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Research article

The Social Nature of Skills: Beyond Dreyfus' Skill Model

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Abstract

Skill is different from knowledge. It is the ability of knowing-how rather than knowing-that as characterized by Hubert Dreyfus' "Skill Model." Dreyfus developed the „Skill Model" to describe the process of acquiring a skill like driving a car. For Dreyfus, skill is an intuitive reflection of the body which is based in experience. However, Dreyfus neglected that skillful activity does not consist in mechanically separable movements that are directed toward a physical object, but a certain way of dealing with things and persons involving know-how in respect to contexts of purposes in use. Accordingly, acquiring a skill involves two types of norms, operational norms and social norms. What Dreyfus emphasised in his "Skill Model" is only the operational norm of skill. As an ability of knowing-how, skill acquisition, skill transfer, and the judgment of skill are based on social norms. This can affect our attitude on artificial intelligence: 1. No computer will be fluent in a natural language, pass a severe Turing Test, and have full human-like intelligence unless it is fully embedded in normal human society. 2. No computer will be fully embedded in human society as a result of incremental progress from the base-line of current technology.

Keywords: Skill; Ability; Michael Polanyi; Hubert Dreyfus; Harry Collins; Operational and Social Norms; AI

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Научная статья

Социальная природа навыков: За пределами модели навыков Дрейфуса

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Аннотация
Навыки отличаются от знаний. В "Модели навыков" Хьюберта Дрейфуса это применение "знания как", а не "знания что". Дрейфус разработал "Модель навыков" чтобы описать процесс приобретения таких навыков, как вождение автомобиля. Для Дрейфуса мастерство –это интуитивное отражение тела, основанное на опыте. Однако Дрейфус упускал из виду, что умелая деятельность состоит не в механически разделенных движениях, направленных на физический объект, а в определенном способе обращения с вещами и людьми, предполагающем "знание как" в зависимости от контекста используемых целей. Соответственно, приобретение навыка включает в себя два типа норм: операционные нормы и социальные нормы. То, что Дрейфус подчеркивал в своей "Модели навыков", –это всего лишь операционная норма навыков. Применение "знания как", приобретение навыков, передача навыков и оценка навыков основаны на социальных нормах. Это может повлиять на наше отношение к искусственному интеллекту: 1. Ни один компьютер не будет свободно говорить на естественном языке, не пройдет строгий тест Тьюринга и не будет обладать интеллектом, подобным человеческому, если он не будет полностью интегрирован в нормальное человеческое общество. 2. Ни один компьютер не будет полностью внедрен в человеческое общество в результате постепенного прогресса если рассматривать современные технологии как стартовый уровень.

Ключевые слова: Навык; Способность; Майкл Поланьи; Хьюберт Дрейфус; Гарри Коллинз; Операционные и социальные нормы; Искусственный интеллект

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INTRODUCTION

With the rapid development of big data, deep learning, microelectronics and other technologies, the autonomous decision-making ability of artificial intelligence has become increasingly stronger. Issues concerning human-like AI agents have become the frontier topics of contemporary philosophy of science, attracting wide attention from the academic community.

From the perspective of functionalism, intelligent agents can possess the knowledge that human beings have, but cannot possess the skills acquired by human beings. Therefore, philosophical research on skills is of methodological significance for deepening our thinking about artificial consciousness, artificial emotion, and artificial morality related to artificial intelligence. Skill is a familiar concept which has been discussed already in the era of Aristotle. Unfortunately, however, the philosophy of science has mainly focused on how to defend the rationality of scientific knowledge, but excluded from its considerations of scientific discovery issues related to scientists' skills, thus greatly neglecting research on the philosophical problems related to skills. At present, with the persistent exploration of the question "Can machines possess human intelligence?" in the field of philosophy of technology, we need to review the concept of skill and its connotations. This paper attempts to deepen the philosophical understanding of artificial intelligence by revealing the social nature of skills.

