This is an Accepted Manuscript of an article published by Taylor & Francis Group in European Journal of Social Work, available online (OnlineFirst: approx. in Dec. 2016): http://www.tandfonline.com/10.1080/13691457.2016.1255931

How do Social Work Novices and Experts solve professional problems? A Micro-Analysis of Epistemic Activities and Knowledge Utilisation

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Evidence-based practice in social work is an intensely debated topic, with many differing perspectives on how it should be done. However, we know surprisingly little about how social workers actually engage in professional problem solving and about the knowledge base of those processes. To shed light on this topic of social work expertise, we present a novel model of scientific reasoning and argumentation and investigate how experts and novices differ in the reasoning processes they engage in as they are confronted with social work problems. Vignettes were used to capture reasoning processes, and the corresponding verbal data was then analysed. In this study, 26 probation officers and 22 social work students participated. The findings show that experts differ from novices with respect to both their knowledge bases and the epistemic activities in which they engage. Furthermore, a cluster analysis revealed three common problem-solving strategies: evidence-based solution seeking (15 experts and 15 novices), shared problem solving (8 experts) and explanation seeking (1 expert and 7 novices). The results indicate the need to improve the practical problem solving skills of students through situated teaching methods.

Keywords: evidence-based practice, knowledge utilisation, social work expertise, probation, vignettes

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Introduction

Problem solving and evidence-based practice

Social workers are confronted with diverse problems in their daily practice. Social problems can even be seen as constitutive of social work (Sommerfeld, 2014). To cope with those problems, universities teach specific knowledge and skills to social work students. However, we do not know much about whether and how social workers use this knowledge and these skills in their later professional problem solving.

Due to the complexity of social work settings, it seems hardly justified to formulate singular standardized requirements of 'good' problem solving. One attempt to do so, however, can be seen in drawing normative inferences based on the rational nature of scientific knowledge. The premise is that when social work practice is grounded in scientifically generated knowledge, the quality of the outcome (i.e., the decision made to solve a problem) increases. Such a stance has been taken in discussions about evidence-based practice (EBP).

The concept of EBP has provoked a strong response in social work (cf. Okpych & Yu, 2014), yet there is no consistent understanding of the definition of the concept (Rubin & Parrish, 2007). In general, we can differentiate between a top-down and a bottom-up version (Okpych & Yu, 2014, p. 25). First, the bottom-up or process-oriented version of EBP focuses on a structured five-step process to address a practical problem by (1) identifying answerable questions, (2) identifying the information needed for the answer and tracking down the best evidence for the question, (3) critically appraising the results, (4) applying the results to the given situation and (5) evaluating the outcome (Gambrill, 1999, p. 346). In contrast to this process-oriented perspective, proponents of the top-down or product-oriented version of EBP emphasize the need to begin by applying empirically supported interventions.

Despite the popularity of EBP, there is ongoing criticism (e.g., Petr & Walter, 2009). Hammersley (2013, pp. 18ff.) claimed that EBP might even reduce service quality due to its

invalid implication of the direct applicability of research evidence. We agree that some points of criticisms are well justified; however, one positive contribution of EBP is that it has triggered important discussions and research on the very nature of social work. The controversies that emerged within these discussions can be seen as indicators of the need to learn more about the scientific nature of social work beyond the simple application of declarative knowledge (Gray, Sharland, Heinsch, & Schubert, 2015).

Scientific reasoning and argumentation in social work

One way to conceptualize 'scientificness' in the reasoning processes of social workers is to refer to more generic models of scientific reasoning and argumentation (SRA). Fischer and colleagues (2014, pp. 53-55) described SRA as a dynamic process including eight epistemic activities that might be part of reasoning processes in several domains. The eight epistemic activities include the following:

(1) Problem Identification: In many domains, reasoning is driven by concrete problems. Hence, the starting point of SRA is the recognition that the available explanations of a phenomenon do not lead to a sufficient understanding of the situation. For instance, a probation officer encountering a client for the first time may perceive a mismatch between a client's declaration of not using drugs and their own perception of the client's glassy eyes. This dissonance may trigger further epistemic processes to solve the problem.

(2) Questioning: In this epistemic activity, one or more answerable questions of interest are formulated. Regarding the example above, the worker might ask him- or herself, 'Is the client telling the truth?' or 'What would be an appropriate treatment for the client?'

(3) Hypothesis Generation: A hypothesis is a predicted answer to a question and is derived from plausible models, theoretical knowledge, and/or existing evidence. It can

be generated before considering evidence or as result of other epistemic activities. A probation officer might, for example, consider his or her own knowledge about addiction (e.g., the physical symptoms of the consumption of specific drugs) and come to the hypothesis that the drug problem is still evident and that professional support would decrease the likelihood of recurrent incarceration.

(4) Construction and Redesign of Artefacts: In many domains, an attempt to solve a given problem on scientific grounds may include the construction of artefacts, based on theoretical concepts, which support further inquiry. Fischer et al. limited the definition of artefacts to physical ones, which can also be a part of social work methods. In the probation context, the worker may create a 'decisional balance sheet' (Prochaska et al., 1994) with the client as both part of an intervention and a method of getting more detailed information about the client's perspective on the problem.

