Chapter 6
How Much Knowledge Is Necessary for Action?

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How much knowledge is necessary for action? This question is fundamental because it suggests that the link between knowledge and action is debatable, that there is no given, fixed causal relationship between knowledge and action. In addition, there seems to be no fixed causal direction. Knowledge can be a prerequisite for action but also a consequence of an action. My opening question relates two key words in psychology. One of them is *knowledge*, about which a large body of knowledge exists (e.g., Halford, Wilson, & Phillips, 2010)—about its different types (e.g., procedural, declarative), styles of acquisition (implicit, explicit), and degrees of accessibility (conscious, subconscious, unconscious). The other word is *action*, about which there are various theories describing human behavior with respect to intention (e.g., Fishbein & Ajzen, 2010). In this introductory section I try to give an overview of these conceptions and of the relation between knowledge and action.

The issues around the keywords *knowledge* and *action*—which constitute the title of a book by Frey, Mandl, and von Rosenstiel (2006)—are captured by the following four main aspects, which generate corresponding questions.

1. The relation between knowledge and action. From the perspective of the psychology of knowledge (e.g., Strube & Wender, 1993), knowledge is a competence for action, a precondition. What is known about the relation between knowledge and action and what is not known? How much of human action is governed by routines, experience, intuition, and knowledge? What is the trade-off between taking action and improving knowledge?
2. Types of knowledge and different phases. To what extent do various types of knowledge (e.g., implicit or explicit) influence the steps from cognition to action (e.g., aspirations, attention, decision-making, problem-solving, the evaluation of situations, the search for alternatives, and the implementation of intentions)?

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3. Rationality and knowledge. What categories of rationality should be identified? Concepts of rationality are common ground in social and economic theories, but rationality in everyday life seems to be something else. To what degree does the concept of bounded rationality (Simon, 1947, p. 61–65) weaken the link between knowledge and action? Is there a threshold of minimal knowledge that is necessary for action?
4. Action theory and language. How constitutive is language use for action? Searle (1969), with his concept of speech acts, points out that speaking can be acting. To speak about X requires knowing something about X. If someone is not able to speak about Z, can that person act upon Z or does the inability to speak about Z imply the inability to act upon Z? What about the idea that "actions speak louder than words" (Tanner, Brügger, van Schie, & Lebherz, 2010)?

The contribution from my own empirical work addresses mainly the first and at least in part the second of these four main aspects, leaving many of the other questions to the reader.

After a short section on definitions, I ask whether action is possible without knowledge and afterward venture the question of whether it is possible for people to act against their own knowledge. Thereafter, I review some of the standard views on the relation between knowledge and action, interpretations that may help this chapter's exploration of that connection through three theories: planned behavior, unconscious thought, and the option-generation framework. The chapter then continues with empirical evidence from my own research area, problem-solving, and shows that the relation between knowledge and action is strong within that area.

Definitions of Knowledge and Action

Knowledge and Belief

Knowledge is not always knowledge; it is necessary to distinguish between knowledge and true belief. A person who believes that leaves of a red tree are green definitely knows about his or her belief. Hence, there is knowledge that depends on states in the outer world (it being a purely empirical question whether the leaves are green or red) and on other knowledge that is a priori true (i.e., my knowledge about my beliefs). In the philosophy of language, this position is called *externalism*. For the issues considered in this chapter, it suffices to state that I am talking about the person's internal knowledge not at a metalevel but rather at the level of assertions that are believed to be true.

Types of Knowledge

The distinction between explicit (verbalizable, declarative) and implicit (nonverbalizable, tacit) knowledge is well known and relates to the distinction between conscious and nonconscious knowledge. Cognitive processes in general are often seen as working in two modes, a deliberate, conscious one and an automatic nonconscious type of processing (e.g., Evans, 2008; Kahneman, 2011).

Action

The definition of action as goal-directed human activity helps set it apart from pure behavior (e.g., sneezing, which is not directed to any particular goal). Action is that part of behavior which occurs intentionally. Keep in mind that even trial-and-error behavior could be classified as action if it happens intentionally.

Is Action Possible Without Knowledge?

