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Expertise Development in the Workplace Through Deliberate Practice and Progressive Problem Solving: Insights from Business-to-Business Sales Departments

Daniel P. Köhler[1] · **Andreas Rausch**[1]

Abstract

Expertise is featured by continued high performance in a particular domain. Expertise research has primarily focused on absolute expertise in structured domains such as chess and emphasized the significance of deliberate practice for expertise development. We investigated the development of relative expertise in commercial domains as part of ill-structured domains. Due to the ill-structuredness and acknowledging the use of the term expert in organizational practice, we developed a taxonomy to distinguish between four types of experts in the broader sense (relative expert, managerial relative expert, evolved specialist, and native specialist). Eighteen peer-nominated individuals from business-to-business sales departments from four German organizations participated in our interview study. A content analysis was applied using both deductive and inductive categorizations. The interview data clearly corresponds to the concept of progressive problem solving rather than to the concept of deliberate practice. Almost all our respondents referred to either "being thrown in at the deep end" by others (assigned complex tasks) or "jumping in at the deep end" of one's own accord (self- selected complex tasks). However, the interview partners described features of deliberate practice for novices. In this very early stage of expertise development, more experienced colleagues structure parts of the ill-structured domain and enable deliberate practice while for advanced beginners and later stages expert development rather resembles progressive problem solving. Our results provide implications on how to foster expertise development in ill-structured domains. Possible limitations arise from the small sample, the peer-nomination process, and the retrospective nature of interview data.

Keywords Expertise development · Workplace learning · Organizational learning · Expert types · Deliberate practice · Progressive problem solving

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✉ Daniel P. Köhler
    daniel.paul.koehler@uni-mannheim.de

[1] Business School, University of Mannheim, 68161 Mannheim, Germany

In this paper, we present an interview study on the characteristics and the development of expertise in commercial domains. Sustained learning in the workplace can lead to expertise in terms of very high competence in the respective domain but expertise is not achieved by every individual (Billett et al., 2018; Ericsson, 2018a, 2018b). Expertise development was originally investigated in structured domains such as sport and chess (Ericsson et al., 1993; Hambrick et al., 2014), but research has focused less on professional domains such as, for instance, medicine (Harteis, 2014), auditing (Grohnert et al., 2018), and insurance agents (Sonnentag & Kleine, 2000). Regarding commercial domains, such as business-to-business sales departments, expertise development in organizations has been theorized (e.g., Salas & Rosen, 2010) but has not yet been investigated.

Classic expertise research in more structured domains such as chess, stresses the significance of mentors and deliberate practice, defined as the focused and supervised practice of designed exercises as key factors of expertise development (Ericsson et al., 1993; Ericsson, 2018b). Discussions continue regarding to what extent deliberate practice is a factor in less structured, professional domains (Billett et al., 2018; Boshuizen et al., 2020; Chow et al., 2015; Dunn & Shriner, 1999; Goller, 2017; Goller & Billett, 2014; Greenwood et al., 2019; Grohnert et al., 2018; Hambrick et al., 2020; Keith et al., 2016; Macnamara et al., 2014; Salas & Rosen, 2010; Sonnentag & Kleine, 2000; Tynjälä, 2013; van de Wiel and van den Bossche, 2013; van de Wiel et al., 2004; van de Wiel et al., 2021). An alternative but a less known explanation for expertise development is the concept of progressive problem solving by Bereiter and Scardamalia (1993) which emphasizes active engagement in work tasks of increasing complexity, reflecting on one's task performance and actively searching for more complexity in tasks and problems one can already solve (Bereiter & Scardamalia, 1993). At the core of our research, we investigate how expertise develops within commercial domains such as business-to-business sales departments. It is of interest for an organization to employ individuals with expertise in different departments and especially within a business-to-business sales department as they bear the responsibility of creating revenue for the organization.

In less structured domains, clear performance standards across organizations and absolute performance are not easily identifiable compared to structured domains (Chi, 2006; van de Wiel et al., 2004). For business-to-business sales departments, there are of course performance measures in terms of business-to-business sales volume during a certain time. Nevertheless, this index depends on the products, workflows, the market, the customers, how much help an individual gets from peers, and so forth. Therefore, this performance index is not the same as performance measurements such as the Elo rating system in chess (i.e., standardized ranking, to rate a chess player relative to other chess players; Elo, 1967) since in chess two individuals perform within a fixed setting. Even though objective external criteria such as the Elo rating system are missing, expertise shows itself within the organizational context. However, this does not necessarily mean that organizational practices also play a major role in the development of expertise. Furthermore, it is unclear which organizational practices foster the development of expertise. For instance, individuals in business-to-business sales departments engage in knowledge intensive tasks for which performance cannot be measured easily. At the core of the

business-to-business sales department are sales representatives (O*Net, 2021) who have to negotiate prices of terms of product sales and services. Furthermore, they have to answer customers' questions about specific products, prices, availability of products, or credit terms and also actively consult customers in order to sell products. They must deal with customer complaints regarding previous sales and services which have to be resolved. Additionally, sales contracts have to be prepared and submitted for orders. Other aspects are customer visits to evaluate product needs and promoting certain products as well as the maintenance of customer records. It is therefore not only unclear how exactly an individual can reach expertise in the domain of sales representatives but also who exactly can be considered an expert. The supporting roles of sales representatives in a business-to-business sales department are sales controlling and analytics as well as sales quality management.

Another role experts play in organizations is within knowledge management and expertise management because knowledge and expertise are sought to be utilized to achieve and maintain competitiveness (Boh et al., 2007; Salas & Rosen, 2010). In organizational contexts, high expertise usually refers to the vast body of knowledge of an individual within a social context (Green et al., 2019; Salas & Rosen, 2010). This vast body of knowledge consists of domain-specific knowledge about, for instance, the market, competitors, and how to solve domain-specific tasks and organization-specific knowledge about, for instance, the social environment and unwritten rules. Additionally, in organizations, the term expert is used more broadly and inconsistently compared to classical expertise research. It is unclear if there are different expert types that the organization must deal with regarding further education and knowledge management. Furthermore, if there are different expert types, there might be different processes regarding the expertise development of each type. In this paper, we develop a taxonomy to distinguish between different types of experts in organizations. An interview study was conducted in four organizations to answer the following research questions (RQ):

- RQ1: How can experts in the business-to-business sales domain be classified and distinguished from specialists?
- RQ2: To what extent does expertise development in the business-to-business sales domain follow the concepts of deliberate practice and progressive problem solving?

In the theoretical section, we define expertise and review the literature on expertise development. The empirical section contains the methods and results of our interview study, followed by a discussion of the results, implications, and limitations.

Expertise in Organizations and Expertise Development

Expertise refers to observable performance and latent competence. Expertise is defined as an individual's very high domain-specific competence which enables "a sustained … high performance" (Gruber, 1999, p. 20; see also Boshuizen et al., 2020; Ericsson &

Smith, 1991; Ericsson, 2018a, 2018b; Mieg, 2001; Nokes et al., 2010; Posner, 1988 as cited in Gruber, 1999, p. 20). Typically, an individual develops expertise in one domain and perhaps becomes an intermediate in related domains but remains a novice in more distant domains. "A businessman, for example, may show expertise at marketing while at the same time being only competent as a financial planner, and a mere novice when it comes to negotiating a merger" (Dreyfus & Dreyfus, 1986, p. 20). Hence, expertise always relates to a certain domain (Chi, 2006) but the definition of what constitutes a domain is difficult and often neglected (Alexander, 1992b).