(5) Evidence Generation: In this activity, the reasoner collects evidence helpful for developing a solution for the problem at hand. There are different understandings of the term 'evidence'. We rely on the definition formulated by Upshure, Ross, VanDenKerkhof and Goel (2001, p. 93): 'Evidence is an observation, fact or organized body of information, offered to support or justify inferences or beliefs in the demonstration of some proposition or matter at issue.' Besides scientific knowledge, there are other sources of evidence, which are important for professionals (Epstein, 1999, p. 834), namely the practitioner's experiences as well as the client's preferences. For instance, scientific knowledge about the long-term effects of drug use is only useful in combination with a clarification of the given circumstances. In order to obtain that, the officer needs to explore the client's living conditions and potential unwillingness to change the problematic behaviour. Moreover, the social worker might compare the given situation to similar situations experienced in the past. This anecdotal evidence could help reduce the complexity of the situation. Therefore, for

our study, we sorted evidence into three subcategories: scientific evidence, anecdotal evidence and evidence retrieved from the client's perspective. These three knowledge sources are often described in the EBP literature (Gambrill, 1999, p. 346). During data analysis, we, however, realised that those three types are not sufficient. We found that many social workers use legal information to justify their inferences. Hence, we inductively added a fourth knowledge type—legal information—which is in line with current demands to broaden the definition of 'evidence' and include more kinds of knowledge important for professional problem solving (Fisher, 2014; Mullen, 2015, pp. 6f.). Note that we do not claim that evidence should be considered equal to knowledge. However, according to the definition of 'evidence' above, evidence can be generated by all potential knowledge sources relevant to social work practice. Hence, our study focuses on the diverse knowledge types used by social workers during their problem solving.

(6) Evidence Evaluation: This epistemic activity involves judging the extent to which the evidence supports the claim or theory in mind; therefore, it includes a critical appraisal of the evidence. For example, the probation officer may doubt the reliability of a study investigating the long-term effects of a particular drug that a client is using. Additionally, the worker may deem reliable the client's statement of not using drugs anymore due to the observation of the client's trustworthy manner.

(7) Drawing Conclusions: The stage of drawing conclusions consists of deciding on the consequences of the previous reasoning process. In social work, this epistemic activity typically involves formulating a diagnosis or deciding on an intervention. In our example, it could be that the probation officer decides to trust the client and not recommend additional programs or therapies. In this case, the worker's conclusion is to reject the former hypothesis that drug use is still evident.

(8) Communicating and Scrutinizing: This step serves as an epistemic activity to interact with others. By engaging in communication, the actor allows others to scrutinize the SRA process. This epistemic activity may occur in relation to any of the other epistemic steps. For example, during the first encounter with the client, the probation officer often retrieves information through communicating with the client. Especially in counselling situations, it is constitutive to also forward information to the client, as well as to other actors. In the probation case given above, the conclusion might be communicated to the responsible court or to other colleagues.

The outlined SRA typology does not dictate a precise order of how these steps should occur in social work practice. For instance, we do not claim that hypothesis generation must be included in SRA, as, in specific situations, it may be more appropriate to follow an exploratory approach without any intention of hypothesis testing. In some domains, this 'forward reasoning' is, even, one indicator of being an expert (Chi, 2006a, p. 24).

In general, we consider the application of the SRA framework a contribution to the scientific basis of social work by 'translating' methods of inquiry developed primarily as forms of research to social work practice, as well as 'translating' models from other disciplines to our own (Shaw, 2015).

Epistemic activities as part of social work expertise

The question of how scientifically generated knowledge influences professionals' reasoning is a core question in many professions. Prior research has indicated that individuals often have problems when it comes to the application of scientific knowledge to real-world problems and that intervention strategies rarely improve the related skills (Gira, Kessler, & Poertner, 2004). For example, Renkl, Mandl and Gruber (1996) pointed to the problem of 'inert knowledge', i.e., a problem solver might have acquired a certain piece of knowledge or a skill that might be helpful to solve a given problem, but he or she does not know that it is applicable in a

given situation. Another problem might be that some professionals may regard scientific knowledge as useless in their daily professional practice (Ghanem, Schwegele, Pankofer, Kollar & Fischer, 2016). However, it could be argued that real experts in professions have knowledge structures that incorporate scientific knowledge and science-based procedures into the vast amount of domain experience acquired over the years. For example, for the medical domain, Schmidt and Rikers (2007) have argued that experts develop so-called 'illness scripts' that embed the bio-medical or scientific knowledge necessary for the right diagnosis and appropriate treatment plan into patient cases, thus forming their experiential knowledge. In other words, the scientific knowledge that is necessary to solve a given problem is encapsulated in knowledge about single cases. This, in turn, enables the expert to quickly categorize the actual case information as an instance for which certain scientific knowledge and skills are required. In many cases, such encapsulated knowledge influences the practice of professionals without them even being aware of it (Dreyfus, 2004; for social work: Fook, Ryan & Hawkins, 2000).

The assumption that certain knowledge structures of professionals are internalized and not directly accessible to them implies the need to investigate social work expertise by directly observing the professional problem solving. Solving a case in social work can be seen an epistemic act by which the social worker generates client-specific knowledge to appraise a situation and come to a conclusion. Based on this theoretical stance and the empirical studies that demonstrate that specific epistemic activities are part of social work expertise (Benbenishty, Segev, Surkis & Elias, 2002; Sheppard, Newstead, Di Caccavo & Ryan, 2000), we recommend the outlined typology of SRA as a promising means to analyse how experts and novices differ in their reasoning processes when confronted with problems in their professional practice. The comparison of experts and novices is rooted in the assumption that the competencies for social work problem solving are not only acquired through higher education programs, but also through experiences garnered by the professional work itself

(Fook et al., 2000). Moreover, those competencies can be considered highly interrelated with the social circumstances in which they are acquired and applied (Billett, 2001). In order to capture the competencies acquired by professional social work practice, one has to both directly observe social workers during their problem solving and compare experienced with inexperienced social workers. Those assumptions led us to pose the following research questions.