Is action possible without knowledge? Can one really posit that idea as a serious option? If one takes the term *action* to mean goal-directed human activity, the answer must be no. Action implies goals, and in order to realize goals a person needs appropriate means. The means–end connection is knowledge—to know that one can use bamboo sticks to fetch a banana lying just beyond arm's reach outside the bars of a cage was an important insight to Sultan, the most intelligent chimpanzee analyzed by Köhler (1925).

But what is the relation between goals and knowledge? Are goals part of what people call knowledge or are they a separate entity only derivative of knowledge? In my understanding, knowledge is a piece of subjectively acquired information about the world. In German one would say that knowledge about the world is *angeeignet* (appropriated, assimilated, internalized). In a certain sense it could be construed as embodied information.

But how is embodied information linked to goals? Goals are representations of future states and derive their power from the possibility of finding a way from the given present state to an envisioned future state. When talking about goals, people always talk about degrees of distance between the given and the goal state. Because the path from the given state to the goal state is sometimes not easy to discover, problem-solving comes into play. Indeed, the epistemologist Karl Popper (1999) argued that "all life is problem solving."

To answer the question of whether action is possible without knowledge, I must thus conclude that the use of the word action logically implies the connection to some background representation, which is normally called knowledge.

Is Action Possible Against One's Better Knowledge?

It may be more interesting to ask whether action is possible *against* knowledge. The question is related to the understanding of human rationality. Newell (1981) stated the principle of rationality simply by saying, "if an agent has knowledge that one of its actions will lead to one of its goals, then the agent will select that action" (p. 8). This principle would not allow a person to act against her or his goals.

Yet everyday experience brims with examples to the contrary. People love animals—but at the same time do not hesitate to slaughter them professionally in the slaughterhouse. Concern about climate change is widespread, though people continue to pollute the environment by driving big cars. The gaps between attitude and behavior are large, but are attitude and behavior the same as knowledge and action? Take smoking for example. Evidence indisputably shows that smoking is detrimental to human health, but people continue to smoke despite their knowledge of this fact. Are they acting against their knowledge? I would say, no! Given even such blatant violations of their own attitudes, people follow principles of bounded rationality. When smoking despite knowledge about the negative consequences of that behavior, a person might argue, "Yes, I know about the negative effects, but my family has a very good gene pool, so I do not assume I'll get cancer as easily as normal people will." This argumentation conveys a kind of justification for behavior that, from the viewpoint of the individual, is no longer irrational but instead has its own limited rationality.

Can Knowledge Impede Action?

Planning before taking action is usually thought to be wise, but it can have disadvantages. Although having plans generally makes people more likely to act on a goal than they would without them, an experiment reported by Masicampo and Baumeister (2012) showed that subjects who had devised plans to achieve a goal failed at that task, particularly when it was essential to recognize and seize an alternative opportunity in order to succeed. The authors concluded that with sufficient (unlimited) time a previously learned specific plan increased attainment of the goal, replicating the usual benefit of planning. With insufficient time, however, the specific plan impaired performance because participants failed to capitalize on an alternative opportunity for accomplishing the goal. The final conclusion by Masicampo and Baumeister was that plans can drastically decrease overall rates of attainment when openness to alternatives is crucial to success.

The Relation Between Knowledge and Action

What are the standard views on the relation between knowledge and action? I concentrate on three approaches that posit assumptions about this relationship: (a) the theory of planned behavior (Ajzen, 1991), (b) the theory of unconscious thought (Dijksterhuis & Nordgren, 2006), and (c) the option-generation framework (Kalis, Mojzisch, Schweizer, & Kaiser, 2008).

The Theory of Planned Behavior

The theory of planned behavior formulated by Ajzen (1991) has become one of the best-known theories in psychology. Roughly, it states that behavior depends on the intention or resolve of the individual to behave in a certain way, say, to exercise at least five times a week. Intention itself depends on a behavioral attitude (e.g., exercising at least five times a week would be good/bad), subjective norms (e.g., most people important to the person think that she or he should exercise at least five times a week), and perceived behavioral control (e.g., exercising at least five times a week would be easy/difficult). This theory, in its new versions, is referred to as the "reasoned action approach" (Fishbein & Ajzen, 2010).