Characteristics of Commercial Domains

According to Alexander (1992a, 1992b) and Maggioni and Alexander (2011), domains are defined by the body of knowledge that refers to a particular part of the world, a studied area, or a discipline. This knowledge is learned in formal contexts (e.g., school) or informally during practice in the domain (Alexander, 1992a). Domains can broadly be classified as structured or ill-structured. Structured domains are characterized by structuredness of knowledge such as "fundamental concepts", "academic rigor", and especially "a set of rules" (Alexander, 1992b, p. 36). Additionally, domains can be divided into subdomains which may vary regarding their structuredness (Alexander, 1992b). However, some bodies of knowledge are more related to each other than others. Hence, clear definitions and distinctions of domains are difficult. For instance, individuals in the sales department often work together with individuals from the logistics department and thus those two domains have a certain amount of related knowledge. Expertise research has typically focused on structured domains such as chess, sport, and music. In these domains, what constitutes an expert performance is agreed on and validly measurable (Ericsson, 2018a, 2018b) such as the Elo rating system in chess. However, many real-life domains lack such generally accepted standards (Goller & Billett, 2014; Shanteau, 1992; van de Wiel et al., 2004), especially when they "involve human behavior" (Shanteau, 1992, p. 258) such as interactions with customers. Hence, workplaces are usually part of rather ill-structured domains (Goller & Billett, 2014, p. 34; Strasser & Gruber, 2004), which include interrelated clusters of well-structured and ill-structured problems which Jonassen (2000, p. 81) refers to as "metaproblems". Therefore, "work tasks may not be as well defined and as static as tasks in many classical domains" (Keith et al., 2016, p. 519). Instead, they contain "ill-defined problems and tasks with unstable dynamic structures" (Salas & Rosen, 2010, p. 104) with less comparable performance standards (Ericsson, 2018a; see also Salas & Rosen, 2010 and van de Wiel et al., 2004). Furthermore, Ackerman (2011, pp. 851-852) divides domains into closed-skills domains and open-skills domains characterized by their "constitutive problems" that represent the essential challenges of a domain such as the elimination of a disease in the medical domain (Bereiter & Scardamalia, 1993, p. 97). In closed-skills domains, there is only a limited set of tasks that have to be learned and perfected (Ackerman, 2011). In open-skills domains, there are far more factors to consider and difficult problems in the domain can increasingly be solved (Ackerman, 2011). Overall, structured and ill-structured domains are different regarding several factors (see Table 1). Table 1 is roughly similar to Shanteau (1992, p. 259) and was influenced by the sources in this

Table 1 Structured and ill-structured domains

Structured domains (e.g., playing an instrument, tennis, painting, chess)	Ill-structured domains (e.g., business-to-business sales, stockbroking, law, psychiatry)
Clear set of rules (e.g., for chess through the Fédération Internationale des Échecs) and tools (e.g., tennis rack)	No clear set of rules (e.g., for price negotiations or workflows) and tools (e.g., individual software)
Rules and tools are defined rather 'top-down' (e.g., chess rules, tennis rules, etc.)	Common practices evolve rather 'bottom-up' and are influenced by supply and demand, division of labor, technological change, etc.
Objective performance assessment (e.g., Elo-scale in chess and Universal Tennis Rating in tennis)	No universally accepted performance assessment (e.g., leadership)
A domain is open for everyone, in principle (e.g., playing tennis)	Access to a domain is regulated by institutional and organizational structures (e.g., personnel selection)
A domain is relatively stable over time (e.g., rules)	A domain is ever-changing (due to changing markets, technologies, etc.)
It is relatively clear what, how, and when to train to become better in the domain	It is often unclear what, how, and when to train to become better in the domain
Most of the time spent in the domain is 'off-time', i.e., not performing but targeted training for future performance (e.g., in competitions)	Most of the time spent in the domain is 'on-time', i.e., performing in the workplace, while the amount of formal 'off-time' training depends on the domain

chapter, especially Alexander (1992a, 1992b), Maggioni and Alexander (2011), Ericsson (2018a, 2018b), Ackerman (2011), and van de Wiel et al. (2004).

In summary, most commercial domains are ill-structured, ever-changing, and are open-skill domains that require knowledge application and continuous learning to complete ill-defined work tasks. Commercial domains consist of, for instance, sales departments, the marketing departments, or human resources departments. Nevertheless, some specific commercial domains might be more structured than others. For instance, compared to business-to-business sales, retail sales for clothes or cars might enable the application of performance measurements more easily. However, the distinction between structured and ill-structured can be quite blurred. Nevertheless, even these domains are still more open and less structured compared to classically structured domains with their defined boundaries and rules.

One ill-structured domain is the domain of the business-to-business sales department, which is a commercial domain characterized by finding customized solutions for complex products and requires extensive knowledge. This specific domain was chosen since it is essential for organizational success and is comparable across different organizations due to similar work processes. Furthermore, the sales department is the antenna of an organization to get to know current developmental trends in the market. Additionally, the sales department must deal with a variety of customers and suppliers who are competent themselves. Therefore, individuals in the sales department must gain extensive knowledge and must learn to consult customers regarding the customer's individual needs. Furthermore, sales representatives must keep up with technological changes over time. After all, the sales department is the face of an organization.

Experts and Specialists in Organizations

Commercial domains are mostly open-skill, ill-structured domains with a mix of well-defined and ill-defined problems, which demand knowledge application and continuous learning. Hence, as in many real-life domains, there is a lack of generally accepted standards (e.g., Goller & Billett, 2014) for an individual's job performance in commercial domains. Furthermore, commercial domains contain a set of tasks, derived from "constitutive problems" (Bereiter & Scardamalia, 1993, p. 97) that must be solved to assure business success. These tasks are typically defined by the respective organization. An example is departments such as sales, in which individuals and teams work on various sales-related tasks. This means that organizations comprise different domains, each of which is a different bundle of "real-world tasks" (Shavelson, 2009, p. 42). Decreasing complexity for individuals usually leads to an increase in the organizational division of labor by assigning selected fine-grained sub-tasks to each individual as is implemented within scientific management (Taylor, 1911). This narrowing down of work tasks is referred to as specialization (e.g., Becker & Murphy, 1992). Therefore, specialization in selected work tasks is not synonymous with expertise in a domain. Still, a combination is often found in practice since one can also further specialize in particular sub-tasks within one's broader domain (Ackerman, 2011). Organizations reduce the demands on each individual through organizational routines and the division of labor.