Research questions

(1) How do social work novices and experts differ in their engagement in epistemic activities (RQ1) and in knowledge utilisation (RQ2) in their problem-solving process?

(2) Is it possible to identify different types of problem-solving strategies used by social work novices and experts? (RQ3)

Method

Context of the study and participants

Our sample was comprised of 45 participants (M_{Age} = 37.24, *SD* = 13.57) and included two groups. First were the novices: social work undergraduates in their 3rd to 7th semester (*n* = 21; Mdn_{Age} = 24.5 /M_{Age} = 28.77, *SD* = 9.67; $M_{Studying\ Experience}$ = 2.64 [years], *SD* = 1.67). To increase motivation to participate in the study, we raffled six online shopping vouchers with a total value of 250 Euro among the students. Second were the experts: professional probation officers (*n* = 24; Mdn_{Age} = 46/M_{Age} = 44.67, *SD* = 11.98; $M_{Working\ Experience}$ = 18.00 [years], *SD* = 12.33). As compensation, every probation officer received a 20 Euro book voucher. In Germany, the field of probation service requires employees to hold a bachelor's degree in social work. Due to a lack of evidence, we cannot claim that our sample represents social workers from other professional fields. There is even evidence from other cultural contexts (e.g., Dellgran & Höjer, 2005) showing that different professional sub-groups differ in their

preferences in terms of knowledge utilisation.

Practice vignette

We assumed that an effective way to capture internalized (process) knowledge was to investigate participants' narratives (Benbenishty, 1992, pp. 610f.). To trigger these narratives, we met with participants in one-on-one sessions with a practice vignette consisting of a written description of a probation case scenario. Vignettes have been considered a promising instrument to assess the knowledge underlying social work expertise (Benbenishty, 1992). Compared to observational methods that enable the researcher to employ more realistic settings, vignettes are advantageous in terms of avoiding the 'observer effect' and investigating larger sample sizes (Gould, 1996). We also assumed the hypothetical nature of the situation would be beneficial, as it distances the participants from the subject under study and reduces social desirability towards the researcher (Gould, 1996; Schoenberg & Ravdal, 2000). This variable was important for our research question because we made the supposition that the topic of scientific reasoning is a sensitive one, at least among German probation officers (Ghanem et al., 2016).

The practice vignette described a 17-year-old teenager sentenced twice for cannabis possession. At the age of 15, he had been incarcerated for robbery and had only been released two weeks before this intake session with his probation officer. In this session, the client is telling the officer that he has stopped using cannabis. He only uses 'kratom'[1]. After this information, each participant was asked to think aloud (Ericsson & Simon, 1993). They had to explicate all the associations that came spontaneously to mind. To scaffold the think-aloud process, we asked three follow-up questions (Schoenberg & Ravdal, 2000) each time they paused thinking aloud: 'What are you thinking?', 'He [the client] asks you about your professional opinion. What are you thinking?' and 'How do you react?' None of the participants knew exactly what kratom was. After the think-aloud process triggered by the

first instruction and followed by the three questions, the participants were interrupted with new information; they were given an abstract of a scientific study about the drug kratom. This abstract provided some information about kratom as a legally purchasable drug and a conclusive emphasis on its 'dangerous effects'. We introduced this new information to get an idea of how the participants would deal with scientific knowledge in their problem solving. As in the first part, we again gave each participant three follow-up questions to support the think-aloud process: 'What are you thinking?', 'How would you communicate this topic in the next session?' and 'What kind of interventions would be appropriate?'

Data sources and instruments

All think-aloud sessions were audio recorded. The 284 minutes of audio material was transcribed. The resulting verbal protocols were investigated by means of quantitative content analysis. We first identified an appropriate unit of analysis and segmented the data based on the approaches formulated by Chi (1997) and Strijbos, Martens, Prins and Jochems (2006). The main segmentation rule was that a full stop indicated a new segment. However, since sentences can consist of several propositions of interest, we formulated rules to separate propositional units on a syntactical basis (e.g., each conjunction and each comma indicated a new segment). For instance, the sentence, 'A teenager is coming due to robbery, that's what we face very often.' (P10:30,31[2]) contains, on the one hand, some simple biographical data of the client (a teenager charged with robbery). On the other hand, this probation officer is constructing an analogy to his or her own experiences. Therefore, this sentence contains two propositions of interest. As Chinn, Buckland and Samarapungavan (2011) argue, such a fine-grained analysis of epistemic processes is seen as appropriate to capture the inner dynamic of epistemic cognitive processes.

For reliability testing, the first author taught a second coder to apply the segmentation scheme to the data. Both coders independently segmented 10% of the data and reached a

proportion of agreement of 88.43% and 87.4% (cf. Strijbos et al., 2006, p. 37). This result was considered sound. The remaining data was then segmented by the first author, leading to the identification of 3530 segments.

Coding of think-aloud protocols

According to the description of SRA above, we developed a coding scheme to capture the eight epistemic activities proposed by Fischer et al. (2014), as well as the different types of knowledge referred to by the participants. Table 1 presents exemplifying quotes for each epistemic activity. Regarding knowledge utilisation, we set the evidence generation codes as (a) anecdotal evidence, (b) scientific evidence, (c) knowledge retrieved from the client and (d) legal information. Finally, we defined a non-epistemic code for all off-task expressions and meta-statements.