I. PRACTICE-BASED SKILL AND EXPLICABLE KNOWLEDGE

Skill is different from knowledge. The distinction between them was first drawn by Socrates in ancient Greece. In *Theaetetus,* Socrates first refuted Theaetetus' view that skill is knowledge about something. Theaetetus argued that shoemaking skill is the knowledge of making shoes. Socrates argued that we should make clear what knowledge is in the first place before we distinguish between knowledge and skill. Later, Socrates critiqued the three interpretations of knowledge proposed by Theaetetus, which are, "knowledge is perception," "knowledge is true judgment," and "knowledge is true justified belief" respectively. In other words, Socrates argued that knowledge needs to be explained, while skills cannot be explained by way of language.

If knowledge is divided into explicit knowledge and tacit knowledge, both skills and tacit knowledge have "tacit" characteristics which cannot be explained by language. However, the two concepts are not identical but have different meanings in usage –- tacit knowledge is obviously "tacit," but not all ways of knowing with "tacit" characteristics is tacit knowledge. Three considerations serve to further elucidate this.

Firstly, the concept of "tacit knowledge" was originally proposed by Michael Polanyi. He mainly used the concept of tacit knowledge to describe an inexplicable functional cognitive system, which is not explicit perceptual experience based on traditional epistemology, but exists and plays a decisive role in the practical activities of human beings. For example, Polanyi said: "We can see more than we can tell" (Polanyi, 1966, p. 4). Skill belongs here as well, as a practice that relies on action.

Secondly, Polanyi emphasized that tacit knowledge has rules, and gave an example of bicycling: "The rule observed by the cyclist is this. When he starts falling to the right, he turns the handle-bars to the right, so that the course of the bicycle is deflected along a curve towards the right. This results in a centrifugal force pushing the cyclist to the left and offsets the gravitational force dragging him down to the right" (Polanyi,1962, p. 51). However, Polanyi argued that the rules of tacit knowledge are not clear enough, because they cannot encompass all elements involved in the process of acquiring tacit knowledge. For example, the working mechanism of a piano is that when one strikes a key, a hammer inside the piano strikes the strings from below to produce sound. However, knowing the rules of the working mechanism does not tell us or explain the speed, strength, and time of hitting the keyboard which are essential to determining the musical effect. In terms of skill, however, the process of practice is continuous, it does not strongly depend on these rules. On the one hand, practice does not completely rely on rules. Taking bicycling as an example, as Polanyi pointed out, cyclists might not successfully complete the task even when they are informed of the rules. And others can do it even if they lack an understanding of the operative norms: One can still ride a bicycle even if one does not explicitly know the rules of cycling. On the other hand, practitioners may not consciously think about how to apply rules in the practice process, in order to ensure the consistency of practice. Taking driving as an example, "Have you ever driven a manual transmission automobile neatly on an urban street and then suddenly begun to think about whether the gear is appropriate? You rarely reflect on your own behaviors, unless something serious had happened" (Dreyfus & Dreyfus, 1986, p. 7).

Thirdly, Polanyi explored whether "tacit knowledge can be transformed into explicit knowledge without acquiring skills; you can discover the general rules of tacit knowledge and turn them into explicit knowledge, but you will lose skills and intuition" (Cheng & Yao, 2013, p. 105). Polanyi proposed that both tacit knowledge and explicit knowlege belongs to the human knowledge system, and Polanyi emphasized that tacit knowledge is more fundamental than explicit knowledge, but it cannot be explained clearly by language. In terms of skills, although some tacit knowledge is implicated in the practice process of skills, skills essentially rely on experience acquired through action. Some experience can be described by language, while some cannot. However, as long as there are practices, there will be accumulation of experience.