Expertise is characterized by large and deep domain-specific (e.g., knowledge about the market or sales-strategies in the sales domain) and organization-specific knowledge (e.g., knowledge about the social network or certain workflows) and concepts (Boshuizen et al., 2020; Mieg, 2001; Salas & Rosen, 2010) which has been acquired through formal education and primarily long-term experience through sustained engagement in a domain (Ackerman, 2011; Ericsson, 2008; Gruber, 1999; Mieg, 2001). In their prevalent model of expertise development, Dreyfus and Dreyfus (1986) describe several stages, starting from novice, to advanced beginner, intermediate, and so forth. An expert's performance is based on the situational recollection of knowledge due to prior experience, a holistic recognition of their environment, intuitive decision making, and absorbed awareness, which means that experts do not have to put much effort into the metacognitive monitoring of their actions (Dreyfus & Dreyfus, 1986). Furthermore, expertise is also associated with non-cognitive components such as motivation (Dreyfus & Dreyfus, 1986). Regarding expertise, there is the distinction between absolute expertise and relative expertise which refers primarily to the structuredness of a domain (see above). Absolute expertise (Chi, 2006, p. 22) refers to "chance" (e.g., availability of a coach) and to some extent an individual's "innate talent" (e.g., reaction time) which facilitates reaching absolute expertise. Absolute expertise can be identified by generally accepted and verifiable performance standards (Chi, 2006). Relative expertise is based on differences between superior performance and inferior performance at a group level and can be achieved by novices over the years (Chi, 2006). For relative expertise, there are seldomly widely accepted and applied performance standards

(Chi, 2006). Nevertheless, the underlying individual components (knowledge structure, situation awareness, decision-making, etc.) are the same for both absolute and relative expertise (Bédard & Chi, 1992; Chi, 2006). It is only the different kinds of empirical indicators to identify experts that distinguish these constructs (Chi, 2006). Hence, relative expertise is more suitable for ill-structured domains in which generally accepted performance standards do not exist across different organizations. Nevertheless, an expert in one organization might very well be at least for a certain training period, an intermediate in a different organization due to different workflows, higher or lower expertise of peers, not knowing the social environment, and not knowing the products (see also expertise's dependency on contextual cues; Green et al., 2019). Marsh (1987) refers to this phenomenon as the "big-fish-little-pond" effect. We therefore refer to the highest-performing individual in a domain within an organization or the highest-performing individual within the domain in each site of the organization as a relative expert. However, we would not describe the best out of a group of apprentices as a relative expert. A relative expert still has to show continued superior performance in his or her domain in an organization which is acknowledged by his or her peers and even individuals outside of the organization such as customers or suppliers (see also peer-nomination in methods below). Furthermore, even in an ill-structured domain, an individual can presumably reach such a high competence level to be considered an absolute expert among, for instance, sales departments across several organizations that sell the same products (e.g., wood construction elements). Additionally, if sales departments agree upon using the same rather complex performance measurement for sales departments, then an absolute expert could be identified far more easily based on this widely established performance measurement.

In organizational practice, the term expert is used more broadly and variable in contrast to expertise research. Specialist who handles a unique cluster of work tasks in an organization that requires specialized knowledge (e.g., Becker & Murphy, 1992) might be included in so-called expert career paths. This does not necessarily mean that the specialist is also an expert in his or her domain. For instance, in small enterprises, there may be only one employee who is responsible for a domain such as human resource management. Hence, it is not clear whether this specialist would also be a relative expert because there are no peers in this domain within the organization. Additionally, formal work units might comprise one expert as the central individual in a team or work units might comprise several experts, specialized in different subtasks (Kudaravalli et al., 2017). Experts and specialists might be involved differently in the social network in the organization (Lave & Wenger, 1991). It is yet unclear if different types of experts and different types of specialists with varying developmental paths can be distinguished in commercial domains. Furthermore, Hatano and Inagaki (1986) differentiate between routine expertise which means the perfection of a certain set of routines, and adaptive expertise which emphasizes the continuous adaptation of learned routines in response to changes, to maintain and extend expertise in knowledge work domains (Ackerman, 2011; Palonen et al., 2014; Salas & Rosen, 2010). Although commercial domains (see above) also require routine expertise, a particular requirement for adaptive expertise arises from changing technologies and market

requirements (Ackerman, 2011), different cultures and structures within organizations, and changes in organizational routines (Hatano & Inagaki, 1986; McKinlay & Starkey, 1988). However, this adaptability must be distinguished from the notion of "flexperts", namely persons who frequently shift back and forth amongst different domains and still show superior performance in each of these domains (Frie et al., 2018, p. 5). T-shaped expertise emphasizes individuals having a broad, general expertise across domains and a high level of expertise in one domain (e.g., Conley et al., 2017).

Expertise Development in Commercial Domains through Deliberate Practice and Progressive Problem Solving

Formal education and time spent in a domain are important, but not sufficient prerequisites to develop expertise (Ackerman, 2011; Ericsson, 2008; Grohnert et al., 2018). Expertise development is understood as a process involving sustained engagement and accumulated experience acquisition in the domain over time (Ericsson, 2008; Gruber, 1999; Tynjälä, 2013). This process takes place through an individual's interaction with the environment described through structural as well as socio-cultural factors (Tynjälä, 2013; Ullén et al., 2016). These factors shape work practices, which in turn affect how a workplace supports or hinders individual engagement (Billett, 2001) and thus learning and expertise development by providing access to complex tasks, feedback, guidance, and so forth. However, these characteristics are not afforded evenly to all workers, but granted, for instance, depending on perceived competence (Billett, 2001; Goller, 2017) and attributed expertise by peers, supervisors, and customers (Mieg, 2001). It is therefore important to distinguish between the assignment of complex tasks and the active choice of complex tasks. The active choice of complex tasks refers to agentic behavior (Goller, 2017) and one's engagement (Billett, 2001).

Regarding activities that foster expertise development over time, a distinction is made between progressive problem solving (Bereiter & Scardamalia, 1993), which describes an active confrontation with continually evolving, complex problems on the one hand, and deliberate practice (Ericsson et al., 1993; Ericsson, 2018b), which – in its original definition – means the purposeful practice of selected (partial) activities or designed exercises to increase performance, often under the supervision of a mentor, on the other hand. These repetitive exercises are separated from actual work task fulfillment and are usually experienced as strenuous, unpleasant, and only sustainable for a short time through high intrinsic motivation (Ericsson et al., 1993). We emphasize the original definition because deliberate practice was defined inconsistently over the years (Hambrick et al., 2020, p. 4, see also Ericsson, 2018b, p. 762). As mentioned above, structured domains have clearly defined performance standards and tasks which enable such an approach to training. Therefore, deliberate practice explains expertise development in structured domains quite well and this highly structured and supervised training outside of work leads to higher performance (Ericsson et al., 1993; Ericsson, 2008; Ericsson & Harwell, 2019; Hambrick et al., 2014; for a critique, see Macnamara et al., 2014; Macnamara et al., 2016, p. 341; Hambrick et al., 2020). However, it is assumed that deliberate practice, according to its original definition, is not

sufficient to explain expertise development in ill-structured domains very well (Billett et al., 2018, p. 106; Guile & Griffiths, 2001). In this case, there is no consensus and an ongoing debate as to how deliberate practice influences expertise development in ill-structured domains (Billett et al., 2018; Boshuizen et al., 2020; Chow et al., 2015; Dunn & Shriner, 1999; Goller, 2017; Goller & Billett, 2014; Greenwood et al., 2019; Grohnert et al., 2018; Hambrick et al., 2020; Keith et al., 2016; Macnamara et al., 2014; Salas & Rosen, 2010; Sonnentag & Kleine, 2000; Tynjälä, 2013; van de Wiel and van den Bossche, 2013; van de Wiel et al., 2004; van de Wiel et al., 2021) which are different from structured domains (see above) and to what extent progressive problem solving can be utilized to describe expertise development (Tynjälä, 2013). In ill-structured domains, learning takes place in "everyday work activities and interactions" (Billett et al., 2018, p. 106), rather informally (Eraut, 2004; Rintala et al., 2019). Processing of complex tasks in workplaces as ill-structured domains deviates from classic deliberate practice:

- Deliberate practice is a special kind of exercise that is clearly distinguished from work (Ericsson et al., 1993, p. 368; Ericsson, 2018b), which is rarely the case in workplaces.
- Deliberate practice is the repeated exercise of a limited training activity with the goal to improve performance, whereby it is designed by a trainer according to the particular needs of the learner (Ericsson et al., 1993, p. 367, 368; Ericsson, 2018b, p. 755, 757), which is rarely possible in the workplace.
- Deliberate practice is so demanding "that [it] can be sustained only for a limited time each day" (Ericsson et al., 1993, p. 369; see also Ericsson et al., 1993, p. 391 and Ericsson, 2018b) and through mere intrinsic motivation (Ericsson et al., 1993, p. 400; Ericsson, 2018b) since it lacks external reward and is described as "not inherently motivating" (Ericsson et al., 1993, p. 368; see also Ericsson, 2018b) whereas in the workplace such an approach is presumably rare (e.g., Rausch, 2013).
- In structured domains, the expert mentor is very competent as a trainer and can assess the current performance level of the individual (Ericsson et al., 1993, p. 368; Ericsson, 2008, p. 991; Ericsson, 2018b, p. 755; see "persons in the shadow", Gruber et al., 2008), which does not hold for informal mentors in the workplace (e.g., Keith et al., 2016, p. 519). For deliberate practice, the involvement of a trainer is essential and decisive (Ericsson & Harwell, 2019; Ericsson et al., 1993).

Progressive problem solving (Bereiter & Scardamalia, 1993) is a concept that describes expertise development which is less frequently cited in the literature on expertise development in the workplace (e.g., Tynjälä, 2008, 2013; e.g., Dunn & Shriner, 1999). Different from deliberate practice, progressive problem solving is characterized as follows:

- Progressive problem solving occurs in everyday work (Bereiter & Scardamalia, 1993, p. 92, 94 ff.) by actively engaging in work tasks of increasing complexity and reflecting on one's task performance (Bereiter & Scardamalia, 1993). Thereby, „skills develop up to the level that is required for the environment" (Bereiter & Scardamalia, 1993, p. 91; see also workplace affordances; Billett, 2001).

- Since progressive problem solving happens in everyday work, tasks are not particularly designed to increase performance. Individuals rather actively „tackle problems that increase their expertise" and look for more complexity in tasks and problems they can already solve (Bereiter & Scardamalia, 1993, pp. 78-82, pp. 94-98; see also Agency; Goller, 2017).
- Progressive problem solving is not a designed exercise and is neither described as being so demanding that it could be only sustained for a short time nor described as being unmotivating (Bereiter & Scardamalia, 1993).
- Interestingly, guidance is not specifically mentioned as a part of progressive problem solving by Bereiter and Scardamalia (1993).

Nevertheless, there are similarities between deliberate practice and progressive problem solving. Individuals engaging in either of these practices are on "the edge of their competence" (Bereiter & Scardamalia, 1993, p. 98) to increase their competence while actively going beyond well-known routines (Bereiter & Scardamalia, 1993, p. 78, 98; Ericsson et al., 1993). The explicit difference between the two is the nature of the practice. While deliberate practice is the focused and supervised exercise of specially designed (sub-)tasks which are different from work (Ericsson et al., 1993, p. 368, 367; Ericsson, 2018b, p. 762), progressive problem solving is the deliberate attempt to tackle and understand the same tasks and problems that can already be solved on a more difficult level to develop expertise during work (Bereiter & Scardamalia, 1993, pp. 78-82, 94-98). An example of progressive problem solving in commercial domains would be an employee who submits a customer's order according to his or her basic understanding of the workflow. Next time when submitting an order, the employee might focus on additional characteristics such as recommending further products.

It is yet unclear if either deliberate practice or progressive problem solving, or both can adequately explain expertise development in ill-structured domains such as commercial domains. Furthermore, the question remains as to whether specialists and experts differ in their developmental processes and contexts. Thus, our empirical study addresses the following research questions:

- RQ1: How can experts in the business-to-business sales domain be classified and distinguished from specialists?
- RQ2: To what extent does expertise development in the business-to-business sales domain follow deliberate practice and progressive problem solving?

Method

Research Design

Participants Favoring sample homogeneity, we focused on the domain of the business-to-business sales department which is a commercial domain characterized by finding customized solutions for complex products and requires extensive knowledge. We chose to sample four organizations, three of which (two in the wholesale

trade of construction components and one a mail-order business) have around 300 employees and one organization (wholesale trade of construction components) has around 1,000 employees. Peer-nomination (e.g., Ericsson, 2018a) was used, and the following selection criteria were communicated to the contact persons, who in turn asked peers in the formal work units to nominate individuals: (a) the individuals should have work experience in the domain for at least six years. For instance, Harteis (2014) reports two studies in ill-structured fields where experts are individuals with more than two and more than 4 years of experience in the domain; (b) the individuals should be regarded as experts in their field by colleagues; and (c) they are consulted in cases of domain-specific problems. These criteria were communicated to account for differences in an individual's definition of expertise and the expertise understanding of the authors. Overall, 18 of 21 nominated individuals were chosen as participants.

Although peer-nomination has shown weaknesses (Ericsson & Smith, 1991; Ericsson, 2008, 2018b; see also the limited accuracy of perception; Gill et al., 1998), it was shown to be a valid tool to identify high-performing individuals within ill-structured domains (Sonnentag, 1998, pp. 509-510; see also Goller, 2017, p. 216). Furthermore, an alternative means of expertise identification by letting potential experts solve a provided task (Ericsson, 2008; Ericsson & Smith, 1991) was not feasible as we would have needed more experts to develop and evaluate these tasks (see also other approaches for identifying expertise in ill-structured domains; Chow et al., 2015; Dunn & Shriner, 1999; van de Wiel & van den Bossche, 2013; van de Wiel et al., 2004). Furthermore, it might be difficult to identify a task which is sufficient to identify expertise across organizations since expertise is context-dependent in ill-structured domains (Green et al., 2019). In addition, no objective performance indices were available in the participating organizations. All interviewees participated voluntarily, provided written consent, and confirmed that they met the above selection criteria. The average age was 47.2 (SD = 12); 11 participants were male and seven were female. The average work experience in the domain was 27.7 years (SD = 11.8). The sample's average work experience of 27.7 years is sufficient time for individuals to engage in the often cited "10,000 h of deliberate practice extended over more than a decade" (Ericsson et al., 1993, p. 394; for critique see: Ericsson, 2013; Ericsson & Harwell, 2019) which exceeds the average of 5000 h of deliberate practice of some expert violinists in one study (Ericsson, 2013). All participants completed typical German formal education programs (secondary education, vocational education, and training as well as further education) early in their careers.