The coding for the reliability test was conducted by the same two coders as for the segmentation. The training of the second coder lasted about 20 hours. Each coder coded more than 10 % of the data (449 segments). We reached a Cohen's Kappa value of 0.69 on the main category level (eight epistemic activities) and 0.65 with all the sub-codes of evidence generation. This was considered satisfactory. The moderate reliability results represent the difficulties of operationalising epistemic activities. Although Fischer et al. (2014) provide concrete ideas about how epistemic activities might be evident in practice, they remain a weakly defined concept, which must be taken into consideration when interpreting of the results (see 'Limitations and perspective').

Statistical analyses

By means of *t*-tests, we investigated the differences between novices and experts regarding the epistemic activities they engaged in (RQ1) and the evidence base of their problem solving (RQ2). To address RQ3, the identification of different types of problem-solving strategies, we

conducted a cluster analysis (Backhaus, 2011; Clatworthy, Buick, Hankins, Weinman, & Horne, 2005). For this cluster analysis, we excluded the Constructing Artefacts variable because most participants had a value of 0.

Some of the epistemic activities showed a high positive correlation with one another. Consequently, we had to transform the descriptive values to percentages (Backhaus, 2011, p. 443). 100% was defined as all applied codes. Each former variable highly correlated with the transformed one (from $r = .55$ up to .9; each $p = .000$), meaning that the meaning did not change dramatically and the correlations simply decreased. This led to a changed meaning of the values, which has to be taken into consideration in the interpretation of the results. All data preparation and analysis steps were conducted by use of 'IBM SPSS Statistics 22'.

Results

RQ1: How do social work novices and experts engage in epistemic activities?

Table 2 shows the mean occurrences of the epistemic activities in both the social work novices and experts. On average, $M = 75.38$ ($SD = 46.91$) of the novices' segments and $M = 81.13$ ($SD = 33.77$) of the experts' segments were coded as epistemic activities. This difference was not significant ($t(43) = .48$, $d = -.142$, $p = .167$).

An inspection of the descriptive frequencies of segments that were coded as epistemic activities under study revealed that experts engaged significantly more often in Constructing Artefacts and Communicating than the novices did. Novices, in turn, showed a significantly stronger engagement in Problem Identification. With respect to the other epistemic activities, no significant differences were observed. We will now report some noticeable observations in detail.

The epistemic activity of Constructing Artefacts has by far the lowest frequency. Examples of the few artefact constructions were the use of an 'addiction diary', a 'decision-balance sheet' and an official probation service form. Due to the skewed distribution, we

confirmed this difference with a nonparametric test (Mann-Whitney *U* Test, p = .008). However, in general, the use of artefacts did not seem to be very relevant in this social work context.

Beyond significance testing, we also found some remarkable descriptive results. For instance, the novices engaged twice as often as the experts in Hypothesis Generation (p = .122). This difference corresponds to a medium effect[3] (Cohen, 1992).

The difference we found in terms of the epistemic activity of Questioning, although insignificant (*p* = .112), corresponded to a medium effect as well. Descriptively, the experts engaged in Questioning around 50% more than the novices did.

RQ2: How do social work novices and experts use different forms of knowledge?

Anecdotal evidence.

Three main ways of generating anecdotal evidence were identified: First, some participants compared the given case to cases they had experienced in the past; second, they used anecdotal evidence from colleagues by directly asking them for their experiences; and third, they consciously planned to gather anecdotal evidence in the future to solve the problem. Although the experts should have had more experiences they could draw upon to make sense of the given situation, the difference between the anecdotal evidence generation of the experts and the novices was negligible (Table 3).

Client's perspective.

Knowledge retrieved from the client's perspective was the most often used knowledge types. It seems that the client was seen as a reliable source of knowledge: '[…] if he takes it [kratom], […] he is the expert. Hence, he can explain to me what this is…what kind of drug [this is] and about its effect.' (P7:21,23,24,26). Experts relied on this type of knowledge significantly more often than did the novices, which amounted to a medium effect.

Scientific evidence.

Scientific evidence was used to a lesser extent by both novices and experts, compared to the previous two knowledge types. Among the responses to the first instruction, the average rate of scientific evidence use was 0.56 times per participant. Thirty-one of the 45 participants did not use scientific evidence at all. However, the second instruction provided scientific knowledge, which led 39 participants to use it in their subsequent reasoning process. The values in Table 3 are based on the responses to both the first and second instruction. The difference between novices and experts was not statistically significant (p = .198). Nevertheless, the standard deviation in the group of novices was much higher than in the experts' group. The novices thus seemed to act more heterogeneously than the experts did, in terms of using scientific knowledge.

Legal information.

The experts used legal information significantly more often than the novices did. The most frequent examples were references to probation-constituting instructions and obligations. However, for both groups, legal information did not play a central role in their problem solving.

RQ3: Is it possible to identify different types of problem-solving strategies?

To answer RQ3, we used the results of RQ1 regarding the occurrences of each epistemic activity the participants engaged in, as well as the results of RQ2 about the types of evidence they generated, to identify patterns of individual problem solving by means of a cluster analysis.