As depicted in Fig. 6.1, action depends on previous knowledge in the form of intention. The empirical evidence bearing out this theory is impressive, with meta-analyses of empirical studies (Armitage & Conner, 2001; Manning, 2009) overwhelmingly showing a strong connection between intention and subsequent

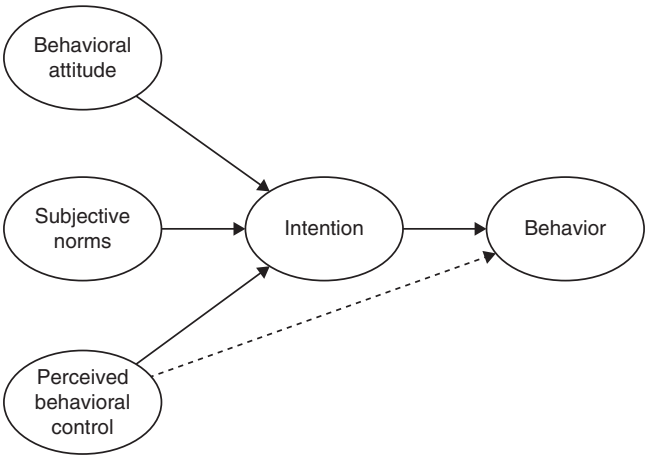

Fig. 6.1 The main elements that constitute the theory of reasoned action. Behavioral attitude, subjective norms, and perceived behavioral control causes intention that brings about behavior (with additional influence from perceived behavioral control)

behavior. But is this finding really a surprise? Werner Greve, a psychologist from Hildesheim University, has argued that the empirical success of the theory of planned behavior is not astonishing. According to him, the connection between intention and action is logical, not causal. In his article "Traps and Gaps in Action Explanation" (2001), he stated that intention is an inherent part of what is called action. Speaking about action therefore implies the assumption that an intention must exist to carry out a certain action.

The consequence of Greve's (2001) argument is clear. In his view most of the empirical studies on the theory of planned action are pseudoempirical research in that things that are true *a priori* are proven empirically. If a person intends to diet and sometime later starts to undergo dietary treatment, that action comes as no surprise. It is a logical consequence of the fact that at some time *t* a person decides to begin dietary treatment and then at time *t + 1* the diet really commences. But what about the cases in which persons do *not* start their dietary treatment? Would their lapse falsify the logical connection between intention and action? No, it would only mean that the intention was not strong enough to reach a threshold needed to turn intention into behavior.

The Theory of Unconscious Thought

A second approach is the theory of unconscious thought (Dijksterhuis & Nordgren, 2006). The basic idea is that the quality of decision-making depends on conscious and unconscious thought simultaneously. The term *conscious thought* is understood to mean a mental state that encompasses a person's rational awareness, whereas the term *unconscious thought* refers to the underlying influence, of which one is typically unaware and which has an impact on one's behavior. Unconscious thought takes place when conscious attention is directed elsewhere. Unconscious thought tends to outmatch conscious thought, especially in complex and untransparent situations.

The relative impacts that conscious and unconscious thought can have on decision-making become evident in the data from experiments by Dijksterhuis, Bos, Nordgren, and van Baaren (2006). The task for participants was to choose the most favorable car from a selection of cars that were described by only four aspects (the simple situation) or as many as twelve aspects (complex situation). Part (a) of Fig. 6.2 shows the percentage of persons who chose the best option; part (b), as a secondary measure, shows the difference in attitude toward the best option. The left-hand set of two bars in part (a) shows that most of the subjects made the correct decision in the simple situation if they were in a conscious-thought mode (represented by the white bar). But when the complexity of the task increased to twelve aspects, as is shown in the right-hand set of bars in part (b), the mode of unconscious thought has a great advantage over that of conscious thought, a finding that supports the theory by Dijksterhuis and Nordgren (2006). As part (b) of Fig. 6.2