Interview The semi-structured interviews were based on an interview guideline; they were recorded and fully transcribed. The introduction of each interview included project-related information, the research procedure, and data protection. The main part included open questions from the interview guideline (see appendix) as well as open ad-hoc questions such as asking for examples or asking for specifics on certain answers. In the end, the interviewees were asked if there were any relevant issues left. All interviews were conducted by the primary author of this paper.

Analysis The 13 h of relevant interview material with an average of 39 min per interview was analyzed with qualitative content analysis using the software (Kuckartz, 2014). We used MAXQDA. Categories for RQ1 (see Table 2) were developed inductively with a type-building text analysis approach (Kuckartz, 2014) based on their description of daily work tasks relative to the work tasks of their colleagues and regarding their biographies and career pathways. Categories for RQ2 (see appendix) were developed deductively with a thematic qualitative text analysis based on the literature research and were then inductively revised where necessary which led to some of the subcategories (Kuckartz, 2014). The second coding of a randomly selected ten percent of the material revealed an inter-coder-reliability across all categories (see appendix) of Cohen's κ = 0.74 which is good regarding the extent of the category system (Landis & Koch, 1977; Mayring, 2014). Both codings were conducted by the primary author and a student research assistant.

Results

Types of Experts in Organizations (RQ1)

Based on their description of daily work tasks relative to the work tasks of their colleagues and regarding their biographies and career pathways, it was possible to classify the interview partners into different types of experts. Table 2 shows the attributed types of expertise in our sample.

Seven out of 18 interview partners were classified as relative experts; that is, they have similar tasks to their peers but show superior performance and are often asked for help by their peers. Seven interview partners were classified as managerial relative experts, which means they are still relative experts, but they have additional tasks such as being the head of the department. Two out of 18 interview partners were classified as evolved specialists, which means they had been relative experts in their field but have become specialists over the years. Hence, their former expertise is no longer updated and has become outdated and fades due to changes in the domain, even though a basic understanding of the domain seems to remain as one interview partner explains:

> But once you are out of this tunnel, which is your main task as a salesman, you slowly forget that. You still know enough about it and understand the connections, you sometimes wonder why employees ask you a question and you explain it to them, even though you've been out of this day-to-day business for so long. (Interview partner 2)

Two of the participants were classified as native specialists. Specialists might also be experts, but this is hard to tell since in their organization there are no direct peers to compare their performance to peers.

Table 2 The expert-specialist taxonomy in the workplace

Three types of relative experts			Type 4
Type 1 Relative expert	Type 2 Managerial relative expert	Type 3 Evolved specialist	Native specialist
More than 6 years in the domain	Develops out of type 1	Develops out of type 1 and 2	Has not been a relative expert
Processes the same bundle of tasks as other individuals	Same characteristics as a relative expert	New, specialized tasks are assigned or offered through merit	The only individual working on specific tasks
Handles tasks at all levels of difficulty	Additional tasks assigned or offered through merit	The only individual working on specific tasks	No comparison with other individuals in the organization
In demand for problematic, technical tasks	Becomes *primus inter pares*	New tasks replace original tasks to a great extent or completely	A high level of competence may be assumed
Perceived as an expert	Relative expertise in original tasks might stagnate depending on the extent of additional tasks	Challenge of building new expertise in a new domain or subdomain	
Perceived as very interested and engaged in the domain			
7	9	3	2
(IP3, IP4, IP7, IP10, IP11, IP13, IP14)	(IP1, IP5, IP6, IP8, IP9, IP17, IP18)	(IP2, IP12)	(IP15, IP16)

Note. IP abbreviates interview partner

Development of Expertise in the Business-to-Business Sales Domain (RQ2)

RQ2 addresses the process of expertise development in the business-to-business sales domain. Due to the small sample size and the qualitative approach, there cannot be final statements on differences amongst the different expert types.

At the early stages of expertise development, easy (partial) tasks are selected and assigned by mentors and apprentices solve these tasks under the supervision of the mentor. These tasks are never just exercising but always real-life tasks. Increasingly challenging tasks require assistance from mentors but can gradually be solved on one's own. For specialists, these mentors are often individuals who have worked in this position before and will soon retire. Thereafter, individuals work independently within the respective team and need to solve more and more difficult variants of the daily tasks. During expertise development, organizational routines are acquired. Surprisingly, reflection on solved problematic tasks and errors was rarely mentioned by our interview partners. Finally, ever-changing products, tools, laws, and regulations are important drivers of expertise development but also challenge expertise maintenance.

Our interview partners emphasized the importance of the duration of domain-specific work experience as an important factor to develop expertise in the business-to-business sales domain. Regarding formal education, a typical three-year apprenticeship program within the German system of vocational education and training (VET) usually leads to an intermediate level. However, our interview partners emphasized large differences depending on the organization and the apprentice. Interestingly, several interview partners estimated that these intermediates are capable of handling about 90% of the typical work tasks, whereas about 10% of their assigned tasks can only be solved with extensive assistance from relative experts. Furthermore, the attribution of expertise within formal workgroups and beyond organizations is important to gain access to complex tasks. Complex tasks are often delegated to (supposed) experts by peers and superiors, but they are also assigned based on expertise attribution by customers as customers request support services and consultation from particular individuals.

Our interview partners distinguished between "jumping in at the deep end" of one's own accord (self-selected complex tasks) and "being thrown in at the deep end by others" (assigned complex tasks). Overall, the assignment of tasks is considered more important, emphasizing the organizational influence on expertise development. Furthermore, these tasks follow the approach of progressive problem solving rather than deliberate practice (see Table 3).

Discussion

We conducted an interview study with 18 employees in four organizations to describe the characteristics and explain the development of relative expertise in the ill-structured domain of business-to-business sales department. We distinguished four types of experts according to the expert-specialist taxonomy in organizations concerning their careers and responsibilities within the organizational context.

Table 3 To get thrown in at the deep end

	Main category 5: Choice of tasks	Main category 6: Assignment of tasks
Deliberate Practice (Purposeful and quite exhausting (repeated) practice of selected or designed [partial] tasks to improve performance under the supervision of a mentor.)	0 Codings	14 Codings "This is the exercise, the constant practice that accounts for it." (IP 5) "Would correct him if necessary or talk to him about it, if something does not fit somewhere but would try to bring him there into an independence. Also always recurring … the tasks. Until you see "that works, he understood." Until he can do that in the end." (IP 9)
Progressive Problem Solving (Active engagement in work tasks of increasing complexity, reflecting on one's task performance, and actively searching for more complexity in tasks and problems one can already solve.)	9 Codings "There is always a little bit added and you can learn a lot from around it." (IP 12) "And then the jump into the management task, since this was a completely new content segment, it didn't help me at all in terms of content, so that was really a jump in at the deep end." (IP 3)	87 Codings "You learn that over the years. And there's always something new added." (IP 2) "Everything else comes step by step." (IP 4) "They are thrown in at the deep end because I experienced it the same way and that's how I got to know the goods most quickly." (IP 1)

Note. IP abbreviates interview partner. "Jump in at the deep end" in German translates as "jump into the cold water"

Furthermore, we investigated expertise development with a particular focus on deliberate practice and progressive problem solving.