The following results are based on the data of all 45 participants, since the single-linkage clustering method did not show any outliers. We used the squared Euclidean Distance (Clatworthy et al., 2005) as a similarity measure method and the 'WARD' method for cluster

identification (Backhaus, 2011, p. 444). Using the 'elbow criterion', we could clearly identify three clusters. This number of clusters was validated by use of the complete linkage method. To check the stability of the clusters, we excluded three arbitrarily picked variables (Hypothesis Generation, Legal Information, Drawing Conclusions) and reran the analysis. This led to very similar results, especially to two mismatches.

Table 4 presents the statistical values of each cluster. The *t*-values indicate the differences between the clusters, with 0 representing the mean of the whole sample. *F*-values indicate the homogeneity within a cluster, with values below 1 indicating a 'totally homogenous' cluster (Backhaus, 2011, p. 440).

Cluster 1: Evidence-based solution seeking

The participants in this cluster largely neglected the epistemic steps Problem Identification and Questioning. Specifically, members of this cluster mainly engaged in the epistemic activities Hypothesis Generation, Evidence Generation, Evidence Evaluation and Drawing Conclusions. Regarding the evidence used, they most frequently relied on objective knowledge such as scientific evidence and legal information, but also on anecdotal evidence. Compared to the other clusters, this group referred to those kinds of knowledge most often and, at the same time, considered the client's perspective least by far. The scientific evidence considered was often very generic, such as '[I would] Google for information what it [kratom] exactly is; just getting some theoretical background knowledge.' (P25:9-11). Nevertheless, there were also some references to scientific studies. For example, one participant referred to a study that indicated a relation between early cannabis use and psychosis (P31:22). Others simply used scientific terms like 'doing addiction' (S43:98) (Schmidt-Semisch, 2010) which can be seen as an indicator of the influence of scientific knowledge on reasoning processes in practice.

Cluster 2: Shared problem solving

In contrast to the previous cluster, participants in the second cluster frequently engaged in the epistemic activities of Evidence Generation from the Client's Perspective and Communicating. Communication activities mainly included when the participant mentioned speaking acts to be addressed toward the client, for example, 'Can he [the client] judge the harm by himself? Which kind of background knowledge does he have, etc.?' (P25:30-31). This cluster's engagement in other epistemic activities was below average, except for the process of Questioning, which also had an exceptionally high frequency. In conclusion, the typical reasoning pattern in this cluster was to formulate questions with respect to the situation and to seek answers together with the client.

Cluster 3: Explanation seeking

Participants in this cluster primarily engaged in Problem Identification and Questioning. Further inspection of the data revealed that 85.5% of the questions in this cluster related to the topic of the drug kratom (compared to 64.82% among all participants). With respect to evidence use, members of this cluster tended to use neither scientific nor legal knowledge. They considered the client's perspective a bit less often than members of Cluster 2, but almost twice as often as did members of Cluster 1.

Cluster membership of novices and experts

As a last step of the analysis, we used the cluster results to analyse how novices and experts were distributed among the clusters. The results show an equal representation of novices and experts in the cluster labelled evidence-based solution seeking (Figure 1). Around two thirds of each group (15 each) belonged to this cluster. The second cluster followed the strategy of shared problem solving and consisted of one third of the experts, but not even one novice. One third of the novices and only one single expert belonged to the third cluster characterized

by explanation seeking.

Discussion

Interpretation and implications

This article presents empirical findings on how the reasoning processes of social work problem solving by experts and novices in the field of probation are constituted. We specifically pursued the following research questions:

RQ1 & 2: How do social work novices and experts use evidence and engage in epistemic activities in their problem-solving process?

By far the biggest difference appeared for the epistemic activity of Problem Identification. Novices engaged more often in this activity than experts. Furthermore, they also engaged twice as often as experts did in Hypothesis Generation. This finding can be interpreted in light of psychological expertise research, which states that novices typically engage in hypothetico-deductive reasoning (Chi, 2006, p.24) and they possess fewer perceptual skills to recognize patterns in a given situation than experts do (Ross, Shafer, & Klein, 2006). Novices rely on theoretical concepts and apply them to a given situation before they actively solve the problem. In contrast, by capitalizing on their encapsulated knowledge, which combines prior experiences with scientific knowledge, experts usually engage in forward reasoning by directly recognizing relevant cues that trigger a solution process. However, if we look at the descriptive occurrences of Questioning, which usually also occurs in the beginning of a reasoning process, we can see that experts engaged more often in this epistemic activity than novices. This might be explained by the fact that the experts, as well as the novices, lacked knowledge about the term ‘kratom’. Some research suggests that when routines are disrupted by a problem, experts tend to apply analytical reasoning (Van Merriënboer, 2013). Analytical reasoning may take the form of generating questions about the problem.

Experts moreover tended to solve the problem in an interactive way by engaging more in the epistemic activity of Communicating, compared to novices. They also retrieved more evidence from the client's perspective. The reference to the client was an important one for the experts in coming to a solution, as indicated by the following quote: 'I would just ask [the client] if he has knowledge about it [kratom]' (P9:9,11). Most experts seemed to know that they could not come to a solution without further communicating with the client and getting more information from the client's perspective. One reason why novices largely neglected the client's perspective may be that this type of knowledge was the only one that was not immediately available. If one insists on the necessity of the client's perspective, a problem may be unsolvable in the moment, and this might cause uncertainty or a fear of being perceived as unprofessional (Ghanem et al., 2016). Although students are typically educated about the importance of client-centred approaches, these results stress the need for specific communication skills instructions; for instance, by means of training methods, like role plays, in which the students must cope with problem-solving situations under uncertain circumstances. Those teaching methods must be complemented by appropriate evaluation methods, like peer feedback or video analysis, which give the learner the opportunity to reflect on and revise their interaction behaviours. An interdisciplinary research group is currently developing an automatic coding system for investigating epistemic activities in verbal data (Lerner et al., 2016). This and similar developments might be used in teaching contexts to enable learners to reflect on their problem solving abilities.