In English, the word "skill" is used to describe capability. However, skills are designed to achieve predetermined objectives: Due to this characteristic, skillful practices are intentional and context-dependent, so the concept of skills cannot be simplified as "doing." After all, "[s]killful activity is structured, significant, and projective in the sense that there is always something at which it is intentionally directed. It is not exemplified by sequences of discrete, mechanically separable movements directed toward a physical object, but by a certain way of dealing with things and persons involving know-how in what we can refer to as contexts of purposes in use" (Stopford, 2009, p. 116). Taking seriously the human and instrumental contexts of skill, it will be maintained in the following that skills involve two sets of norms, operational norms and social norms. Obviously, users should comply with social norms, but relying on tools alone cannot establish a system of standards or technical norms. The standardization of tools is based on the use of tools, thereby distinguishing the concept of skill from that of technology: "Technology refers to a special method of executing procedures and has to be evaluated by standards" (Winch, 2010, pp. 41-42). Because technology is universally applicable like a method, it can be disseminated in a standardized way. Therefore, the applicable scope of technology is not necessarily limited to specific tasks. Technology can be applied in a wider range of industries, such as automobile manufacturing, fishery, etc. In terms of the relationship between skill and technology, "the development of skills includes not only the acquisition of technology, but also the successful application of technology" (p. 44). In particular, the formation of the three capabilities involved in the practice of skills – learning capability, transfer capability and judgment capability –depends on social norms.

II. SKILL ACQUISITION DEPENDS ON SOCIAL NORMS

The most famous discussion of skill in philosophy is Herbert Dreyfus' "Skill Model." He thinks that "The know-how of [...] skillful individuals is not innate, like a bird's skill at building a net. We have to learn" (Dreyfus & Dreyfus, 1986, p. 19). His account of the process of skill acquisition is completely descriptive. He divides it into five stages. Stage 1: Novice, Stage 2: Advanced Beginner, Stage 3: Competent, Stage 4: Proficient, and Stage 5: Expert. Dreyfus emphasized that the whole process of skill acquisition is a kind of "knowing how" process that is based on experience through practice, rather than a "knowing that" process of mastering facts and rules. According to Dreyfus, skill acquisition is different from obtaining information, and skill acquisition should reach a state of "fluent performance": "The beginning student wants to do a good job, but lacking any coherent sense of the overall task he judges his performance mainly by how well he follows learned rules" (Dreyfus & Dreyfus, 1986, p. 22). Advanced beginners begin to realize that some situations encountered in practice are not reflected in the rules after they master the practical experience for specific situations. At the competence stage, the learner has been immersed in operations: "[...] not conscious of solving problems, that is, of selecting goals and combining elements by rule to reach them [...]" (p. 27). At the proficiency stage, "the expert driver becomes one with his car, and he experiences himself simply as driving, rather than as driving a car" (p. 30). In other words, the so-called proficient operation state is a state of exercising a skill without thinking, but relying only on intuitive reaction. And finally, at the expertise stage, "an expert's skill has become so much a part of him that he need be no more aware of it than he is of his own body" (p. 30).

Meanwhile, Dreyfus emphasized that the formation of intuitive response depends on context, "a skill is not one or several fixed reactions formed in different methods" (Dreyfus, 1992, p. 249). For driving, at the novice stage, "The student automobile driver learns to recognize such domain-independent features as speed (indicated by the speedometer) and is given rules such as shift to second when the speedometer needle points to ten" (Dreyfus, 2001, p. 167). "The advanced beginner driver uses (situational) engine sounds as well as (non-situational) speed in deciding when to shift. He learns the maxim: Shift up when the motor sounds like it's racing and down when it sounds like it's straining” (p. 168). At the competent stage, “A competent driver leaving the freeway on an off-ramp curve, learns to pay attention to the speed of the car, not whether to shift gears” (p. 168). At the proficient stage,

> The proficient driver, approaching a curve on a rainy day, may feel in the seat of his pants that he is going dangerously fast. He must then decide whether to apply the brakes or merely to reduce pressure by some specific amount on the accelerator. Valuable time may be lost while making a decision, but the proficient driver is certainly more likely to negotiate the curve safely than the competent driver who spends additional time considering the speed, angle of bank, and felt gravitational forces, in order to decide whether the car’s speed is excessive. (Dreyfus, 2001, p. 170).