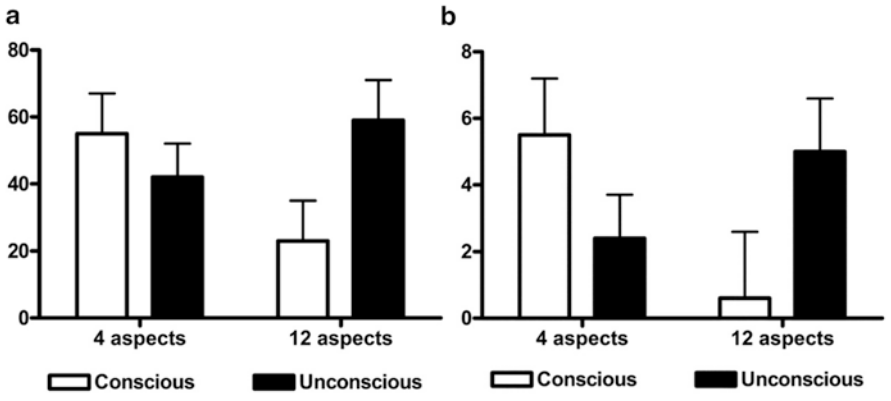

Fig. 6.2 Decision-making criteria for choosing a car: (**a**) Percentage of participants who chose the most desirable car as a function of complexity of decision and of mode of thought (n = 18 to 22 in each condition). Error bars represent the standard error. (**b**) Difference in attitude (on a scale of –25 to +25) toward the desirable and undesirable car as a function of complexity of decision and of mode of thought (n = 12 to 14 in each condition). Error bars [the *vertical lines* above the bars] represent the standard error (Reprinted from Dijksterhuis et al. (2006, p. 1005) with permission from the American Association for the Advancement of Science)

illustrates, not only are the decisions improved by unconscious thought but the attitude toward the desirable and undesirable car depends on the mode of thought.

The Option-Generation Framework

A third theory that deals with the relation between knowledge and action is the option-generation framework by Kalis et al. (2008). Studying the weakness of will (a phenomenon known as acrasia), these researchers concentrated on option generation, a little-understood process that precedes option selection and action initiation.

Figure 6.3 illustrates the idealized process of option generation, option selection, and action initiation and gives the background of the ideas that Kalis et al. (2008) have about degenerative processes in this area. Table 6.1 affords an overview of the ways in which dysfunctions in option generation can result in irrational behavior. The table presents two dimensions—dysfunction in the quantity of options (*hypo*-generation and *hyper*generation) and dysfunction in the quality of options. The two rows separate instrumental irrationality from noninstrumental irrationality, meaning that options can be seen either as a means to realize certain goals (i.e., the instrumental understanding) or as irrationality in the goals themselves (i.e., noninstrumental irrationality). This concept links knowledge and action in a special way: It makes a connection between options and actions.

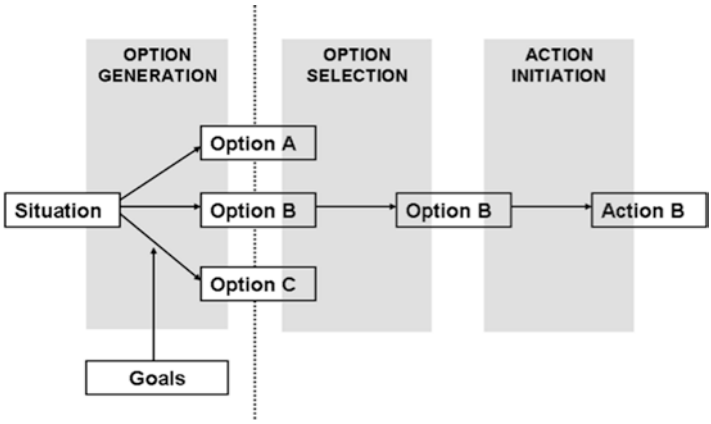

Fig. 6.3 Stages of decision making in our model. (Kalis et al., 2008, p. 403) (Copyright 2008 by Springer Science + Business Media. With permission of Springer)

Table 6.1 Six types of irrational behavior

	Dysfunction in quantity of options		Dysfunction in quality of options
Irrationality	Hypogeneration	Hypergeneration	
Instrumental	(1) Absence of options leads to leads to reduced effectiveness in attaining one's goals.	(2) An increase in the number of options leads to problems in selection and initiation.	(3) Options are inadequate means to one's goals.
Noninstrumental	(4) Absence of goals leads to a reduction in one's options.	(5) An increase in the number of goals leads to defocused option generation.	(6) Options are means to goals that are themselves irrational.