Besides the frequent consideration of the client's perspective, experts used more legal information as well, maybe due to their domain-specific knowledge about probation-relevant laws. In general, the experts used and integrated more varied knowledge sources for their problem solving than the novices did. This can be seen as consistent with the findings of Benbenishty et al. (2002), who observed that expert social workers tended to search for evidence in a more holistic way. This holistic approach of experts is also described in other

domains (Chi, 2006, p. 24). This finding might indicate the need to enhance students' abilities to triangulate different sources of knowledge. Since this kind of applied knowledge triangulation requires complex skills, situated teaching methods seem to be promising in this respect. One such method is 'key situations' (Staempfli, Kunz, & Tov, 2012), which provides the structure for triangulation of different types of knowledge by means of hands-on activities and a guided process of reflection.

In terms of using scientific knowledge, we found that novices acted more heterogeneously regarding the use of scientific knowledge than the experts did. On the one hand, this may imply that there are simply some students who are really interested in or able to apply scientific knowledge in their reasoning and others who are not able to use this kind of knowledge or do not perceive it as useful for their problem solving. On the other hand, when viewed in light of the homogenous behaviour of the experts, the heterogeneous behaviour of the novices may imply that expertise in social work leads to a singular way of dealing with scientific knowledge. Our results further indicate that scientific knowledge did not seem to play a crucial role for either the novices or the experts, which is in line with other findings (e.g., Drury-Hudson, 1999; Närhi, 2002). It is, however, important to consider that we have only coded explicitly referenced scientific knowledge. Social workers' problem solving may be informed by either conceptual or tacit knowledge that has been influenced by scientific knowledge. To uncover further insights about this topic, a reconstructive analysis is needed to examine in depth, though we are well aware that not all kinds of tacit knowledge (Collins, 2010) can be investigated empirically. Nevertheless, both novices and experts showed specific patterns of scientific reasoning and were able to integrate scientific knowledge (in the form of a research abstract) into their problem solving. This finding supports the notion that pre-structured scientific knowledge for social workers might be an effective tool to enhance professional social work (Fisher, 2014).The ability to retrieve scientific evidence from the provided abstract does not imply that the relationship between theory and practice is a solely

'technical' one that can simply be bridged by providing scientific knowledge. The relationship between science and probation service is more complex (Ghanem et al., 2016). It is not enough to see science as a product that can be applied directly to practical social work contexts (cf. Scurlock-Evans & Upton, 2015). One might argue instead that only the process of reasoning itself can qualify as scientific (Poulter, 2003).

RQ3: Is it possible to identify different types of problem-solving strategies used by social work novices and experts?

A further question we asked referred to whether it is possible to differentiate types of problem-solving strategies among our participants. A cluster analysis revealed three different clusters: evidence-based solution seeking, shared problem solving and explanation seeking.

The first cluster, which denotes a strategy of evidence-based solution seeking, comprised the majority of our sample and was equally prevalent for novices and experts. These participants largely neglected the epistemic activities of Problem Identification and Questioning and instead directly started to solve the problem by stating a hypothesis and then generating and evaluating different kinds of evidence, most often the more objective types, like scientific evidence and legal knowledge. Members of this cluster engaged comparably little in attempts to yield further evidence from the client's perspective. It is interesting that this kind of problem solving was applied by the majority of both the novices and the experts. Unfortunately, it is difficult to offer valid interpretations of these patterns, since the *F*-values indicate a high heterogeneity within this cluster. It might also be the case that the quality of this strategy differs between students and experts, in the sense that experts relied more on encapsulated knowledge, whereas novices applied concepts that were more theoretical. However, the interpretation of our analysis is limited on this point.

A second cluster type followed a strategy of shared problem solving, characterized by communication with the client and acknowledgement of the client's needs. This type included

experts exclusively. One interpretation is that these experts may have learned over time that it is crucial to be context-sensitive and involve the client as a co-producer of the outcome. An explanation for this strategy is offered in the theory of knowledge encapsulation. These experts do not have to systematically search for relevant information. Specific features of the case description may activate the relevant encapsulating concepts that enable the experts to directly solve the problem by interacting with the client.

A third type of problem-solving strategy we identified was labelled explanation seeking. Participants in this cluster seemed to get stuck early in their reasoning as they were simply trying to understand the client's problem. Participants in this cluster mainly talked about the problem, but seemed to have difficulties regarding how to solve the problem. They seemed to be overwhelmed and often did not come to a conclusion. This may be caused by the complexity of the situation for which they lacked an appropriate schema. Thus, it is not surprising that this type was almost exclusively novices. Regarding social work education, our results indicate that this subgroup of students may have problems solving practical social work problems. There is a need to support these students in the acquisition of practical problem-solving strategies and the underlying knowledge required.

