticipations of laypersons' knowledge. Our results, however, clearly indicate that they should be augmented by studies that refer to other layers of expert knowledge.

Concluding Remarks. So far we have discussed the accuracy and bias of people's anticipations regarding what others know and we have been able to report some data which indicate relations between anticipation and adaptation. The differences between different types of knowledge are revealing: The veridicality scores of the conceptual knowledge task show a significantly higher predictive value for communicative performance than the scores from the other two tasks (descriptive knowledge and aesthetic judgment). This result clearly points to the fact that the type of knowledge which is used in the experimental design may contribute to the impact of anticipation on adaptation. In summation, with regards to communication between expert and layman, the typically complex anticipations of the expert are indispensable to successfully adapt to a layperson's communicative needs. In other words, adaptation does not merely emerge from interaction, but has its origin in the interactants' minds.

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