Types of Experts in Organizations

The expert-specialist taxonomy describes four ideal types of experts in the broader sense which served well to classify our interview partners. Relative experts (type 1) are entrusted with work tasks that – as opposed to specialists – are also processed by several of their peers but the relative experts stand out by sustained exceptional work performance due to their very high domain-specific competencies. These relative experts often progress to become a *primus inter pares*, as they are entrusted with additional, prestigious managerial tasks such as a head of a department (type 2: managerial relative expert). If these new responsibilities increasingly replace the former domain of relative expertise, the managerial relative expert will become an evolved specialist (type 3) who is now entrusted with managerial tasks that none of his or her (former) peers are concerned with. The expertise in the former domain will sooner or later fade because the former expert will no longer keep up with the ongoing changes in the domain and he or she will also forget parts of the expert knowledge (e.g., Ackerman, 2011). Instead, being a site manager, for instance, comes with new tasks and expectations of the social environment and with a self-perception of being a novice again since the expertise cannot be transferred (Chiesi et al., 1979). This necessitates close supervision by an organization to foster expertise development in the new domain. Experts of type two and three are usually selected based on formal or informal mechanisms, and organizations face the challenges of managing these career paths. In addition to these types of experts (relative expert, managerial relative expert, and evolved specialist), in organizational practice, the term expert is also used for persons that we refer to as native specialists (type 4). The native specialist is entrusted with a very special cluster of work tasks that no one else in his or her organizational context is entrusted with. Therefore, it is often difficult to say whether he or she is also a relative expert in this domain because there is no social comparison. Furthermore, there are presumably differences regarding the typical social interactions and involvement in the social network (Lave & Wenger, 1991) in the workplace of specialists (type 3 and 4) and experts (type 1 and 2). For instance, relative experts are presumably more frequently consulted by peers with less expertise in the respective domain, whereas specialists are also consulted by quite experienced colleagues from different domains. Recognizing different types of experts helps organizations to identify and utilize expertise, to manage career paths, define skill demands, and foster expertise development.

Moreover, it is rather likely to encounter this taxonomy in other professional ill-structured domains as well, especially in organizations. The developed taxonomy is dynamic and opens up further developments after an individual reaches expertise in his or her domain. Regarding the concepts of T-shaped expertise and flexperts, types 1, 2, and 4 are rather uneventful. All three types presumably develop a competency profile that is similar to T-shaped expertise (Conley et al., 2017; Dreyfus & Dreyfus, 1986, p. 20), while type 2 has to adapt to a few new tasks. Furthermore,

type 2 does not leave his or her domain and the already gained experiences in the domain might additionally supplement expertise development in the new tasks (Barnett & Koslowski, 1997; e.g., Boshuizen et al., 2020). Regarding the concepts of T-shaped expertise and the flexpert, the taxonomy differs mainly in the development from type 1 to type 3. Type 3 might actually develop expertise more quickly in the new domain since he or she already gained expertise which might be similar to the flexpert (Frie et al., 2018.). Additionally, although we did not encounter this in our sample, it cannot be ruled out that an individual develops into expertise type 3 and later goes back to being type 1. However, this development would be different from what is described as a flexpert since the striking element of a flexpert is the frequent switch amongst domains and continually showing very high performance (Frie et al., 2018). This is highly unlikely in business-to-business sales and presumably other domains in organizations such as controlling or logistics. Regarding the concept of T-shaped expertise, while type 1, 2, and 4 presumably would have a T-shaped expertise profile with the horizontal (broad general competency across domains) and the vertical characteristic (domain-specific expertise), type 3 has two vertical lines: The former domain as well as the new domain or subdomain. However, the vertical line, meaning the expertise, of the former domain will fade over time due to technological changes and a lack of maintenance of expertise (e.g., Ackerman, 2011).

Regarding the concepts of routine and adaptive expertise (Hatano & Inagaki, 1986), types 1 and type 4 are similar as they operate in one domain for a long time and presumably develop a mix of routine and adaptive expertise dependent on the actual scope of tasks to be able to solve daily tasks as well as maintain their expertise. However, type 3 and type 4 might either gain more adaptive expertise since no other individual can be asked, when encountering a problem, or they might fall back and develop far more routine expertise to cope in his or her domain. Additionally, type 2 in particular might develop far more adaptive expertise due to modifying, for instance, learned routines to new tasks (e.g., Barnett & Koslowski, 1997).

Development of Expertise in the Business-to-Business Sales Domain through Deliberate Practice and Progressive Problem Solving

Regarding the development of expertise, our interview partners emphasized the duration of domain-specific work experience. However, they had difficulties in expressing more details on the process of expertise development at first. Time spent in the work domain is necessary but not sufficient for expertise development (e.g., Ericsson, 2008) since not all individuals reach an intermediate level after an apprenticeship. Overall, our interview partners estimated that ten percent of work tasks are complex tasks that are assigned to relative experts. Being entrusted with these kinds of tasks is seen as the key factor for one's expertise development (see also workplace affordances; Billett, 2001). Hence, the attributed level of expertise as it is perceived by peers and customers plays an important role in the assignment of complex tasks which in turn fosters the further development of one's expertise (e.g., Billett, 2001; e.g., Mieg, 2001). Novices have to prove themselves. However, this mechanism does not apply to specialists (type 4) since they are not part of a community that shares a common domain-specific practice in the sense of

Lave and Wenger (1991). At least, their communities stretch out over the boundaries of an organization and hence, hardly influence the assignment of work tasks. Moreover, the attribution of expertise and the provision of complex tasks differs between peers and customers. Though customers can evaluate the quality of service that they have received, they usually do not know whether their sales representative had to consult colleagues. Colleagues, in contrast, know quite well who of their peers has to consult others and who is being consulted. When it comes to access to new complex tasks, our interview partners distinguished between "jumping in at the deep end" of one's own accord (self-selected complex tasks) and "being thrown in at the deep end" by others (assigned complex tasks). Perceived motivation, competence, and personality affect who is "thrown in" and who is not (e.g., see also workplace affordances and engagement; Billett, 2001; see also agency; e.g., Goller, 2017). Altogether, according to our interview partners, it is the assignment of tasks by the social environment that fosters expertise development.