After reaching the expertise stage, “The expert driver not only feels in the seat of his pants when speed is the issue; he knows how to perform the appropriate action without calculating and comparing alternatives. On the off-ramp, his foot simply lifts off the accelerator and applies the appropriate pressure to the brake. What must be done, simply is done” (Dreyfus, 2001, p. 170).

The establishment of Dreyfus‘ “Skill Model” provides a paradigm for the research on skills, so it has normative significance. However, the model is entirely based on the “first person” perspective. Dreyfus described the process of skill acquisition from the perspective of participants, but not from the dimension of “others.” Therefore, the context of skill acquisition emphasized by Dreyfus is just an operational context and does not involve a social context. For example, Dreyfus only described how to shift gears and what speed to maintain while driving, but ignores the traffic rules. In other words, what Dreyfus described is a “bodily skill.” However, as John Dewey has shown, “experience” is a “…double barrelled word. Like its congeners, life and history, it includes what men do and suffer, what they strive for, love, believe and endure, and also how men act and are acted upon, the ways in which they do and suffer, desire and enjoy, see, believe, imagine in short, processes of experiencing” (Dewey, 1929, p. 8). In other words, experience is dominated by two sets of norms, namely, operational norms and social norms. The Skill Model discusses only the former. The acquisition of experience is inseparable from social norms, which has been a subject of discussion in psychology for a long time. In *The Principles of Genetic Epistemology*, Jean Piaget gave an example about how children learn to play “marbles,” emphasizing that the experience acquisition proceeds from passive acceptance to active occurrence. However, both are influenced by social norms. In the passive acceptance stage of rules, “The little boys who are beginning to play are gradually trained by the older ones in respect for the law; and in any case they aspire from their hearts to the virtue, supremely characteristic of human dignity, which consists in making a correct use of the customary practices of a game. …Before playing with his equals, the child is influenced by his parents. He is subjected from his cradle to a multiplicity of regulations, and even before language he becomes conscious of certain obligations. These circumstances even exercise, as we shall see, an undeniable influence upon the way in which the rules of games are elaborated” (Piaget, 1948/1984, p. 2). If only for this, skill acquisition generally depends on social norms.

III. SKILL TRANSFER DEPENDS ON SOCIAL NORMS

In regard to skill transfer, the Dreyfus "Skill Model" adopted a cognitive presupposition. Inspired by Maurice Merleau-Ponty's concept of the "lived body," Dreyfus takes the body as the precondition of skill transfer, because the intuition mainly comes from the body's response to external stimuli. Therefore, Dreyfus argued that machines do not have the physical conditions of human beings, and human skills cannot be transferred to machines. Dreyfus' argument is too general, however. Skill transfer involves different dimensions, for example, "1. Skills can be transferred by individuals between different tasks, applications or fields; 2. Skills can be transferred between people, just like in the process of education and training; 3. In a society or institution, skills can be transferred between groups, so skills and their impact exist in a specific field" (Goranzon & Josefson, 1988, pp. 69-70). According to different recipients of skill, the question of skill transfer can be divided into two problems: skill transfer between people, and skill transfer from human to machine.