In general, the results show that some of the five process steps proposed by the classic EBP model do play a crucial role in the actual reasoning of social workers. EBP, however, does not cover all the epistemic activities that play a central role in our sample, especially the activity of Communicating. Hoefer and Jordan (2008, p. 549) stressed this issue by claiming that the interaction with the client can be considered as a 'missing link' in the EBP model. The reconsideration of communication as a constituting act of problem-solving processes may prevent fallacies of thinking about social work as a linear process of a technical knowledge application. We therefore conclude that the SRA typology echoes the demand for a process-oriented perspective on knowledge (Reid, 2001; Sheppard et al., 2000; Trevithick, 2008). It

can serve as a useful framework to empirically capture the actual procedural knowledge of social workers.

Limitations and conclusion

Although this study is among the first to systematically analyse the reasoning processes of probation officers as they are confronted with problems common to their professional practice, the results need to be interpreted against a background of several limitations.

The use of vignettes raises the issue of external validity. We investigated the participants' problem solving in individual settings, although in practice, social work problem solving is discursive in nature. Undoubtedly, the use of vignettes leads to a selective representation of authentic social work practice (Hughes, 1998; Wilks, 2004). Therefore, it should be considered an "exceptional method with which to estimate what subjects intend to do in a particular situation" (Thurman, 1986, p.452, cited in Hughes & Huby, 2004). Evaluating the validity of our results would undoubtedly be a task for future researchers, to explore additional methods for observing probation officers' and students' thinking processes when confronted with true professional problems. For instance, officers could keep a diary in which they reflect on their client encounters right after they have happened, or researchers could apply ethnographic methods to study the knowledge in action. Reconstructive and ecologically more valid data collection methods would be useful in investigating whether epistemic activities are well captured by our approach, or whether they can also be analysed beyond the means of the manifest structure of narratives. We, however, assume that our method of coding verbal protocols provides, at least, a valid picture of the information processed during task performance (Ericsson & Simon, 1993). Even though oral utterances cannot be equated with cognitive processes, they reveal how epistemic processes take place during social work problem solving. The last point about the use of vignettes relates to their hypothetical character. The scenario the participants were confronted with may have had an

influence on their problem solving. Especially, the topic of drug use might invoke strong normative views that may interfere with the reasoning process, which is exactly the point Feltovich, Prietula and Ericsson (2006) made by emphasizing high context-sensitivity of expert behaviour. The use of vignettes can however be seen as an effective method to create a distance between the subject under study and the normative implications of the problem-solving content (Finch, 1987). Nevertheless, due to assumed context-sensitive responses it would be interesting to study whether the results could be reproduced using different case vignettes as well as other fields of social work practice.

Moreover, although our study led to preliminary evidence characterizing the constitution of social work expertise, we did not control for cohort effects that might have influenced our results. If we considered, for instance, the influence of education on professional work and recent progress in scientific concepts and methods, the variance between novices and experts may have been partially explained. To clarify this, longitudinal studies on the topic of development of scientific reasoning are needed.

Lastly, the operationalization of epistemic activities requires several judgments on the part of the researcher, as evidenced by the rather moderate interrater reliability coefficients. Although our analysis based on the SRA framework shows that epistemic activities can be measured, it still leaves space for interpretation. We addressed this problem by opting for the development of a coding scheme and a quantitative reliability testing, to increase objectivity during our analyses and make replication studies possible.Despite these limitations, the results of this empirical study are promising in several respects. First, they illustrate how probation officers and students of social work display scientific reasoning while solving problems in their professional practice; however, the reasoning processes of the two groups exhibit certain marked differences. Second, the results imply that theoretical concepts from other domains,

like the theory of knowledge encapsulation, might be useful in social work research and practice. Last, the results generate clear recommendations for supporting social work students in acquiring the skills and competencies necessary for high-level problem solving in social work practice. Although we believe that this study and its findings make contributions that will ultimately be helpful in promoting professional social work practices, we are certainly aware that additional and diverse studies must be conducted to construct a solid scientific knowledge base.

Acknowledgements

We are very grateful for the support of András Csanadi in terms of coding training and reliability testing as well as for the useful feedback of the manuscript reviewers. We thank all probation officers and students who participated in this study. This research was supported by the Elite Network of Bavaria under Grant K-GS-2012-209.

Disclosure Statement

The other authors do not have any conflicts of interest. The first author is a probation officer who is on special leave (without salary) for the time of his PhD. However, the study was not funded by the Ministry of Justice.

Notes

1. The leaves of the kratom plant can be consumed and the intoxication is similar to opioids (Babu, McCurdy, & Boyer, 2008).
2. Citations of participants were labelled according to the structure of the data within the used software ‘MAXQDA 11‘: P10 = probation officer number 10; 30,31 = Segment numbers 30 and 31.
3. Calculated by use of the online tool provided by ‘Psychometrica – Institute for Psychological Diagnostic’, which applies the effect size analysis of Borenstein (2009, pp. 228f.).

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Tables

Table 1. Applied codes and associated quotes.

CODE	EXAMPLES
Problem Identification	*'Kratom, sorry, I have no idea what this might be.' (P10:8)*
Questioning	*'First of all: What the hell is kratom?' (P25:5)*
Hypothesis Generation	*'It could be a synthetic drug.' (P3:50)*
Constructing Artefacts	*'I would also make a decisional balance sheet.'(P3:24)*
Evidence Generation	
- Anecdotal Evidence	*'[…] because I have had many similar experiences.' (P24:68)*
- Client's Perspective	*'[…] and exploring his motivation to stop using drugs.'(P19:66)*
- Scientific Evidence	*'There is, for instance, a study from Israel which revealed healing effects of cannabis.' (P6:131,132)*
- Legal Information	*'[…] because I don't have a statutory mandate.' (P29:124).*
Evidence Evaluation	*'One opinion from this research institute is not enough,[…]' (P26:24)*
Communicating	*'I would clearly tell him, [that I don't know the drug]'(P28:35)*
Drawing Conclusions	*'Due to the danger of it, I would say 'poor guy' and that he should rather smoke cannabis.' (P2:58-60)*
Non-Epistemic	*'Was that [the task] all?' (P6:24).*

Table 2. Occurrence (number of segments) of epistemic activities of social work novices (n = 21) and experts (n = 24).