Expertise development by mastering increasingly complex work tasks resembles the approach of progressive problem solving (Bereiter & Scardamalia, 1993) rather than the approach of deliberate practice (Ericsson et al., 1993). This is in line with, for instance, Goller and Billett (2014), Macnamara, Hambrick, and Oswald (2014), and Billett, Harteis, and Gruber (2018) who challenged the role of deliberate practice in expertise development in ill-structured domains. Nevertheless, deliberate practice does play a role at the very early stages of expertise development (see also Dunn & Shriner, 1999). To guide novices, the more experienced peers structure a part of the ill-structured domain and thus, create a structured subdomain like a sandbox in which novices can experiment and learn. In this structured subdomain, deliberate practice takes place, and the novice takes on (partial) tasks which are selected for the particular need of the learner. Solving these tasks is separated from the normal workflow in the domain and solved tasks are checked by the mentoring peers. Furthermore, this early stage is characterized by an alternation of active phases when novices are engaged in work tasks and more passive phases of observing their peers, asking questions, and being instructed by more experienced colleagues who act as informal mentors. However, these informal mentors are not expert trainers as would be the case within the deliberate practice in structured domains (Gruber et al., 2008; Keith et al., 2016). Furthermore, these structured phases aim to help novices to reach the level of advanced beginners according to Dreyfus and Dreyfus (1986), not to lead them to higher expertise. Hence, these informal mentors of novices are not necessarily the domain experts but have to be intermediates in the domain, at least. In the case of specialist domains, this initial structuring is often provided by senior specialists who introduce their successors before they leave, or by external coaches. Furthermore, formal training, for instance executive training, might also help to master the first steps in a new domain.

After the end of an early phase of structured mentoring, advanced beginners enter the realm of the ill-structured domain, and from then on deliberate practice, in its original definition by Ericsson et al. (1993), no longer seems to play a role in expertise development in the workplace anymore. However, there are aspects of deliberate practice in a broader sense, such as reflection and feedback through colleagues, that also apply to expertise development in the workplace (see also van de Wiel et al., 2021). As suggested by other authors, the concept of deliberate practice has to be

adapted to better fit ill-structured domains (Grohnert et al., 2018; Salas & Rosen, 2010; Sonnentag & Kleine, 2000). Nevertheless, if only certain aspects of deliberate practice are present, such as feedback or deliberately engaging in daily work tasks without a teacher, it is not deliberate practice (Ericsson & Harwell, 2019; Ericsson et al., 1993). Hence, instead of "bending" the original concept of deliberate practice (Hambrick et al., 2020; Ericsson, 2018b), we prefer the concept of progressive problem solving (Bereiter & Scardamalia, 1993) to describe expertise development of advanced beginners which is very much in line with what our interview partners reported. While novices engage in deliberate practice according to its original definition, advanced beginners develop their relative expertise by tackling increasingly complex domain-specific problems which are self-selected or assigned by the social environment (see above). Hence, we agree with Ericsson in that novices engage in deliberate practice. However, we differ from Ericsson in that after the novice phase, individuals acquire expertise through processes other than deliberate practice (see Ericsson, 2004, 2006, 2009 as cited in van de Wiel & van den Bossche, 2013, p. 140). For instance, the development of expertise without deliberate practice, after the initial phase in the domain, is also documented for the domain of teaching without referring to the concept of progressive problem solving by Dunn and Shriner (1999, p. 644, 647; see Bereiter & Scardamalia, 1993, pp. 78-82, 94-98).

Deliberate practice in its original definition seems to be less relevant in the business-to-business sales domain after the initial phase because it might simply not be practical to let advanced beginners engage in deliberate practice (e.g., van de Wiel et al., 2021) although deliberate practice in itself is effective for developing expertise (Ericsson, 2008; Ericsson & Harwell, 2019; Ericsson et al., 1993; Hambrick et al., 2014). Nevertheless, although deliberate practice in its original definition is only observed for novices in the business-to-business sales domain, and presumably other commercial domains, it cannot be ultimately ruled out that deliberate practice might take place at certain times later in expertise development. For instance, deliberate practice might be helpful if experts are confronted with new work tasks or new tools because in this particular work area, they are also novices, too and deliberate practice according to its original definition takes place. Furthermore, the environment might differ amongst organizations, which in turn might influence the usage of deliberate practice through more experienced peers (e.g., van de Wiel et al., 2004). Hence, deliberate practice, defined as purposefully designed tasks under surveillance of a teacher outside of work (e.g., Ericsson et al., 1993), might play a role after the initial time as a novice. However, we did not find evidence for such processes in our data.

Furthermore, this description of expertise development is applicable to individuals developing expertise towards becoming a relative expert. Regarding the further development of relative experts to managerial relative experts or even evolved specialists, and native specialists, we assume that deliberate practice can be used to describe early expertise development and later progressive problem solving being the more applicable concept. Nevertheless, an individual can, to a certain extent take over the monitoring of the teacher within the deliberate practice concept without substituting the teacher (Ericsson &

Harwell, 2019; Ericsson et al., 1993). Therefore, relative experts developing into managerial relative experts or evolved specialists might be able to engage in deliberate practice by themselves to a certain extent through knowledge that they gained during the development of expertise in their original domain. However, organizations must foster the development in this early stage by providing training. Regarding specialists, it became clear that the mentor is often the former specialist who leaves the position. Nevertheless, due to the small sample size, this cannot be generalized since it depends on an organization if and for how long two individuals are paid for the same position.

To conclude, we recognize the importance of deliberate practice for expertise development, especially for novices. Regarding the ongoing debate on the role of deliberate practice in its original definition (Ericsson et al., 1993) in ill-structured domains, our study suggests that an answer is not static but dynamic, depending on the work environment and the level of an individual's competences. For instance, while structured domains allow deliberate practice more easily, ill-structured domains make it more difficult to engage in deliberate practice (Dunn & Shriner, 1999; van de Wiel et al., 2004). However, for ill-structured domains, there is likely a spectrum of domains and even tasks within domains that make it more feasible to implement deliberate practice. When investigating a domain, the domain must be analyzed to discover potential tasks or environmental factors that allow the application of deliberate practice in its original definition.

Practical Implications, Limitations, and Further Research Needs

Practical Implications Organizations should differentiate amongst the various types of experts and specialists. It is important to identify relative experts (type 1) when establishing career path models, knowledge management initiatives, or mentoring programs. Based on our findings, we would recommend that organizations provide relative experts with time to mentor intermediates, while novices should rather be mentored by intermediates to preserve the experts' resources. Furthermore, managerial relative experts (type 2) and evolved specialists (type 3) may also be offered formal training to foster initial expertise development in their new domains. Additionally, evolved specialists (type 3) and native specialists (type 4) should get access to external knowledge sources and inter-organizational communities since they can hardly consult and learn from colleagues in their direct environment. Lastly, organizations should ensure a structuring of the ill-structured commercial domain for novices and novices should also engage with customers at an early stage.

Limitations There are several limitations of the study. First, a relative expert in one organizational context may be perceived as an intermediate in another if the average level of competence is higher in that organization, which Marsh (1987) refers to as the "big-fish-little-pond" effect. It is yet unclear if experts can be identified more objectively since different authors come to different conclusions

regarding the applied process of peer nomination (Ericsson, 2008; Ericsson & Smith, 1991; Goller, 2017; Sonnentag, 1998). Second, the sample is small, and all generalizations should be interpreted as hypotheses for further research. Third, the four types are ideal, and overlaps are possible in practice. In practice, it might be a continuum rather than the four categories. Fourth, the participants' subjective perspectives may have led to an incomplete view of expertise development since they might not be aware of every aspect of these processes and, related to this. Fifth, and related to this, retrospective studies on expertise development like this interview study are susceptible to memory biases. Sixth is the potential of domain-specificity of the expert-specialist taxonomy and limited generalizability of the expert-specialist taxonomy which might not be transferable to other domains. Seventh is the differences in the expertise definition of individuals who participated in the peer-nomination process, differences in the expertise definition of interview participants and the expertise definition in the scientific literature. In addition, the results are rather descriptive. Further research is needed to replicate and validate or modify the results.