Based on Kalis et al. (2008, pp. 407–411)

This walk through the three theories on the connection between knowledge and action gives an understanding of current approaches to that area of inquiry. In this chapter's final section I bring to this subject empirical evidence from my own research area, problem-solving.

Evidence From Problem-Solving Research

What is meant by problem-solving? In my understanding, problem-solving is the intentional generation of knowledge for action instead of simple trial-and-error behavior. From the perspective of a problem-solving approach, the connection between knowledge and action is a classical means–end relation. The question remains how one can demonstrate that subjects generate knowledge intentionally

for action? My tentative answer comes from experiments in which researchers present subjects with problems by using multistep tasks of reasonable complexity (Funke, 2010).

Figure 6.4 illustrates the MicroDyn approach, which was implemented for the 2012 cycle of the OECD's worldwide Programme for International Student Assessment (PISA) (Wüstenberg, Greiff, & Funke, 2012). In the upper part is a screenshot of a small scenario, called "Handball Training." It involves three types of training—A, B, and C (input variables). The task of the problem-solver is to find out how the types of training influence the three output variables (motivation, power of throw, and exhaustion). The problem-solver can change the amount of training and will see the response on the side displaying the output variables. Giving certain amounts of input, as in this example, seems to increase the motivation level and decrease exhaustion.

The experiments that my colleagues and I have designed and conducted typically have three stages (see Fig. 6.5). First, subjects have to explore the system for about 3 min. This stage is "information retrieval" because in unguided explorations subjects generate information for the second stage, "model-building." This second stage requires reflection about the causal model behind the different entities. There are assumed connections between input and output; training A, for example, increases motivation only. The third stage is "forecasting" and requires the subjects to achieve given values on the various endogenous variables—the output variables in this example—by entering the correct values into the system. In such experiments subjects have to work on many similar tasks. This requirement allows for psychometrically sound measurement of the three abilities—information retrieval, model-building, and forecasting (for more details, see Greiff & Funke, 2009; Wüstenberg et al., 2012).

As demonstrated by the results of the studies reported in this section, a clear connection exists between the generation of knowledge and the application of that knowledge (action). This structural equation model with three latent variables shows that model-building is a major prerequisite for the two other postulated abilities, forecasting and information retrieval. The fit between this model and the data is fine and allows acceptance of the model. My colleagues and I have also constructed a measurement model that sequences the three abilities—*information retrieval*, *model-building*, and *forecasting*. It is simple, another characteristic that fits the data well. Our empirical results thus reveal strong connections between knowledge and action. Acting on a system requires knowledge about the system's structure if goals are to be attained successfully.

Berry and Broadbent (1984) argued that this system knowledge need not be verbalizable and explicit and that, instead, implicit knowledge might guide the action of subjects controlling a system. They even postulated a negative correlation between control performance and verbalizable knowledge. But Buchner, Funke, and Berry (1995) showed that this explanation is not fully convincing, for the only subjects who acquired knowledge about the system were those who were *not* able to accomplish the given goal immediately.

