an interview study Görner (1994) analyzed commentary by 74 experienced designers. The question they answered was whether they use – in order to develop a solution principle – "mainly thinking about it or mainly sketching." Of the designers, 69.3% were mainly sketching, 3.8% were "mainly thinking" and 26.9% reported a balanced combination of thinking and sketching. This result, however, is only valid for individual work, whereas engineering design projects are usually carried out by teams of several designers and thus a high degree of collaboration is required; therefore, verbal communication is a major part of designing in everyday work.

What is the reason that verbal communication is the main venue for "design representation" for the purpose of information transfer in decisive "critical situations"?

How are verbal design representations initiated?

We started our analysis of design representations by asking the question: what triggers the exchange of design information? To better answer this question, we differentiate between "active" information requisition and "passive" reception of important information.

Figure 5.9 depicts how often focused questions to colleagues on the one hand and individual "independent" information searches in documents on the other, were observed in critical situations. Results show that individual searches in documents were much less successful in terms of their impact on the result than focused questions. It is not surprising that, contrary to the active search for information, the passive reception of information always accompanies the good availability of this information. Passive reception of information means that the information transmitted was not asked for. This information transfer can happen unintentionally as part of a (often informal) conversation between colleagues, or it can be initiated by a colleague who is interested in informing a co-worker who is likely to need this information later in the design process.

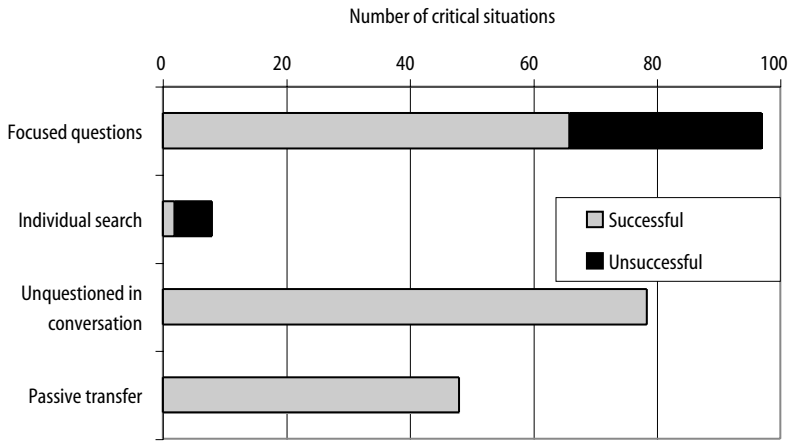

Figure 5.9 Successful and unsuccessful ways of information transfer in critical situations.

In connection with the high percentage of collaboration in critical situations, it is interesting that, in these situations, individual search for information in documents occurred very rarely and was not successful for the most part. But why is this the case? People do not like to search for information in catalogues, in computer-mediated systems, or in information lists because they assume that the search will take too long and because their previous experience has been that such a search often had not elicited relevant information. A further strong argument for preferring consultation with colleagues is that it provides an additional check on the context and the content of the required design information.

Another interesting aspect is that not only formal and organized information transfer is helpful; informal conversation can also be very useful: we observed that nearly 30% of important information is delivered "unsolicited" through informal conversation, in addition to the information transfer that follows a specific question. The great importance of verbal communication in determining information availability motivates us to take a closer look at verbal design representations in different types of critical situations.

What are important aspects of information transfer in critical situations?

Observing the verbal exchange of design information in design teams, we realized how diverse the ways to "shared understanding" may be (Klimoski and Mohammed 1994). Therefore, the important questions for us are reiterated: what kind of communication is suitable in a specific situation and, consequently, what kinds of communication support a successful result?

Without any doubt, the basic elements of communication, such as listening, positive feedback etc., are relevant to any form of interaction, including in a design team. We must keep in mind, though, that addressing negative aspects of a design proposal or solution, presented by a colleague, risks hurting the feelings of the colleague(s) and hence threatening the group climate. Because of this conflict, group-training often concentrates on supporting group climate in order to increase the effectiveness of group performance.

Our main goal was to determine the central elements of information transfer. Therefore, we created a category system that divides information into four categories: questions (searching for information), explanations (furnishing with information), evaluations (positive and negative statements); and procedural instructions (process information). In addition, there are three "neutral" categories: silence, repetition, and "other."

We encoded 11 positive and 11 negative critical situations of the types "solution-search," "goal-analysis and goal-decision," and "solution-analysis and solution-decision," comprising 2318 entities (sentences = communication units). Table 5.4 is a sample of the encoded transliteration of an informal conversation between two colleagues, B and C. It is derived from a critical situation of the type "search for a solution" during which the two designers were searching for a roller bearing for the spreader head of a particleboard production plant. The first column displays the time of the utterance, the second column shows the speaker, the third column transcribes the utterance, and the last column shows the assigned category applied to describe the information process (for abbreviations see Table 5.3).