Further Research Needs First, replication studies are needed. The taxonomy as well as the significance of deliberate practice and progressive problem solving must be validated across different ill-structured domains and different organizations. In particular, the question of whether all four expertise types develop expertise through deliberate practice in early stages and progressive problem solving in later stages needs to be addressed. In addition, it is of interest to explore whether and how the work environment can be optimized to make it easier for individuals to engage in deliberate practice, as ill-structured areas make it difficult for individuals to engage in deliberate practice (e.g., Dunn & Shriner, 1999; van de Wiel et al., 2004). Additionally, it is of interest if individuals can regress from type 3 or type 2 to type 1 and if so, why. Further research is needed on a) the interplay of expertise development and career paths in organizations, b) the generalizability of such processes across domains and organizations, and c) the organizational factors that influence these processes. Our expert-specialist taxonomy in the workplace can be a starting point for the integration of and research on further concepts. Moreover, our qualitative approach should be supplemented by quantitative research in further studies to enlarge the sample size. Expertise development and the development through the various types should be investigated in longitudinal studies although this would be very work intensive. Such a longitudinal study of expertise development would enable the processes that take place for expertise development in ill-structured domains to be understood. Furthermore, peer-nomination should be supplemented by more objective measures, for instance work performance. In addition, it may be of interest to develop tasks to identify expertise more clearly, as peer nomination is not without criticism (Ericsson & Smith, 1991). However, as stated before, it is difficult to design tasks which can be used across organizations to identify expertise since expertise in ill-structured domains is context specific (Green et al., 2019).

Appendix

Table 4 Interview guideline

Research question	Question (examples of ad-hoc-questions)
1	Please describe your curriculum vitae
1	Please describe your daily work (specific examples)
1	Why were you chosen for the interview?
1	Which tasks would you say you are proficient at, while inexperienced professionals (e.g. directly after training) are less proficient at?
1	Would you describe yourself as an expert in your field of work? (Why?)
1	For which tasks would you specifically ask colleagues?
1	Who asks you in your everyday work and why?
2	How does someone become an expert in your field? (How did the interview partner become an expert?)
2	What influences the development of expertise positively / negatively? (Why and examples)
2	What role do colleagues play in learning tasks and routines? (examples)
2	How did you learn to solve your daily tasks? (examples)
2	When do you deliberately practice tasks? (examples)
2	Were there more experienced colleagues in your past or currently available to serve as support?

Note. After each regular question, there was always a lot of back and forth with open questions (why…?, how exactly…? Etc.) to understand fully what the interview partner was saying

Table 5 The main categories and definitions

Main category	Subcategories	Definition of categories and their subcategories
1 = Formal education, curriculum vitae, and work tasks	1.1 = Formal education, curriculum vitae 1.2 = Work tasks	Statements regarding formal education, curriculum vitae, and current and past work tasks
2 = Experience over time (2)	2.1 = Time spent in the domain 2.2 = Accumulation of experience in the domain as reasons for expertise development	Aspects of time spent in the domain, the organization (seniority), and accumulation of experience in the domain as reasons for expertise development. [Most of these statements remain vague concerning what exactly happens during this time of expertise development.]
3 = Attribution of expertise and access to complex / problematic tasks (9) (inductively revised)	3.1 = Just attribution of expertise (peers) 3.2 = Access to problematic tasks due to attribution of expertise (peers) 3.3 = Access to problematic tasks because of other reasons (peers) 3.4 = Just attribution of expertise (customer) 3.5 = Access to problematic tasks due to attribution of expertise (customer) 3.6 = Access because of other reasons (customer) 3.7 = Just attribution of expertise (superiors) 3.8 = Access to problematic tasks due to attribution of expertise (superiors) 3.9 = Access because of other reasons (superiors)	Access to problematic tasks based on the attribution of expertise by colleagues, customers, and supervisors/ organization (e.g., in case of complex requirements, customers request a specific salesperson because they rely on his/her expertise) or due to other reasons
4 = Learning from others (5) (inductively revised)	4.1 = Informal mentor during the apprenticeship 4.2 = Informal mentor after apprenticeship within the organization 4.3 = Informal mentor after apprenticeship outside the organization 4.4 = Knowledge exchange within informal network within the organization 4.5 = Knowledge exchange within informal network outside of the organization	Reports on interactions with more experienced individuals inside and/or outside the organization who are available or have been available as mentors during and/or after the apprenticeship. The interaction aims to learn from an experienced individual. Exchanges in informal networks within or outside the formal working group (own department) and/or exchange within networks are captured as well

Table 5 (continued)

Main category	Subcategories	Definition of categories and their subcategories
5 = Assignment of complex tasks (2)	5.1 = Progressive Problem Solving 5.2 = Deliberate Practice	The extent to which workplace learning is perceived as practice in the sense of deliberate practice (Purposeful and quite exhausting (repeated) practice of selected or designed [partial] tasks to improve performance under the supervision of a mentor.) or growing into it according to the progressive problem solving (Active engagement in work tasks of increasing complexity, reflecting on one's task performance and an active search for more complexity in tasks and problems one can already solve.). Emphasizes the assignment of tasks
6 = Choice of complex tasks (2)	6.1 = Progressive Problem Solving 6.2 = Deliberate Practice	The extent to which workplace learning is perceived as practice in the sense of deliberate practice (Purposeful and quite exhausting (repeated) practice of selected or designed [partial] tasks to improve performance under the supervision of a mentor.) or growing into it according to the progressive problem solving (Active engagement in work tasks of increasing complexity, reflecting on one's task performance and an active search for more complexity in tasks and problems one can already solve.). Emphasizes the choice of tasks
7 = Reflection (2)	7.1 = Reflection on mistakes 7.2 = Reflection on own work	Learning from reflection on mistakes and reflection on the general quality of one's work
8 = Adjustment to changes (2)	8.1 = Changes in the domain 8.2 = Changes in the organization	The pressure to adapt (e.g., to develop new organizational routines) due to dynamics of changes in the domain (e.g., changed markets) or to adapt to internal initiatives of change in the organization

Note. The inductive revision of categories led to the subcategories

Declarations

Ethics Approval The study has been approved by the ethic commission of the University of Mannheim.

Consent to Participate The participance stated written consent.

Consent for Publication Furthermore, we confirm that this manuscript has not been previously published and is not currently under consideration by any other journal.

Conflicts of interest The authors declare no conflicts of interest.

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Dr. Andreas Rausch is a Full Professor of Economic and Business Education at the Business School at the University of Mannheim (Germany). His current research interests include workplace learning, expertise development, domain-specific problem solving, simulation-based learning and competence assessment.