In terms of skill transfer between people, Harry Collins carried out a survey on the repeated experiments of "Transversely Excited Atmospheric pressure CO_2 laser" (hereafter referred to as TEA laser) (Collins, 1992). He found that although all the written materials related to the experiment were publically available, some laboratories successfully replicated the experiment, while others failed. Based on this investigation, the characteristics of skill transfer between people are as follows: Firstly, the process of transfer is invisible. For the replicated TEA experiment, scientists do not know whether they have successfully acquired the skills before or after the experiment. Secondly, the process of transfer is capricious. According to the Situated Learning Theory, skills are composed of "situated activities," that is, in the process of skill transfer, actions will be greatly affected by the situation. Because the situation is changeable, situated activity differs from person to person. When replicating TEA experiments, some scientists succeeded, while others failed. Some scientists who failed at the beginning, after several trials finally replicated the experiment successfully, while other scientists with successful experience encountered failure when replicating the experiment again. Thirdly, the condition of transfer is to establish a social relationship, especially the mentorship between master and apprentice (Polanyi, 1966). Situated Learning Theory also emphasizes that "Learners are inevitably integrated into the communities of practitioners. In order to master knowledge and skills, new comers must be fully integrated into the social culture of the communities of practice" (Lave & Wenger, 1991, p. 29). Especially in the replicated TEA experiment, all the laboratories that successfully replicated the experiment have established good interpersonal interaction relationship with the source laboratory, and such relationship will remain until the end of the experiment. Therefore, "The transfer of experimental skills is a social process – just like mastering a language – which is different from the transfer of information [...]" (Pinch et al., 1996, p. 164).

In terms of skill transfer from human to machine, there is a symmetrical relationship between two skill transfer models: skill transfer between people, and skill transfer from human to machine. In other words, the process by which a machine acquires human-like skills is based on skill transfer between people. To be sure, Dreyfus had proposed that machines were subject to physical conditions that prevent them from acquiring human skills which are conditioned by biology, psychology, epistemology, and ontology. His argument, however, was limited to the traditional "functionalism" approach of artificial intelligence. In more recent developments of artificial intelligence, the traditional research paradigm that was dominated by notions of information input has been abandoned, and the "deep learning" paradigm has been advanced. Machines have thus acquired a large degree of autonomous learning ability.

However, no matter how artificial intelligence develops, the skill transfer between people and that between people and machine still have a symmetrical relationship. In other words, machine learning is still based on the human learning process. The difference is that the path of skill transfer from human to machine has changed from the early instruction input mode to the so-called deep learning mode. The deep learning mode is based on massive data, but in fact, it is impossible for computers to obtain data independently and without human aid. All the data needed by computers are "fed" to machines by humans, who will consciously select different data input into computers according to different task requirements. From this point of view, the computer is inseparable from the development of human society and cannot develop self-learning ability independently.

IV. SKILL ASSESSMENT DEPENDS ON SOCIAL NORMS

In addition to skill acquisition and skill transfer, the judgment or assessment of skill also depends on social norms, and again involves two levels: assessment of human skills, and assessment of machine skills. The former is related to "who is qualified to be an expert," and the latter is related to "whether the machine has mastered human-like skills." Because skill acquisition norms include operational norms and social norms, expert assessment should also start from the two aspects mentioned above. As for the former, the Dreyfus Skill Model specified a set of criteria for making judgments: Firstly, experts can be identified based on the context sensitivity of their exercise of skill or skill operation. The difference between experts and novices is whether they have intuitive responses according to different contexts. Secondly, experts can be identified in respect to their dependence on rules in skill operation. "If something happens, an expert does not need to intentionally solve problems or make decisions, but just needs to work normally" (Dreyfus & Dreyfus, 1986, p. 31). Thirdly, experts can be identified according to the relationship between practitioners and the world. For novices and beginners, they are separated from the world and often feel "frustrated" and "at a loss" in the skill operation process; for experts, their actions have been integrated with the world.

The Dreyfus Skill Model also mentions the moral standards of skill assessment, but the moral standards of Dreyfus extend only to the rationality of the exercise of skills. He emphasized that the implementation of skills cannot be measured by rationality. As for skill operation, Dreyfus considers three levels of rationality: irrational, rational and arational. Some experts' intuitive judgment is neither rational nor irrational, but occupies an arational state between them. However, the skill operation of some experts may be reasonable, but that is no guarantee that their actions are therefore ethical.