	Experts		Novices		*t*-test		
	M	*SD*	*M*	*SD*	*t*	*df*	d_{Cohen}
Problem Identification	2.25	1.57	5.05	3.51	-3.67***	26.86	-1.09
Questioning	6.25	3.05	4.76	3.08	1.62	43	.48
Hypothesis Generation	4.63	5.10	8.48	10.01	-1.59	28.81	-.47
Constructing Artefacts	.63	.92	.05	.22	2.97***	25.90	.89
Evidence Generation	31.21	14.69	24.43	15.45	1.50	43	.44
Evidence Evaluation	17.25	12.47	14.67	13.80	.66	43	.20
Communicating	6.79	3.35	4.43	3.52	2.31**	43	.69
Drawing Conclusions	8.29	5.84	9.29	9.71	-.42	43	-.12
Non-Epistemic	3.38	3.70	4.24	2.97	-.40	43	-.12

Note: * = $p < .1$, ** = $p < .05$, *** = $p < .01$ (two-tailed).

Table 3. Occurrences (number of segments) of generating different kinds of evidence of social work novices (n = 21) and experts (n = 24).

	Experts		Novices		*t*-test		
	M	*SD*	*M*	*SD*	*t*	*df*	d_{Cohen}
Anecdotal Evidence	*7.63*	*7.38*	*7.00*	*6.82*	.29	43	.09
Client's Perspective	*11.50*	*7.07*	*7.33*	*5.09*	2.24**	43	.67
Scientific Evidence	*3.17*	*1.99*	*4.57*	*4.51*	-1.32	26.73	-.39
Legal Information	*3.25*	*3.25*	*1.38*	*1.88*	2.40**	37.68	.72

Note: * = $p < .1$, ** = $p < .05$, *** = $p < .01$ (two-tailed).

Table 4. Results of the cluster analysis (N = 45).

	Cluster 1 (n = 30)			*Cluster 2 (n = 8)*			*Cluster 3 (n = 7)*		
	M	*t*	*F*	*M*	*T*	*F*	*M*	*t*	*F*
Problem Identification	3.9	-.27	.24	2.77	-.50	.16	13.95	1.74	1.71
Questioning	5.87	-.38	.53	12.91	.87	1.42	11.61	.64	.88
Hypothesis Generation	7.95	.12	1.09	4.13	-.45	.42	7.3	.02	1.21
Evidence Generation									
- *Anecdotal Evidence*	*9.68*	*.2*	*.14*	*4.27*	*-.71*	*.35*	*8.05*	*-.07*	*.55*
- *Client's Perspective*	*9.62*	*-.45*	*.55*	*22.93*	*1.19*	*.52*	*17.72*	*.55*	*.81*
- *Scientific Evidence*	*6.19*	*.21*	*1.23*	*3.82*	*-.29*	*.31*	*2.4*	*-.59*	*.27*
- *Legal Information*	*3.24*	*.23*	*1.09*	*2.5*	*-.04*	*.63*	*.00*	*-.96*	*.00*
Evidence Evaluation	20.73	.31	.89	11.49	-.80	.71	14.74	-.41	.67
Drawing Conclusion	12.97	.16	1.19	10.4	-.13	.56	6.93	-.53	.45
Communicating	7.71	.03	.74	11.89	.96	.46	2.03	-1.23	.21

Figure caption

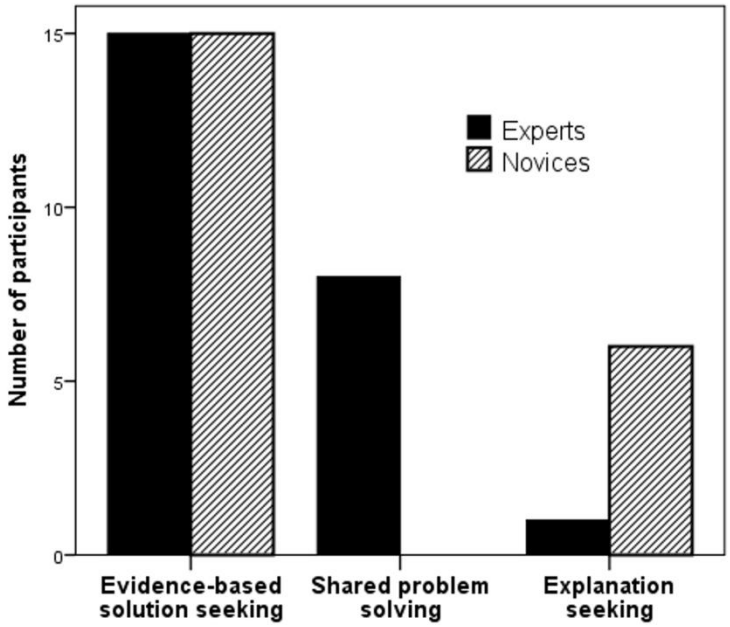

Figure 1: Distribution of novices (n = 21) and experts (n = 24) among the clusters.