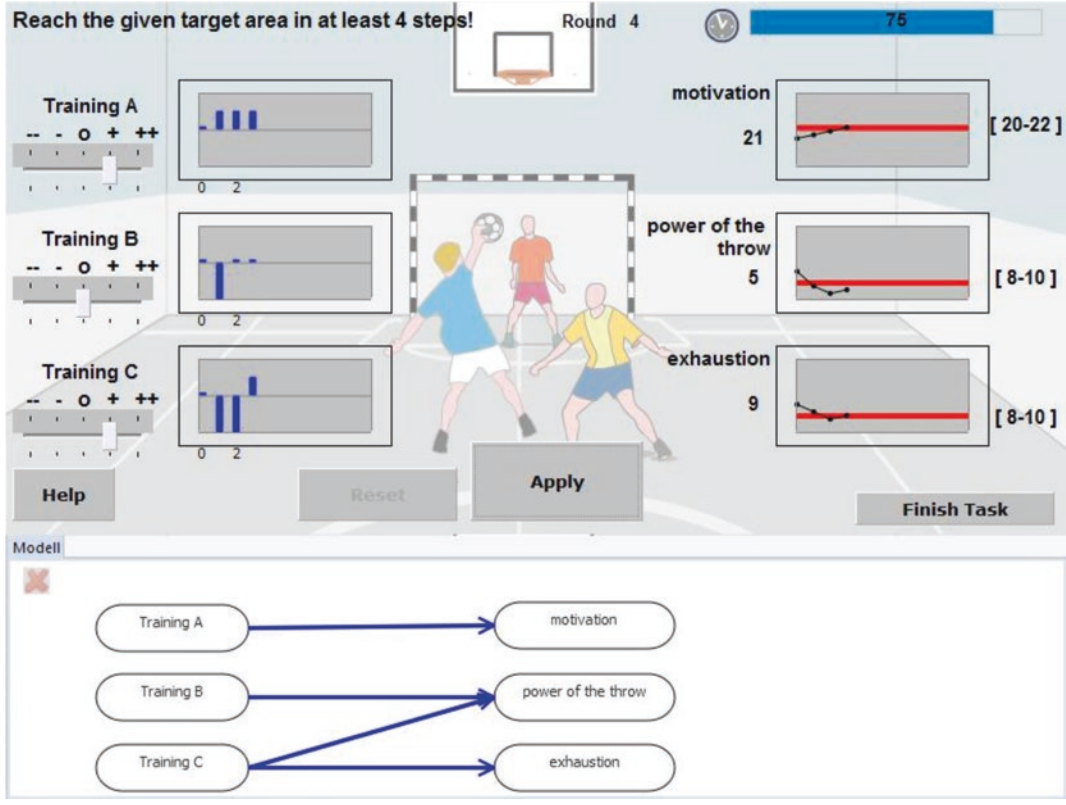

Fig. 6.4 Screenshot of the MicroDYN item "handball-training" control phase. The controllers of the input variables range from "--" (value = −2) to "++" (value = +2). The current value is displayed numerically and the target values of the output variables are displayed graphically and numerically (Reprinted from Wüstenberg et al. (2012, p. 202) with permission of Elsevier)

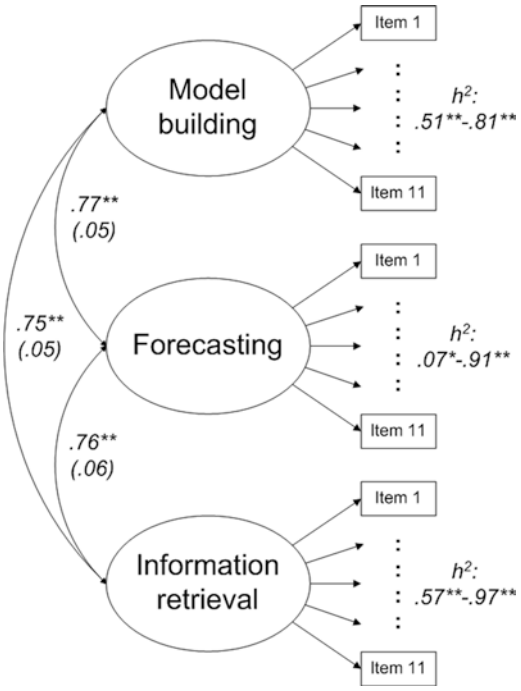

Fig. 6.5 Internal structure of MicroDYN processes including intercorrelations and communalities (n = 114). Note: Standard error in parentheses. Variances of the latent variables were set to 1.0. Residuals of the items within a task (not depicted) were not allowed to correlate. *p < .05; **p < .01 (Reprinted from Greiff, Wüstenberg, & Funke, 2012, p. 202) with permission of Sage Publications)

Conclusion

Knowledge and action is an interesting relationship! As I have shown, there are conscious and unconscious influences, and they are primarily logical, not causal. Kaiser, Wölfing, and Fuhrer (1999), who analyzed the relation between environmental knowledge, environmental values, and ecological behavior (intention as well as observed behavior), concluded on the basis of structural equation modeling that only 40 % of the variance in the intention that it entails was attributable to knowledge and values but that this intention explained 75 % of the variance in observed behavior. From the viewpoint of action, I have concluded that it is not possible to act *without* knowledge but that we humans can act—at least at a surface level—*against* our knowledge! For God's sake, may all persons in our small world act in concordance with their knowledge.

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