As early as in the ancient Greek period, Aristotle emphasized that skill should aims at good. American moral philosopher Alasdair MacIntyre further developed Aristotle's views. He emphasized that “Every activity, every enquiry, every practice aims at some good” (MacIntyre, 2007, p. 148). As for the origin of morality, modern liberalism claimed that morality adheres to individual desire. However, MacIntyre (2007) argued that moral norms have some insuperable inherent contradictions: “I want to argue that any project of this form was bound to fail, because of an ineradicable discrepancy between their shared conception of moral rules and precepts on the one hand and what was shared—despite much larger divergences—in their conception of human nature on the other” (p. 52). In short, MacIntyre believes that the foundation of individualistic moral values is “individual rights” on which it is difficult to establish universal moral norms. Alasdair MacIntyre emphasized that virtue acquisition depends on the community. Since virtue comes from practice, and the establishment of practice is based on an interactive relationship, this requires that morality must be obtained through the cooperation among members in the social community. In the social community, each member will play a different role, and each role has its own meaning and purpose. Only when all members perform their own functions, they can achieve the common goal and finally obtain virtue. Therefore, morality does not come from individuals, but from the social community.

The assessment of human-like skills mastered by machines draws for reference mainly on the assessment criteria for human skills. As mentioned above, the assessment of human skills depends on social norms. Therefore, the assessment of human-like skills mastered by machines mainly depends on the degree to which the machine has been “socialized.” Accordingly, Collins established a socialization model of artificial intelligence, and divided the socialization process of artificial intelligence into six stages. Stage 1 “Engineered Intelligence” is the lowest primary intelligence and is shown as a kind of control ability, such as the control system of washing machines and automobiles. Stage 2 “Asymmetrical Prostheses” refers to the replacement of human intelligence by machines, just as artificial limbs replace real legs, or artificial hearts replace real hearts. “AIs are ‘social prostheses’ – they take the place of some human activity, not by replacing a bit of the body but by replacing a bit of society” (Collins, 2018, p. 67). This is called “asymmetric prosthesis” because “we can, and continually do, repair the machines’ faults, but they cannot repair ours” (p. 69). The artificial intelligence at the two stages mentioned above can only replace human labor in terms of some functions, but does not involve the social culture of human beings. Machines really start the process of “socialization” from Stage 3 “Symmetric Culture-consumers” which are “fully symmetrical prostheses – social prostheses that are so good at repairing our broken speech and other rule-breaking activities, and so good at recognizing and absorbing our precedent-setting activities, that they can respond appropriately to even the most novel interactions and recognize when they are legitimate” (Collins, 2018, p. 69). There is very little difference between Stage 3 and Stage 4: If machines can understand society at Stage 3, then machines can fully integrate into human society at Stage 4 “Human Challenging Culture Consumers.” The first four stages of artificial intelligence socialization represent the process of machine integration into human society. In this process, the deep learning method of artificial intelligence reflects the human–machine interaction. Based on this interactive relationship, machines can understand human society. However, starting with Stage 5 "Autonomous Human-like Societies" machines will gradually occupy a place in human society, so machines must behave like human beings – machines should have a biological body which is similar to the human body. At Stage 6 "Autonomous Alien Societies" machines will not only become a part of human society, but also be able to construct their own social culture. By that time, the whole process of AI socialization will be completed.

In fact, the model mentioned above only represents the "ideal" state of artificial intelligence socialization, which is actually very difficult to realize. This is because "society" is not a holistic concept. Society is composed of different cultures, and different cultures have different language paradigms. And even that does not mean that people who can speak the same language, such as English, can enjoy the same culture. As far as the scientific community is concerned, it was shown by Kuhn's theory of "scientific revolutions" that the scientific community is stratified and that different scientific communities employ different paradigms. As paradigms are not convertible, different scientific communities constitute different scientific cultures and it is difficult to overcome these cultural barriers. It can thus be seen that "we can't transfer our skills to computers through programming, because we haven't really figured out what the process of socialization is" (Collins, 1989, p. 209). Therefore, "1. No computer will be fluent in a natural language, pass a severe Turing Test and have full human-like intelligence unless it is fully embedded in normal human society. 2. No computer will be fully embedded in human society as a result of incremental progress based on current techniques" (Collins, 2018, p. 1).

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